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# FOREWORD

I am pleased to put into the hands of readers Volume-6; Issue-11: 2019 (Nov, 2019) of “**International Journal of Advanced Engineering Research and Science (IJAERS) (ISSN: 2349-6495(P) | 2456-1908(O)**” , an international journal which publishes peer-reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers. Now journal has also been indexed in **Qualis (Interdisciplinary Area) (Brazilian system for the evaluation of periodicals, maintained by CAPES)**.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

**Dr. Swapnesh Taterh**

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# Inhibition of $\alpha$ -amylase and $\alpha$ -glucosidase enzymes by extracts of plants of the genus *Zanthoxylum*

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**Abstract**— Diabetes mellitus type 2 represents 90% of all cases of diabetes, being characterized by a series of metabolic dysfunctions, including hyperglycemia. The literature points to  $\alpha$ -amylase and  $\alpha$ -glucosidase as potential therapeutic targets for the development of medicines to treat postprandial hyperglycemia. Among the plants of the semiarid region of Bahia, species of the genus *Zanthoxylum* have phytochemicals with pharmacological potential not yet explored. Therefore, the present work aims to evaluate the *in vitro* effect of crude extracts of some plants of the genus *Zanthoxylum* on the enzymes  $\alpha$ -amylase and  $\alpha$ -glucosidase. A total of eleven stem, stem bark and leaf extracts of *Z. monogynum* and *Z. rhoifolium* were obtained by cold maceration in the hexane, ethyl acetate, ethanol and methanol solvents. The extracts were incubated with  $\alpha$ -amylase or  $\alpha$ -glucosidase, and residual enzyme activities were determined. Phenolics were quantified by the Folin-Ciocalteu method. All extracts reduced enzyme activity, especially the methanolic leaf extract of *Z. monogynum* reduced  $\alpha$ -amylase activity (53.5%) and the stem bark extract of *Z. rhoifolium* of  $\alpha$ -glucosidase (99.2%). In any experiment the inhibitory effect correlated with the concentration of phenolic compounds ( $p > 0.05$ ). The half maximal inhibitory concentration ( $IC_{50}$ ) values of the extracts in the case of  $\alpha$ -amylase was 25.9 and 61.5  $\mu\text{g/mL}$ , while in  $\alpha$ -glucosidase  $IC_{50}$  values were between 21.6 and 26.5  $\mu\text{g/mL}$ . The results indicate that the extracts are potentially useful for the treatment of diabetes. Further phytochemical studies directed to the isolation of bioactive molecules and characterization of the mechanism are needed.

**Keywords**— diabetes tipo 2;  $\alpha$ -amilase;  $\alpha$ -glicosidase; *Zanthoxylum*.

## I. INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder of multiple etiology, characterized by hyperglycemia resulting from insufficient insulin production, defect in its action, or both mechanisms (Garber et al., 2013; SBD, 2014). Thus, depending on its etiology, DM can be classified into type 1 DM, type 2 DM and gestational DM, among other specific types (Tonelli and Resende, 2013). In 2015, this syndrome affected about 415 million people worldwide (IDF, 2015).

Given the important role in the initial metabolism and intestinal absorption of carbohydrates, amylase and glucosidase have been explored as therapeutic targets in the development of hypoglycemic drugs (Gamboa et al.,

2017). Currently the commercially available enzyme inhibitors for the treatment of type 2 DM are acarbose, miglitol and voglibose. In general, these drugs act as reversible competitive inhibitors on the enzymes  $\alpha$ -amylase and  $\alpha$ -glucosidase. Although these drugs are well tolerated by patients, reports of gastrointestinal changes severely limit treatment adherence (Ali et al., 2006; Kim et al., 2011).

$\alpha$ -amylases ( $\alpha$ -1,4-glycan-4-glycanhydrolases) are present in mammalian saliva and pancreatic juice and are classified as endoamylases, that is, they hydrolyze  $\alpha$ -1,4-type glycosidic bonds inside starch. They are crucial in the early stages of the process of starch degradation to smaller subunits, the dextrins (Sales et al., 2012; Yang et al.,

2012). Inturn,  $\alpha$ -glucosidases ( $\alpha$ -D-glycoside glycohydrolases) are classified as exoglycoside hydrolases because they cleave  $\alpha$ -1,4 and  $\alpha$ -1,6 glycosidic bonds from the non-reducing end of substrates, releasing  $\alpha$ -D-glucose units. In men, they are attached to the surface of intestinal villi and actively participate in glucose absorption at these sites (Peng et al., 2016).

In recent years much effort has been directed to identifying natural sources of  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitor molecules in the attempt to develop safer and cheaper drugs for the treatment of postprandial hyperglycemia (Gonçalves et al., 2011). In this context, plants stand out for synthesizing a range of bioactive metabolites with enormous pharmacological potential (Gadelha et al., 2013).

Among the plants of the region, the family Rutaceae is one of the most important because it is widely distributed. This family has about 160 genera and 1900 species distributed worldwide (Grosso and Pirani, 2012). In Brazil, 33 genera and 193 different species have been cataloged in all regions (You et al., 2015). The genus *Zanthoxylum* has 250 species and has been used in folk medicine to treat a variety of diseases such as diabetes, tuberculosis, malaria, cardiovascular diseases, and has been used as pain killer and antiophidic (Karki et al., 2014; Alope et al., 2014). Furthermore, phytochemical studies have identified alkaloids, flavonoids, coumarins, lignans and terpenes with antidiabetogenic, antinociceptive, antiarrheal, antimalarial, antioxidant, immunomodulating, antimicrobial potential in this genus, among others (Krause et al., 2013; Krause, 2013; Fernandez et al., 2017).

Therefore, the present work aimed to evaluate the *in vitro* effect of extracts of *Zanthoxylum monogynum* and *Zanthoxylum rhoifolium* on the activity of  $\alpha$ -amylase and  $\alpha$ -glucosidase. This investigation may contribute to the isolation of prototypes for new hypoglycemic drugs, as well as to promoting the rational and self-sustainable exploitation of the flora of the semiarid region of Bahia.

## II. MATERIAL AND METHODS

### A. Materials

Ethyl acetate, ethanol, hexane, methanol were purchased from Qhemis. Folin-Ciocalteu reagent, gallic acid, porcine pancreatic  $\alpha$ -amylase type VI-A,  $\alpha$ -glucosidase from *Saccharomyces cerevisiae*,  $\rho$ -nitrophenyl- $\alpha$ -D-glycopyranoside substrate ( $\rho$ NPG), and sodium carbonate were purchased from Sigma Aldrich. The Amilase kit (K003) was kindly donated by Bioclin (Belo Horizonte, Minas Gerais).

### A. Obtaining extracts

The plants were collected at Brejo Novo Farm, in the city of Jequié, located in southwestern Bahia. Leaf and stem bark samples of *Z. monogynum* St.-Hil. and stem, stem bark, thick stem bark, and leaf samples of *Z. rhoifolium* Lam. were subjected to oven drying at 40°C. After trituration, they were thoroughly macerated with hexane, ethyl acetate, ethanol or methanol solvents (Cechinel and Yane, 1998). After removal of solvents in rotary evaporator with reduced pressure, the hexane, ethyl acetate, ethanolic and methanolic extracts were obtained. One sample of each plant was deposited at the Herbarium of the State University of Southwest Bahia, Jequié campus, with registration numbers HUESB 1348 (*Z. monogynum*) and 7737 (*Z. rhoifolium*).

### B. Determination of $\alpha$ -amylase activity

The activity of  $\alpha$ -amilase was determined using a commercial kit (Bioclin). The extracts (1 mg/mL) were preincubated with type VI-A porcine pancreatic  $\alpha$ -amylase (0.1 mg/mL) in 50 mM phosphate buffer, pH 6.6, for 15 min at 37°C. Then an aliquot of the enzyme was incubated with starch (40 mg/mL) for 7.5 min at 37°C. After addition of iodine (4 mg/mL), the absorbance of the residual starch-iodine complex was measured at 660 nm in a spectrophotometer (GEHAKA UV340G). Acarbose (1 mg/mL) and solvent (5  $\mu$ L) were used as positive and negative controls, respectively.

The inhibition of enzymatic activity was determined by the following formula:

$$\text{Inibição (\%)} = 100 - [(Abs A / Abs B) \times 100]$$

Where Abs A is the absorbance of the negative control at 660 nm and Abs B is the absorbance of the sample at 660 nm.

### C. Determination of $\alpha$ -glucosidase activity

The activity of  $\alpha$ -glucosidase was determined using the modified Shinde method. The principle of the method is based on the hydrolysis of the chromogenic substrate  $\rho$ -nitrophenyl- $\alpha$ -D-glycopyranoside ( $\rho$ NPG) to  $\rho$ -nitrophenol ( $\rho$ NP) by  $\alpha$ -glucosidase, producing coloration.  $\alpha$ -glucosidase (*Saccharomyces cerevisiae*, 10  $\mu$ g/mL) was incubated with the extracts (1  $\mu$ g/mL) in 100  $\mu$ L sodium phosphate buffer (50 mM), pH 6.8, for 15 min at 37°C. Then 40  $\mu$ L of the substrate  $\rho$ NPG (1 mM) was added. After a further 15 min at 37°C, the reaction was stopped by the addition of 100  $\mu$ L sodium bicarbonate (10%). The absorbance of the product was measured at 405 nm in a microplate reader (Biotek ELx800®). Acarbose (1 mg/mL) and solvent (5  $\mu$ L) were used as positive and negative controls, respectively.

The inhibition of enzymatic activity was determined by the following formula:

$$\text{Inhibition (\%)} = 100 - [(\text{Abs}_c/\text{Abs}_D) \times 100]$$

Where  $\text{Abs}_c$  is the absorbance of the negative control at 405 nm and  $\text{Abs}_D$  is the absorbance of the sample at 405 nm.

#### D. Determination of $\text{IC}_{50}$ values of extracts

*Zanthoxylum* extracts that reduced the activity of  $\alpha$ -amylase and  $\alpha$ -glucosidase by more than 50% were selected for determination of the half maximal inhibitory concentration ( $\text{IC}_{50}$ ). For the dose response curve, enzymes were preincubated with extracts at concentrations of 1.5 to 200  $\mu\text{g}/\text{mL}$ . The subsequent steps were the same as the items for determining  $\alpha$ -amylase and  $\alpha$ -glucosidase activity.  $\text{IC}_{50}$  values were determined by rectangular hyperbolic fitting of dose response curves using nonlinear regression in the GraphPad Prism 6.0 software.

#### E. Quantification of total phenolics

The concentration of total phenolic compounds present in *Zanthoxylum* extracts was determined by the Folin-Ciocalteu spectrophotometric assay described by Singleton<sup>43</sup>. Samples were diluted in their respective solvents to a final concentration of 1  $\text{mg}/\text{mL}$ . An aliquot of 125  $\mu\text{L}$  of the extract was mixed with 125  $\mu\text{L}$  Folin-Ciocalteu reagent and 1 mL distilled water. After 3 min at room temperature, 125  $\mu\text{L}$  of saturated of  $\text{Na}_2\text{CO}_3$  solution

was added and then incubated in water bath for 30 min at 37°C. At the end of incubation, the absorbance of the sample was measured spectrophotometrically at 750 nm in a quartz cuvette with 0.5 cm optical path. To quantify the total phenolics, a standard curve with 0.5, 5, 10, 15 and 25  $\mu\text{g}$  gallic acid solution was used.

#### F. Statistical analyses

All analyses were performed in triplicate and the results were expressed as mean  $\pm$  standard deviation. Data normality was checked using the D'Agostino-Pearson test ( $p > 0.05$ ). The data were then compared by one-way ANOVA and Bonferroni post-hoc test for normally distributed data, and by the Kruskal-Wallis test and Dunn's post-hoc test for non-normally distributed data using the GraphPad Prism 6.0 software. The statistical significance level used was 5% ( $p < 0.05$ ).

## B. RESULTS AND DISCUSSION

Initially, eleven *Zanthoxylum* extracts at 100  $\mu\text{g}/\text{mL}$  were evaluated for their effect on the effect over  $\alpha$ -amilase. The results of this screening demonstrated that only EMFZM and EMCCZR extracts were able to reduce enzyme activity by more than 50% (Table 1).

Table 1. Inhibition of  $\alpha$ -amilase by *Zanthoxylum* plant extract.

Extracts	Inhibition (%) <sup>a</sup>
EMCCZM	11,7 $\pm$ 0,5*
EMFZM	53,5 $\pm$ 3,0
EECGCZR	21,3 $\pm$ 6,4
EECZR	11,7 $\pm$ 1,7*
EHCCZR	36,7 $\pm$ 1,3
EAECZZR	52,1 $\pm$ 3,3
EECCZR	26,5 $\pm$ 1,5
EMCCZR	12,6 $\pm$ 0,6
EHFZR	22,5 $\pm$ 1,2
EAEFZR	10,8 $\pm$ 1,1*
EMFZR	13,2 $\pm$ 0,3
Acarbose	87,6 $\pm$ 0,1

<sup>a</sup> The enzyme was preincubated with the extracts (100  $\mu\text{g} / \text{mL}$ ) and acarbose (100  $\mu\text{g} / \text{mL}$ ) for 15 min. \*  $p < 0.05$  when compared to acarbose according to Kruskal-Wallis followed by Dunn's posttest. EMCCZM: Methanolic extract of *Zanthoxylum monogynum* stem bark. EMFZM: Methanolic extract of *Zanthoxylum monogynum* leaves. EECGCZR: Ethanolic extract of thick stem bark *Zanthoxylum rhoifolium*. EECZR: *Zanthoxylum rhoifolium* ethanolic stem extract. EHCCZR: *Zanthoxylum rhoifolium* hexane stem bark extract. EAECZZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* stem bark. EECCZR: *Zanthoxylum rhoifolium* ethanolic stem bark extract. EMCCZR: *Zanthoxylum rhoifolium* stem bark methanolic extract. EHFZR: Hexane Extract of *Zanthoxylum rhoifolium* Leaves. EAEFZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* leaves. EMFZR: Methanolic extract of *Zanthoxylum rhoifolium* leaves.



As for *Z. monogynum*, the methanolic leaf extract (EMFZM) inhibited enzyme activity by 53.5%, while methanolic stem bark extract (EMCCZM) by only 11.7%. In the case of the species *Z. rhoifolium*, extracts from different parts of the plant were evaluated. Crude thick stem bark extract (EEGCZR) caused a considerable inhibition of 21.3%, while ethanolic stem extract (EECZR) of this species showed an inhibition of only 11.7%. Among the crude extracts derived from stem bark, the ethyl acetate extract (EAECZR) stood out by inhibiting  $\alpha$ -amylase activity by 52.1%, while the hexane (EHCCZR), ethanolic (EECCZR) and methanolic (EMCCZR) extract reduced this activity by 36.7, 26.6 and 12.6%, respectively. Finally, the hexane extract (EHFZR), methanolic extract (EMFZR) and ethyl acetate extract (EAEFZR) of leaves reduced  $\alpha$ -amylase activity by 22.5,

13.2 and 10.8%, respectively. These differences in activity within the same plant and between genera may be due to variation in concentration and type of secondary metabolites in different plant organs (Oliveira et al., 2016).

At the initial screening, EMFZM and EAECZR extracts alone inhibited  $\alpha$ -amylase by more than 50% and, therefore, curves with varying concentrations of these extracts (1.1 to 100  $\mu\text{g/mL}$ ) were plotted to determine  $\text{IC}_{50}$  values (Figure 1).  $\text{IC}_{50}$  values for EMFZM and EAECZR extracts were 25.9 and 61.6  $\mu\text{g/mL}$ , respectively. In comparison, acarbose inhibited  $\alpha$ -amylase by 50% at 52.1  $\mu\text{g/mL}$ . The results suggest that EMFZM, in particular, has bioactive substances. Although diluted in the extract, it seemed to be more effective than acarbose.

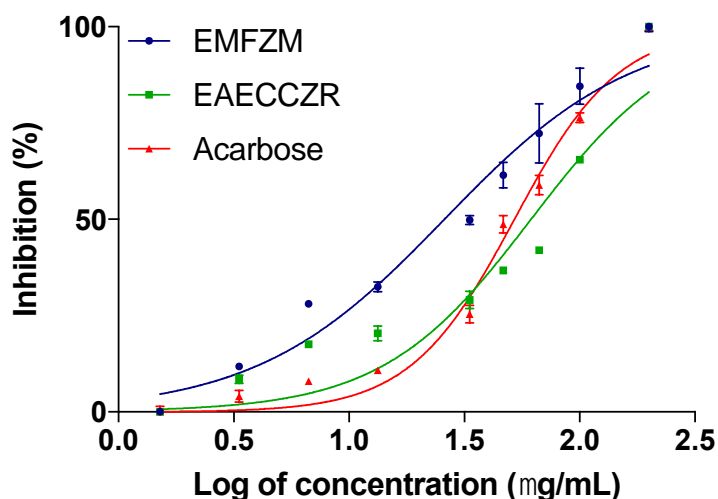


Fig.1: Determination of  $\text{IC}_{50}$  values of *Zanthoxylum* plant extracts on  $\alpha$ -amylase.

EMFZM: Methanolic extract of leaf of *Z. monogynum*. EAECZR: Ethyl Acetate extract of stem bark of *Z. rhoifolium*.

The extracts were also evaluated for their ability to inhibit  $\alpha$ -glucosidase activity. The results showed that eleven *Zanthoxylum* extracts were able to inhibit  $\alpha$ -glucosidase activity likewise acarbose (Table 2).

In turn, methanol EMCCZM and EMFZM extracts of *Z. monogynum* had a similar inhibition potential over  $\alpha$ -glucosidase. In the case of *Z. rhoifolium*, the thick stem bark extract (EEGCZR) showed an inhibition of 76.5%. Although lower than the values found for the other extracts, it is still considerable. In turn, the ethanolic stem extract (EECZR) presented an inhibition of 86.1%. Among the crude extracts originating from the stem bark of this plant, the methanolic extract EMCCZR was the one that stood out by inhibiting 99.2% of enzyme activity, while the other extracts EHCCZR, EAECZR, EECCZR

showed similar inhibition on  $\alpha$ -glucosidase (88.0, 87.8 and 84.4%, respectively). Finally, the extracts obtained from the leaves were evaluated. Hexanic extract (EAEFZR), methanolic extract (EHFZR), ethyl acetate extract (EMFZR) reduced  $\alpha$ -glucosidase activity by 96.8, 90.6 and 81.4%, respectively. These results suggest that compounds capable of inhibiting  $\alpha$ -glucosidase are equally distributed in the different parts of both plants.

After screening, it was found that all extracts were able to inhibit  $\alpha$ -glucosidase by more than 50% and, therefore, the  $\text{IC}_{50}$  value was determined for all of them and the results are presented in Table 3.

Table 2. Inhibition of  $\alpha$ -glucosidase by plant extracts of genus *Zanthoxylum*.

Extracts	Inhibition (%) <sup>a</sup>
EMCCZM	82.2 ± 0.6
EMFZM	90.2 ± 0.3
EECGCZR	76.5 ± 1.0
EECZR	86.0 ± 0.5
EHCCZR	88.0 ± 0.1
EAECZZR	87.8 ± 1.0
EECCZR	84.4 ± 1.0
EMCCZR	99.2 ± 0.3
EHFZR	90.6 ± 0.3
EAEFZR	96.8 ± 0.3
EMFZR	81.4 ± 0.3
Acarbose	92.6 ± 0.2

<sup>a</sup> The enzyme was preincubated with the extracts (100  $\mu$ g/mL) and acarbose (100  $\mu$ g/mL) for 15 min. Data were tested by ANOVA followed by Bonferroni test. EMCCZM: Methanolic extract of *Zanthoxylum monogynum* stem bark. EMFZM: Methanolic extract of *Zanthoxylum monogynum* leaves. EECGCZR: Ethanolic extract of thick stem bark *Zanthoxylum rhoifolium*. EECZR: *Zanthoxylum rhoifolium* ethanolic stem extract. EHCCZR: *Zanthoxylum rhoifolium* hexane stem bark extract. EAECZZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* stem bark. EECCZR: *Zanthoxylum rhoifolium* ethanolic stem bark extract. EMCCZR: *Zanthoxylum rhoifolium* stem bark methanolic extract. EHFZR: Hexane Extract of *Zanthoxylum rhoifolium* Leaves. EAEFZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* leaves. EMFZR: Methanolic extract of *Zanthoxylum rhoifolium* leaves.

Table 3. IC<sub>50</sub> determination of *Zanthoxylum* extracts on  $\alpha$ -glucosidase.

Extracts	IC <sub>50</sub> ( $\mu$ g/mL)
EMCCZM	24.1 ± 0.5
EMFZM	24.7 ± 0.8
EECGCZR	24.5 ± 0.2
EECZR	25.1 ± 0.4
EHCCZR	28.6 ± 0.7
EAECZZR	22.4 ± 1.5
EECCZR	26.5 ± 0.4
EMCCZR	25.1 ± 1.3
EHFZR	22.2 ± 0.2
EAEFZR	21.6 ± 1.4
EMFZR	23.5 ± 2.2
Acarbose	19.5 ± 0.2

Data were tested by ANOVA followed by Bonferroni test. EMCCZM: Methanolic extract of *Zanthoxylum monogynum* stem bark. EMFZM: Methanolic extract of *Zanthoxylum monogynum* leaves. EECGCZR: Ethanolic extract of thick stem bark *Zanthoxylum rhoifolium*. EECZR: *Zanthoxylum rhoifolium* ethanolic stem extract. EHCCZR: *Zanthoxylum rhoifolium* hexane stem bark extract. EAECZZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* stem bark. EECCZR: *Zanthoxylum rhoifolium* ethanolic stem bark extract. EMCCZR: *Zanthoxylum rhoifolium* stem bark methanolic extract. EHFZR: Hexane Extract of *Zanthoxylum rhoifolium* Leaves. EAEFZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* leaves. EMFZR: Methanolic extract of *Zanthoxylum rhoifolium* leaves.

The activity of  $\alpha$ -glucosidase was reduced by EMCCZM, EMFZM, EECGCZR, EECZR, EHCCZR, EAECZZR, EECCZR, EHFZR, EAEFZR, EMFZR

extracts with IC<sub>50</sub> values of 24.1, 24.7, 24.5, 25.1, 28.6, 22.4, 26.5, 25.1, 22.2, 21.6 and 23.5  $\mu$ g/mL, respectively. These values did not differ statistically from each other or

from acarbose inhibitor, whose  $IC_{50}$  was in the range of 19.5  $\mu\text{g/mL}$  (Figure 2). These finding indicates that the molecule responsible for enzyme inhibition is dispersed in all organs of the plant and the application of bioguided fractionation techniques may help in the identification and isolation of this substance.

For the species *Z. monogynum*, only one phytochemical study on stem bark is available in the literature so far, where the presence of alkaloids, triterpenes and steroids was identified (Moura et al., 2012). However, there are no publications on the leaves of the species. Likewise, there are no data in the literature about the chemical composition of the thick stem bark of *Z. rhoifolium*. As for the stem, the phytochemical analysis identified twelve benzophenanthridine alkaloids, six alkaloids with furoquinoline nucleus, one pentacyclic triterpene, lupeol and one steroid,  $\beta$ -sitosterol (Krause et al., 2013; Krause, 2013).

The stem bark extracts of this study were produced in solvents of different polarity and the literature reports the predominant presence of flavonoids in this part of the plant (Santos et al., 2013; Turnes et al., 2014). The

phytochemical analysis of *Z. rhoifolium* leaves also identified alkaloids with benzophenanthridine nucleus, alkaloids, triterpene, steroids and flavonoids (Tavares et al., 2014; Christofoli et al., 2015). Another systematic study of *Z. rhoifolium* leaves revealed the presence of flavonoids in the ethyl acetate fraction and steroids and triterpenoids in the hexane fraction (Krause, 2013). Although not evaluated in this study, steroids and triterpenoids may be responsible for the effects observed in this study. In general, the literature associates the inhibition of  $\alpha$ -amylase and  $\alpha$ -glucosidase with the most diverse secondary metabolites of plants. Phenolic compounds, triterpenoids, tannins and flavonoids have been described as  $\alpha$ -amylase inhibitors (Ponnusamy et al., 2011; López and Santos, 2015). In turn,  $\alpha$ -glucosidase can be the target of more than 400 plant molecules, including phenols, terpenes, alkaloids, quinines, flavonoids, phenylpropanoids, steroids, among other types of compounds (Yin et al., 2014). Recently, an *in vivo* study conducted with the species *Z. alatum* Roxb. revealed the hypoglycemic potential of the plant, which was associated with the presence of phenolics (Suman, 2014).

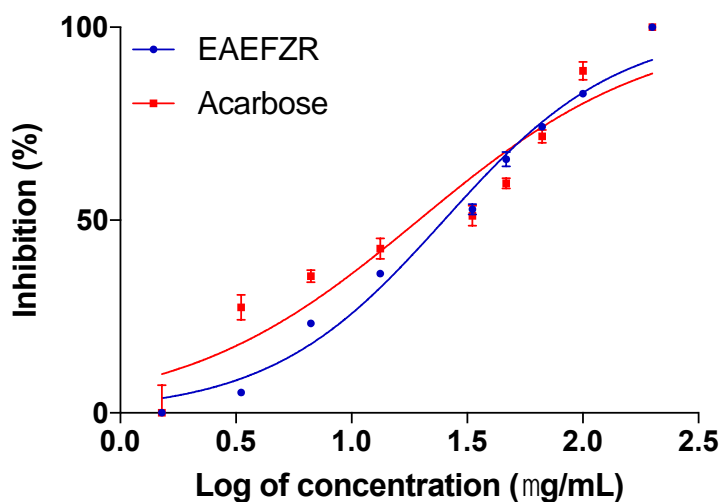


Fig.2:  $IC_{50}$  determination extracted EAEFZR on  $\alpha$ -glucosidase.

EAEFZR: Ethyl acetate extract of *Zanthoxylum rhoifolium* leaves.

Thus, as phenolic derivatives are described in the literature as important inhibitors of  $\alpha$ -amylase and  $\alpha$ -glucosidase, the concentration of these compounds was determined in plant extracts by the Folin-Ciocalteu method (de Lima et al., 2014; Marques et al., 2014). The results are shown in the Table 4 as equivalent micrograms of gallic acid per milligram of extracts.

The extracts with the highest phenolic concentration were EMCCZM, EMFZM and EMCCZR (126.1, 155.2 and 145.8  $\mu\text{g}$  EAG/mg, respectively). However, only

EMFZM significantly inhibited  $\alpha$ -amylase ( $IC_{50} = 26$   $\mu\text{g/mL}$ ), and this excludes any correlation between the concentration of these compounds and the observed effect ( $p > 0.05$ ). In the case of  $\alpha$ -glucosidase, all extracts inhibited its enzymatic activity in a similar manner and, therefore, there was no correlation with the presence of phenolics ( $p > 0.05$ ). These results support the idea that inhibition of the enzymes  $\alpha$ -amylase and  $\alpha$ -glucosidase by *Zanthoxylum* extracts stems from metabolites other than phenolic compounds.



Crude extracts are complex due to the diversity of secondary metabolites, many of which are not yet known. Therefore, for a better characterization of the inhibitory effect, it is necessary to fractionate the extracts in an attempt to isolate bioactive substances, as well as to determine their IC<sub>50</sub>. It is emphasized that there is an ongoing strategic search for substances that have a greater inhibition over  $\alpha$ -glucosidase and with a moderate effect on  $\alpha$ -amylase in order to reduce the side effects produced by unfermented carbohydrates (Kim et al., 2011).

### ACKNOWLEDGMENT

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# Antioxidant and antibacterial activities of the stem bark of *Aspidosperma spruceanum* Benth

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**Abstract**— The pharmacological activity of plants of the Apocynaceae family is mainly attributed to the presence of alkaloids. *Aspidosperma spruceanum* is a representative of this family, whose wood has been largely used in the construction industry. However, reports of its pharmacological and chemical properties are incipient. Therefore, this work aimed to investigate the antioxidant and antibacterial properties of extracts and fractions of this plant. After plant collection and identification, methanolic extract and fractions of the stem bark were prepared. Antioxidant activity was determined by •DPPH radical scavenging assay and total phenolics were estimated by reaction with Folin-Ciocalteu reagent. Minimum inhibitory and minimum bactericidal concentrations were estimated by the broth microdilution method against *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The samples were also investigated for hemolytic activity. The phytochemical profile was determined by classical phytochemical tests. The methanolic extract of the bark showed bactericidal activity against *S. aureus* and bacteriostatic activity against *P. aeruginosa*. The hexane fraction obtained from crude extract fractionation acted as a bactericide against both strains. The ethanolic fractions of crude extract and dichloromethane and ethyl acetate fractions obtained from acid-base fractionation contained higher concentration of phenolics and, consequently, higher antioxidant activity in vitro. The analysis of the phytochemical profile indicated the presence of alkaloids, triterpenes and steroids in the samples. In conclusion, this article brings the first description of the antioxidant and antibacterial properties of *A. spruceanum* and preliminary chemical composition, and also values the components of the biodiversity of the state of Bahia not yet studied.

**Keywords**— *apocynaceae*; *A. spruceanum*; *antioxidant*; *anti-bacterial*.

## I.

### INTRODUCTION

The family Apocynaceae has between 3700 and 5100 species, classified in 250 to 550 genera, and is commonly found in the tropics and subtropics. In Brazil, this family is represented by more than 400 species distributed in 41 genera, present in all biomes, including Caatinga, Cerrado and forests (Pereira, 2007; Gomes, 2011).

The genus *Aspidosperma* is one of the most important in the Apocynaceae family. Ethnopharmacological studies have shown that species of this genus can be used to treat malaria, leishmaniasis, uterine and ovarian inflammation, fever, diabetes, impotence, disorders, cancer, rheumatism,

among others (Oliveira, 2008; Aguiar, 2010; Dolabela, 2012).

The pharmacological properties of species of the Apocynaceae family have been mainly attributed to the presence of alkaloids. In the genus *Aspidosperma* alone, more than 247 indole alkaloids with a great structural diversity have been identified through phytochemical studies. For this reason, these alkaloids are considered chemotaxonomic markers of *Aspidosperma* species (Pereira, 2007; Gomes, 2011; Henrique, 2010; Teugwa et al; 2013).

*Aspidosperma spruceanum* is an important representative of the genus and a native tree of the Atlantic Forest, being 5 to 20 m tall and presenting a round crown.

Its trunk, 30 to 40 cm in diameter, is covered by a thick layer of cork, and is an excellent source of wood used in the construction industry. As typical of the genus, this plant is also rich in indole alkaloids, being some of them exclusive to the species (Fumagali, 2008).

The few reports of the pharmacological properties of *A. spruceanum* attribute to their leaves and stems a moderate to high antispasmodic and antiparasitic activity against *Trypanosoma cruzi* and *Leishmania infantum*, which justifies the need for more systematic studies aimed at investigating the biological potential of this plant (Paula, 2014; Reina et al., 2014).

Thus, in view of the need for new therapeutic strategies for the treatment of inflammatory and infectious diseases (Rabêlo and Rodrigues et al., 2014), this study aimed to investigate the antioxidant and antibacterial properties of extracts and fractions of *A. spruceanum*. In addition, it is expected to contribute to the still incipient scientific knowledge about the regional flora.

## II. MATERIAL AND METHODS

### A. Plant material

Plant material from *Aspidosperma spruceanum* Benth. ex Müll. Arg. were collected in June 28<sup>th</sup> of 2012, in a forest fragment in Brejo Novo Farm (13°56'41"S and 40°06'33.9"W) between 617 m and 755 m of altitude at 9 km from Jequié, Bahia State, Brazil. The botanic identification was performed by comparison with a voucher (HUESB 2418) deposited in the Herbarium of the State University of Southwest of Bahia.

### B. Preparation of extracts

The plant material was dried in Tecnal drying oven (TE 394\2 Model) at 40 °C for 48 h and submitted to cold maceration with methanol for prepare of the bark extract from *A. spruceanum* (ME). The extract solution was filtered and concentrated under vacuum in rotary evaporator (Fisatom, 801 Model) at 50 °C (Serafin et al., 2007).

### C. Extraction fractionation

The methanolic extract (ME) (3.6 g) was initially dissolved in methanol and subsequently fractionated by silica gel 60 column chromatography (Silva et al., 2014). Hexane, ethyl acetate, ethanol solvents were used as the mobile phase. Finally, the hexane fraction (HF), ethyl acetate fraction (EAF), and ethanolic fraction (EF) of the stem bark were concentrated in a rotary evaporator.

### D. Isolation of total alkaloid fraction

The ethyl acetate fraction (EAF) (0.94 g) was dissolved in methanol before acid-base fractionation. HCl (1%) was then added until the pH of the suspension was 2.0. Extraction with dichloromethane (3x50 mL) was made in a

separation funnel. After separation of the dichloromethane phase (DF1) from the acidic aqueous phase (AAF), aqueous NH<sub>4</sub>OH (5%) was added to the AAF to approximately pH 10 to obtain the basic aqueous phase 1 (BAF1). Then, in a separation funnel, alkaloids (lower polarity) were extracted from BAF1 with dichloromethane (3x30 mL) to result in the dichloromethane phase 2 (DF2) and basic aqueous phase 2 (BAF2). The most polar alkaloids were extracted from BAF2 with ethyl acetate (3x30 mL) by partition to obtain the ethyl acetate fraction 2 (EAF2) and the basic aqueous phase 3 (BAF3). Finally, BAF3 was extracted with butanol to obtain the butanol fraction (BuF) and the basic aqueous phase 4 (BAF4). All organic fractions obtained were concentrated in a rotary evaporator (Matos, 2009).

### E. Detection of alkaloids by Dragendorff test

The extract and fractions were analyzed by Thin Layer Chromatography on 60 GF<sub>254</sub> silica gel plates (dimensions 5 x 10 cm), eluted with a mixture of chloroform and methanol (9:1). After elution, the plates were dried and observed under ultraviolet (UV) light. Finally, the Dragendorff reagent was sprayed onto the plate, and the appearance of orange bands suggests the presence of alkaloids (Costa et al., 2008).

### F. Detection of triterpenes and steroids by Liebermann-Burchard assay

About 10 mg of the hexane fraction of *A. spruceanum* bark was dissolved in chloroform. Then 5 drops of Liebermann-Burchard reagent were added. After a few minutes, the change in the color of the solution was inspected, until a greenish color appeared, suggesting the presence of triterpenes and/or steroids (Burke et al., 1974).

### G. Minimum Inhibitory Concentration (CIM) and Minimum Bactericidal Concentration (CBM)

*Staphylococcus aureus* (ATCC 29213) and *Pseudomonas aeruginosa* (ATCC 2785) suspensions were diluted in BHI broth to 0.1 absorbance at 625 nm. Then extracts or fractions were added at varying concentrations (25 to 1000 µg/mL). The antibiotics ceftriaxone (50 µg/mL) and tetracycline (50 µg/mL) were used as positive control for gram negative and gram positive bacteria, respectively. After incubation at 37°C for 24 h, 60 µL of the resazurin dye (0.01%) was added in 200 µL of the bacterial suspension. MIC corresponded to the lowest concentration at which no visible bacterial growth (blue color) was seen after additional incubation at 37°C for 30 min. For determination of MBC, 10 µL of the bacterial suspension preincubated with extracts or fractions at different concentrations (25 to 1000 µg/mL) were plated on Muller-Hinton Agar at 37°C for 24 h. MBC corresponded to the concentration at which no evidence of

bacterial growth on the surface of the culture medium was seen (Santos et al., 2017).

#### H. Phosphomolybdenum complex reduction method

The concentration of total phenolic compounds present in the samples was determined by the Folin-Ciocalteu spectrophotometric assay (Singleton et al., 1992). Samples were diluted in their solvents to a final concentration of 1 mg/mL. An extract aliquot of 125  $\mu$ L was mixed with 125  $\mu$ L of Folin-Ciocalteu reagent and 1 mL of distilled water. After 3 min, 125  $\mu$ L of saturated Na<sub>2</sub>CO<sub>3</sub> solution was added and incubated for 30 min at 37°C. At the end of incubation, the absorbance of the sample was measured spectrophotometrically at 750 nm. A standard gallic acid curve (0.5 to 25  $\mu$ g) was constructed to quantify the total phenolics in the samples ( $y = 0.366x + 0.0721$ ,  $R^2 = 0.9932$ ), which were expressed as  $\mu$ g gallic acid equivalents per milligram sample ( $\mu$ g GAE/mg).

#### I. 2,2-Diphenyl-1-picrylhydrazyl (\*DPPH) radical scavenging method

Antioxidant activity was assessed by the ability of the extract and fraction to react with the free radical \*DPPH (Brand-Wiliams, 1995; Duarte-Almeida, 2006). Samples were diluted in ethanol to a final concentration of 1 mg/mL. Aliquots of 12.5, 25, 50, 100, 200, and 300  $\mu$ L of samples were diluted in 1700  $\mu$ L of \*DPPH-ethanol solution (50  $\mu$ M). Ethanol was used to complete the reaction volume to 2 mL. Reaction mixtures were incubated for 20 min at 20°C, and the residual absorbance of \*DPPH was determined at 517 nm. The effective concentration capable of reducing 50% of free radical concentration (EC<sub>50</sub>) was determined by nonlinear adjustment of the data in the GraphPad Prism 6.0 software.

#### J. Determination of cytotoxicity

The *in vitro* hemolytic activity of extracts and fractions was evaluated as described by Farmacopeia and Homen, with some modifications (Homem, 2015; Farmacopeia Brasileira, 2010). Citrate blood was collected from apparently healthy donors, washed three times with saline (0.9%) and resuspended in PBS (phosphate buffer) at the final hematocrit concentration of 2%. Extracts and fractions (1 mg/mL) were added to the suspension of erythrocytes and incubated at 37°C for 3 h. Then, the reaction mixtures were centrifuged at 3000 rpm for 5 min. To quantify hemolysis, supernatants were transferred to an ELISA plate and supernatants were observed and classified into: total hemolysis (+++), moderate hemolysis (++) , low hemolysis (+) and no hemolysis (-). Triton X-100 (1%) was used as positive cell lysis control (+++). Ethanol was used as negative control (-). These procedures were approved by the Research Ethics Committee under number 46135315.4.0000.0055.

#### K. Statistical analysis

All tests were performed at least in triplicate and expressed as mean  $\pm$  standard deviation. Data normality was verified by the Shapiro-Wilk test ( $p > 0.05$ ). Data were analyzed using one-way ANOVA and Dunnett as post-test. The correlation was made according to the Pearson's correlation coefficient. All tests were performed using the GraphPad Prism (6.0) software. A significance level of 5% ( $p < 0.05$ ) was adopted.

### III. RESULTS AND DISCUSSION

Extracts and fractions were initially evaluated for their ability to inhibit the growth of *S. aureus* and *P. aeruginosa* strains. ME and HF presented MIC and MBC of 25 and 50  $\mu$ g/mL for *S. aureus*, respectively. In the case of *P. aeruginosa*, ME and HF presented MIC of 50 and 500  $\mu$ g/mL and MBC of 1000 and 500  $\mu$ g/mL, respectively (Table 1).

According to Tanaka et al. (2005), antimicrobial activity can be classified as: inactive (MIC  $>$  1000  $\mu$ g/mL); weak (500  $<$  MIC  $<$  1000  $\mu$ g/mL); moderate (100  $<$  MIC  $<$  500  $\mu$ g/mL), and good (MIC  $<$  100  $\mu$ g/mL). When the MBC/MIC ratio of any compound is between 1:1 and 2:1, the substance can be considered bactericidal. On the other hand, if the ratio is greater than or equal to 2:1, the most likely mechanism of action of the compound is bacteriostatic (Faria, 2012). Thus, ME has the characteristic of an antibacterial agent, with bactericidal mechanism on *S. aureus* strains (MBC/MIC = 2:1) and bacteriostatic mechanism on *P. aeruginosa* (MBC/MIC = 20:1). The ME fraction, on the other hand, possibly acted as a bactericide in the case of both *S. aureus* and *P. aeruginosa*, with MBC/MIC ratios of 2:1 and 1:1, respectively. EAF presented MIC and MBC greater than 1000  $\mu$ g/mL for *S. aureus*, but could not be tested for *P. aeruginosa* due to a sample limitation. The literature indicates that indole alkaloids often present in species of the Apocynaceae family may be responsible for the antibacterial activity of plants in this family (Teugwa et al., 2013). In a previous study with the alkaloid fraction of *A. pyrifolium* bark, it was observed that this plant inhibited the growth of *S. aureus* and *Bacillus subtilis* with MIC of 125 and 250  $\mu$ g/mL, respectively (Pessini, 2015). *A. olivaceum* extracts were also active against *B. subtilis* (Oliveira et al., 2009).

Extracts and fractions of *A. spruceanum* were monitored by thin layer chromatography (TLC) for the presence of alkaloids. The results showed that the ME presents metabolites that react positively on Dragendorff's reagent, suggesting the presence of alkaloids (Costa et al., 2008). In fact, the alkaloids aspidoalbina, *N*-acetyl-*N*-



despropionylaspidoalbine (*N*-acetyl aspidoalbine), des-*O*-methyl-aspidolimidine, spruceanumine A, and spruceanumine B have already been isolated from *A. spruceanum* (Oliveira, 2008). Since TLC demonstrated

that EAF had the highest concentration of alkaloids (Figure 1), this fraction was subjected to extraction of total alkaloids.

Table 1. Determination of minimum inhibitory and minimum bactericidal concentrations of *A. spruceanum* extracts and fractions

Sample	MIC (µg/mL)		MBC (µg/mL)		MBC/MIC	
	<i>S. Aureus</i>	<i>P. aeruginosa</i>	<i>S. Aureus</i>	<i>P. Aeruginosa</i>	<i>S. aureus</i>	<i>P. Aeruginosa</i>
ME	<25	<25	50	1000	>2:1	>40:1
EAF	>1000	>1000	>1000	>1000	-	-
HF	< 25	500	50	500	>2:1	1:1
DF2	1000	1000	1000	1000	1:1	1:1
BuF	>1000	>1000	>1000	>1000	-	-
Tetracycline	50	-	50	-	-	-
Ceftriaxone	-	50	-	50	-	-

(-): Not tested. \*The amount of the ethyl acetate fraction was not sufficient for the assay. ME: Methanolic extract of the stem bark of *A. spruceanum*. EAF: Ethyl acetate fraction of the methanolic extract of the stem bark of *A. spruceanum*. HF: Hexane fraction of the methanolic extract of the stem bark of *A. spruceanum*. D2F: Dichloromethane fraction 2 of the stem bark of *A. spruceanum*. BuF: Butanolic fraction of the stem bark of *A. spruceanum*. \*p < 0.05 when compared to tetracycline and ceftriaxone by ANOVA with Dunnet's post-test.

Additionally, the Liebermann-Burchard qualitative assay indicated the presence of triterpenes and/or steroids in the hexane fraction of the stem bark of *A. spruceanum*. It is noteworthy that these compounds can be partitioned into the

hexane fraction due to their non-polarity, being equally important from a biological point of view due to the myriad properties, including antibacterial properties (Virtuoso et al., 2005; Barbosa et al., 2010; Bannwart et al., 2013).



Fig.1: Detection of alkaloids in *A. spruceanum* extracts by plate chromatography.

The arrow indicates the spot containing alkaloids. A- Alkaloid detection. 1) ME: Hexane fraction of the stem bark of *A. spruceanum*; 2) EAF: Ethyl acetate fraction of the stem bark of *A. spruceanum*; 3) EF: Ethanolic fraction of the stem bark of *A. spruceanum*. Stationary phase: silica gel layer 1.0 mm thick. Mobile phase: chloroform and methanol. Dragendorff's reagent was used for staining alkaloid molecules.

DF2, rich in alkaloids, presented MIC and MBC values of 1000 µg/mL for Gram positive strains, while BuF presented values greater than 1000 µg/mL for Gram negative strains (Table 2). It is possible that these

Phenolic compounds present in plants are another class of molecules with a number of pharmacological properties including anti-inflammatory, vasodilatory, antitumor, antiulcerogenic, antiplatelet, antimicrobial, and antiviral activity. The antioxidant activity of the extracts was evaluated by the DPPH free radical reduction method. ME presented lower EC<sub>50</sub> value (28.67 µg/mL) and, consequently, the phenolic concentration was relatively high (123.28 µg EAG/mg) (Table 3). Extracts with EC<sub>50</sub> values below 50 µg/mL indicate high antioxidant activity, below 50-100 µg/mL indicate moderate antioxidant activity, below 100-200 µg/mL indicate low activity, and above 200 µg/mL are considered inactive.

The ethanolic fractions of the crude extract and dichloromethane and ethyl acetate fractions obtained from acid-base fractionation contained higher concentration of phenolic components and, consequently, higher antioxidant activity *in vitro* (Table 2). On the other hand,

molecules were not responsible for the antibacterial properties of *A. Spruceanum*, or they may be important only when acting synergistically with other substances (Betoni et al., 2006).

the antioxidant activity of the alkaloid fractions did not correlate with phenolic concentration (p = 0.761). A study with iboga alkaloids of *Peschiera affinis* (Apocynaceae) demonstrated that the antioxidant activity in these plants may be attributed to the presence of these alkaloids (Santos, 2009), which may also have occurred in the present work.

Thus, antioxidant activity in the alkaloid fractions of *A. spruceanum* can be associated not only with phenolic compounds but also with iboga alkaloids, which explains the difficulty in obtaining a correlation between the two phenomena. Taken together, the results suggest that *A. spruceanum* bark may contain bioactive molecules with important pharmacological properties, being a source of antioxidant and antibacterial substances.

Table 2. Phenolic concentration and antioxidant activity of the extracts of *A. spruceanum*

Sample	Total phenolics (µg EAG/mg)	CE <sub>50</sub> (µg/ml)
ME	123.28±0.14	28.67±0.01*
HF	-	-
EAF	46.73± 0.014	54.23±0.02*
FMCASE	116.3±0.0014	38.66±0.03*
FBu	104.56±0.002	43.41±0.01*
EF	141.52±0.018	31.28±0.01*
DF2	173.69±0.030	39.36±0.72*
Gallic acid	-	7.11±0.23

(-): Not tested. Results expressed as mean ± standard deviation (n = 3). (-): Not tested. \* ME: Methanolic extract of the stem bark of *A. spruceanum*. EAF: Ethyl acetate fraction of the methanolic extract of the stem bark of *A. spruceanum*. HF: Hexane fraction of the methanolic extract of the stem bark of *A. spruceanum*. EF: Ethanolic fraction of the stem bark of *A. spruceanum*. D2F: Dichloromethane fraction 2 of the stem bark of *A. spruceanum*. BuF: Butanolic fraction of the stem bark of *A. spruceanum*. \* p < 0.05, when compared to gallic acid by ANOVA with Dunnet's post-test.

Finally, *A. spruceanum* extracts and fractions were tested for lytic activity on human erythrocytes. Erythrocytes are useful as a model for assessing the preliminary toxicity of a wide variety of substances, allowing for information on their effects on the cell membrane. The occurrence of hemolysis after exposure to the test product may be directly correlated with its cytotoxicity and used as the first step in *in vitro* toxicological screening (Souza et al., 2014). With the exception of HE, all other samples caused little or no hemolysis (Table 3).

Considering that plant bioactive substances may be responsible for the protective effect against the risks of many pathological conditions, the results described in this work stimulate the continuity of studies on the biological properties of the total alkaloid (D2F), butanolic (BuF) and hexanic fraction (HF) of *A. Spruceanum* as well as the isolation and characterization of bioactive molecules.

Table 3. *In vitro* cytotoxicity of *A. spruceanum* extracts and fractions.

Sample	Hemolysis (%)
ME	+
EAF	+
HF	++
BuF	-
Triton X-100	+++
Ethanol	-

+++ = total hemolysis; ++ = moderate hemolysis; + = low hemolysis; - = no hemolysis. Triton X-100 was used at 1% concentration. ME: Methanolic extract of *A. spruceanum* stem bark. EAF: Ethyl acetate fraction of methanolic extract of *A. spruceanum* stem bark. HF: Hexane fraction of the methanolic extract of the stem bark of *A. spruceanum*. BuF: Butanolic fraction of the stem bark of *A. spruceanum*.

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# Filter Performance in the Reduction of Hydrogen Sulfide in Biogas

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**Abstract**— The objective of this study was to verify the efficiency of filters in reducing the concentration of hydrogen sulfide ( $H_2S$ ) in biogas. In this case, adsorbent calcined clay and commercial activated charcoal were employed, both with chemical activation utilizing ferric chloride. The filters were compared with iron filings with the values obtained for standard filters. The experimental design was completely randomized, with six treatments and three replications. The treatments consisted of the collection of  $H_2S$  present in biogas generated in a biodigester without filtration (control), with an iron filter (ERBR®), with filters formed by calcined clay with and without impregnation by iron, and commercial activated charcoal with and without iron impregnation. The adsorbents were characterized in relation to the crystalline or amorphous phases present determined by X-ray diffractometry, the specific surface area, volume and distribution of pore size, and tests of adsorption isotherms in blue methylene. The commercial activated charcoal filter with iron impregnation was the most efficient in the removal of hydrogen sulfide from biogas. Its superior performance with a higher adsorption capacity is due to the large specific surface area of activated charcoal, as well as the chemical interaction between  $H_2S$  and iron ions impregnated over coal.

**Keywords**— commercial activated carbon filter, calcined clay filter, iron mesh filter.

## I. INTRODUCTION

The agricultural and industrial technology revolutions have transformed how we live, enabling a growing percentage of the world's population to heat and illuminate their homes, to be more connected globally with advancements in transportation, and to more productively fertilize and irrigate their crops. This progress has been fueled by the ability to effectively locate, extract, and use energy with increasing ingenuity. Materials science research continues to pursue sustainable solutions that contribute to achieving technically- and economically-feasible clean energy generation, transmission, distribution, and storage, with greater energy efficiency, and improved energy management systems [1].

According to the Brazilian Energy Research Company (EPE), in 2016 renewable energy accounted for 43.5% of the nation's total domestically-produced energy supply, while the world average was around 14%, with only about 6% in developed countries. This 43.5% encompassed 17.5% sugarcane biomass, 12.6%

hydropower, 8% firewood and charcoal, and 5.4% from other sources including 0.9% from biogas[2].

Anaerobic digestion is a biological process that can convert organic substrates into biogas in the absence of oxygen. The anaerobic digestion process generates a series of compounds. Among them is hydrogen sulfide ( $H_2S$ ), which is useless for energetic purposes [3].

$H_2S$  is a flammable gas, denser than air, with an unpleasant odor, toxic to humans, and caustic. It corrodes critical engine components, negatively impacting power generation, and must be extracted to enhance biogas quality. The recommended level of  $H_2S$  in biogas for direct combustion is in the range of 0.02% to 0.05% (200 to 500 ppm). Therefore, desulfurization is necessary to protect the combustion equipment from damage and prevent the formation of sulfur dioxide ( $SO_2$ ), which is a precursor of acid rain. The removal of  $H_2S$  from biogas is commonly accomplished with the use of filters [4, 5].

A review of the literature revealed multiple applications and approaches for the removal of  $H_2S$  being investigated in recent years including the study of

anaerobically digested fiber charcoal for H<sub>2</sub>S removal in biogas by Pelaez-Samaniego et al. [6], the removal of H<sub>2</sub>S from biogas involving the anaerobic fermentation of swine manure using iron oxide, calcium hydroxide, and charcoal verified by Machado et al. [7], and, in the investigation of biogas purification from household waste, Ebunilo et al. [8] used materials found in Nigeria, including charcoal, potash, clay, iron ore, and zeolite, as filter elements.

Since at the small scale the cost of using commercial filter media based on iron or carbon to remove H<sub>2</sub>S can act as a barrier to the adoption of biogas technology on the farm, Skerman et al. [9], seeking low-cost filtering media, studied a red soil filter for its potential to remove H<sub>2</sub>S present in standard gas. And in one review focused on nanoporous materials, such as H<sub>2</sub>S adsorbents for biogas purification processes, Peluso et al. [10] asserted that activated charcoals have been studied extensively for many years in this application, providing good results, although they have limited regenerability.

The mesoporous silicas ordered with amino function produced very interesting results, both in terms of adsorption performance and regenerative capacity, but were not tested on a large scale and deserve further investigation. On the contrary, despite reporting very good results, there are few studies dealing with the adsorption of H<sub>2</sub>S in organic structures of nanoporous metal. Thus, the objective was to verify the efficiency of filters that incorporate calcined clay and activated charcoal impregnated with iron ions for the reduction of hydrogen sulfide (H<sub>2</sub>S) in biogas.

## II. MATERIAL AND METHODS

Initially, we proceeded to characterize the materials used as adsorbents (calcined clay-CC and commercial activated charcoal-CAC). As a reference in gas filtration, the characterization of the specific surface area, volume, and pore size of the calcined clay and commercial activated charcoal was performed. For this analysis, the samples were subjected to drying and cleaning of their surfaces by heating at 200 °C for 3 hours under vacuum in the degasser system. After this operation, the samples were analyzed for the gaseous nitrogen physisorption isotherms (N<sub>2</sub>) at the liquid N<sub>2</sub> temperature (77 K) in a Quantachrome Instruments® model NOVA touch LX2. The obtained isotherms were treated with the appropriate mathematical models to obtain the information of interest.

For the qualitative analysis of phases present in the adsorbents, the X-ray diffractometry technique was used, where the samples were prepared with the maceration of the material to obtain a fine powder, and deagglomerated

in a 325 mesh sieve (opening 45 µm). The diffractograms were collected in continuous scanning mode in an X-ray diffractometer, model XRD-6000 (Shimadzu), equipped with a graphite-curved monochromatic and copper anode, with K $\alpha$  radiation (1, 54060 Å). The equipment was operated at 40 kV and 30 mA, with divergence and dispersion cracks of 1.0 ° and a receipt slit of 0.3 mm. The analysis was performed with a 2 min<sup>-1</sup> scanning speed on the theta-2theta movement axis.

In iron impregnation, the materials were placed in a 0.5 mol L<sup>-1</sup> iron nitrate solution. A 0.8 g mL<sup>-1</sup> adsorbent ratio was used in relation to the iron ion solution. The mixture was under agitation for 3.0 h at 300 rpm in a mechanical agitator Fisatom until impregnation occurred. After the elapsed time, the modified adsorbents with iron were filtered, dried in a greenhouse for 12h to 100 °C, and stored in a desiccator until the filters were assembled. This step was performed to increase the adsorption efficiency of H<sub>2</sub>S by chemical interaction with iron ions.

The adsorbents, pure and adsorbed with iron ions, were characterized by isotherms in methylene blue solution, where 1.0 g of each adsorbent was used (calcined clay, calcined clay impregnated with iron, commercial activated charcoal, and commercial activated charcoal impregnated with iron). The adsorbents were added in vials containing methylene blue solution at different concentrations (10, 25, 50, 100, 250, 500 and 1000 mg L<sup>-1</sup>). The adsorbents were in contact with the solution in static mode for 24 hours at room temperature. The remaining concentrations of methylene blue were analyzed in a Varian Cary 50 UV-Vis spectrophotometer at 660 nm. The number of methylene blue was defined based on the Langmuir isotherm, plotting EQF (mg G<sup>-1</sup>) as a function of the methylene blue concentration in the equilibrium time. The parameters of the Langmuir isotherm (Q<sub>max</sub> and K<sub>L</sub>) were found by regression of the quadratic equations.

The preparation of the filters occurred in the laboratories of the State University of Ponta Grossa (PR-Brazil) in 2018. To assemble the filters, each adsorbent material (calcined clay and commercial activated charcoal, pure and activated with iron) was placed inside a closed PVC container where covers with copper tubes were adapted for gas passage. The established mass of each adsorbent was 10.0 g per filter (Figure 01).

The efficiency of the filters was evaluated in-situ at the farm Vale do Jotuva® (Carambéi, Paraná, Brazil), with biogas generated by a biogas digester (ERBR®-Canadian model) using milk cattle residue. The filters were installed in a biogas-driven electric motor-generator in conjunction with a gas suction pump (Electric Air Pump®-2021/127) for a constant flow of 7.0 L min<sup>-1</sup>, and an H<sub>2</sub>S meter (Gas Clip

Technologies<sup>®</sup>-SGC H<sub>2</sub>S). To quantify the volume of gas that passed through the filter, a Protec<sup>®</sup> Flowmeter was used with a capacity of 15 L min<sup>-1</sup> (Figure 02). The concentration of H<sub>2</sub>S was measured 1.0 m after the filter for a period of 60 minutes of gas passage through the filters.

The experimental design was completely randomized, with six treatments and three replications. The treatments consisted of a control (no filter for H<sub>2</sub>S reduction), a standard iron filter (ERBR<sup>®</sup>), calcined clay (with and without iron adsorption), and commercial activated charcoal (with and without iron adsorption). The repetitions were composed of three filters for each treatment.

The values recorded were analyzed by Hartley's test to verify the homoscedasticity of the variances, and by the Shapiro-Wilk test to examine the normality of the data. The variables measured were subjected to analysis of variance by the Fisher-Snedecor test, and the mean values compared by Tukey's test, with a confidence level higher than 95% of probability ( $P < 0.05$ ).

### III. RESULTS AND DISCUSSION

The specific surface area (BET) was 1.5 m<sup>2</sup> G<sup>-1</sup> for calcined clay, a value much lower than the 817 m<sup>2</sup> G<sup>-1</sup> of commercial activated charcoal. Pore volume (BJH) was 0.0004 and 0.0459 (cm<sup>3</sup> G<sup>-1</sup>) for calcined clay and commercial activated charcoal, respectively. The pore radius (BJH) was similar among the evaluated materials, being 1.66 and 1.67 (nm) for calcined clay and commercial activated charcoal, respectively. The clay was calcined at high temperatures (1300 °C), which did not contribute to interlamellar porosity as in activated charcoal, and which is only due to the external surface area of the particles.

Utilizing the X-ray diffractometry technique, the presence of crystalline phases in the adsorbents was qualitatively identified. There was observed in the diffractogram of calcined clay (Figure 03-A) several diffraction peaks identified as cristobalite (SiO<sub>2</sub>), quartz (SiO<sub>2</sub>), and mullite (3Al<sub>2</sub>O<sub>3</sub>·2 SiO<sub>2</sub>). Also observed was a region of amorphous material, probably referring to some phase of SiO<sub>2</sub>, not crystallized. For commercial activated charcoal (Figure 03-B), a diffraction pattern was observed identified as the graphite crystalline phase (C) - that is, a more organized charcoal - confirming its larger surface area. Some silica-related diffraction peaks were identified. A pattern of amorphous material was also observed, referring to the disorganized carbon phase, not yet fully converted to graphite.

For the characterization of adsorbents by methylene blue adsorption isotherms, the standard curve for concentrations by molecular absorption spectrophotometry in the UV-Vis region was determined. Methylene blue adsorption isotherms are shown in Figure 4.

The values of the Q<sub>max</sub> and KL parameters of the Langmuir isotherm (Table 01) establish the maximum value in milligrams of dye that the adsorbent is capable of adsorbing per gram, highlighting large differences between the tested materials. Thus, the adsorbent capacity (Q<sub>max</sub>) of commercial activated charcoal is 4.4 times greater than the calcined clay. This is directly related to the large specific surface area of activated charcoal observed in the N<sub>2</sub> physisorption. The impregnation with iron (adsorption) reduces the adsorption of methylene blue dye in both adsorbents since the active sites are occupied with iron ions. For the adsorption of H<sub>2</sub>S, the adsorbents impregnated with iron should be potentialized since chemical adsorption of H<sub>2</sub>S can occur at sites occupied by iron ions.

The Hartley's test to verify homoscedasticity, and Shapiro-Wilk to examine the normality of the data, were not significant; thus, not requiring data transformation or analysis of variance. With the significance of the Fisher-Snedecor test, the retention of H<sub>2</sub>S by Tukey was compared (Table 2).

When the adsorbents studied were applied in the production of biogas filters, it was observed that the concentration values of H<sub>2</sub>S reached the limit of the reading of the apparatus for the control treatments (without filter) and iron filings (standard). Subsequently, the H<sub>2</sub>S retention sequence by the filters was in the following ascending order: calcined clay, commercial activated charcoal, calcined clay adsorbed with iron, and commercial activated charcoal adsorbed with iron. These values confirm the previous analyses of specific surface area and adsorption of methylene blue.

The results obtained in the present study do not confirm the conclusions of Pelaez-Samaniego et al. [6]. The authors concluded that the coal capacity obtained from anaerobically digested fibrous solids for H<sub>2</sub>S removal is comparable to that of activated charcoal. The retention of H<sub>2</sub>S is in consonance with the calculation of the Q<sub>max</sub> parameter of the Langmuir isotherm. For the adsorption of methylene blue, the higher the determined value, the more methylene blue adsorbed on the material. Thus, the efficiency of commercial coal proved to be greater than that of clay. The iron impregnation in the adsorbents improved the adsorption of H<sub>2</sub>S, as discussed, in the adsorption isotherm of methylene blue.

The results obtained in this study corroborate the investigation by Machado et al. [7], as they conclude that the serial treatment (filtration by iron oxide, calcium hydroxide, and charcoal) is optimal for the removal of H<sub>2</sub>S and CO<sub>2</sub> (53.5%).

The H<sub>2</sub>S reductions in the biogas of this assay were higher than obtained by Ebunilo et al. [8] using materials found in Nigeria as a filter element. In this African country, the best result was obtained with a filter consisting of a mixture of the materials clay, iron, coal, potassium and zeolite, which reduced H<sub>2</sub>S in biogas to 0.01%. In Brazil, the reduction of H<sub>2</sub>S in biogas was reduced further to 0.0028% with the commercial activated carbon filter adsorbed with iron.

The clay and activated charcoal filters tested appear to be more promising than those investigated by Skerman et al. [9] when searching for low-cost filter media. In that work, the red soil filter was the most promising alternative medium, yet far below the ideal, removing only 5% of the H<sub>2</sub>S present in standard gas. These filters maintained H<sub>2</sub>S at recommended levels of use for direct combustion [4 and 5]. In the present work, the treatments that cannot be confirmed to have maintained the recommended level of H<sub>2</sub>S in biogas for direct combustion were the control (without filter) and the iron filter (standard).

Thus, it follows the contribution to progress towards a sustainable future [1], since the supply of renewable energy sources has great potential for expansion [2]. The ability to withdraw hydrogen sulfide (H<sub>2</sub>S), present in biogas generated by anaerobic digestion, is problematic for energetic purposes [3, 4 and 5]. It is emphasized the importance of studying alternatives that deal with the adsorption of H<sub>2</sub>S in organic structures, by the few studies focused on this objective, as highlighted by Peluso et al. [10] in review on the subject. Thus, the clay and activated charcoal filters produced in this work were prominent to solve this problem.

#### IV. CONCLUSION

The commercial activated charcoal filter with iron impregnation was the most efficient in the removal of hydrogen sulfide from biogas. Its superior performance with a higher adsorption capacity is due to the large specific surface area of activated charcoal, as well as the chemical interaction between H<sub>2</sub>S and iron ions impregnated over coal.

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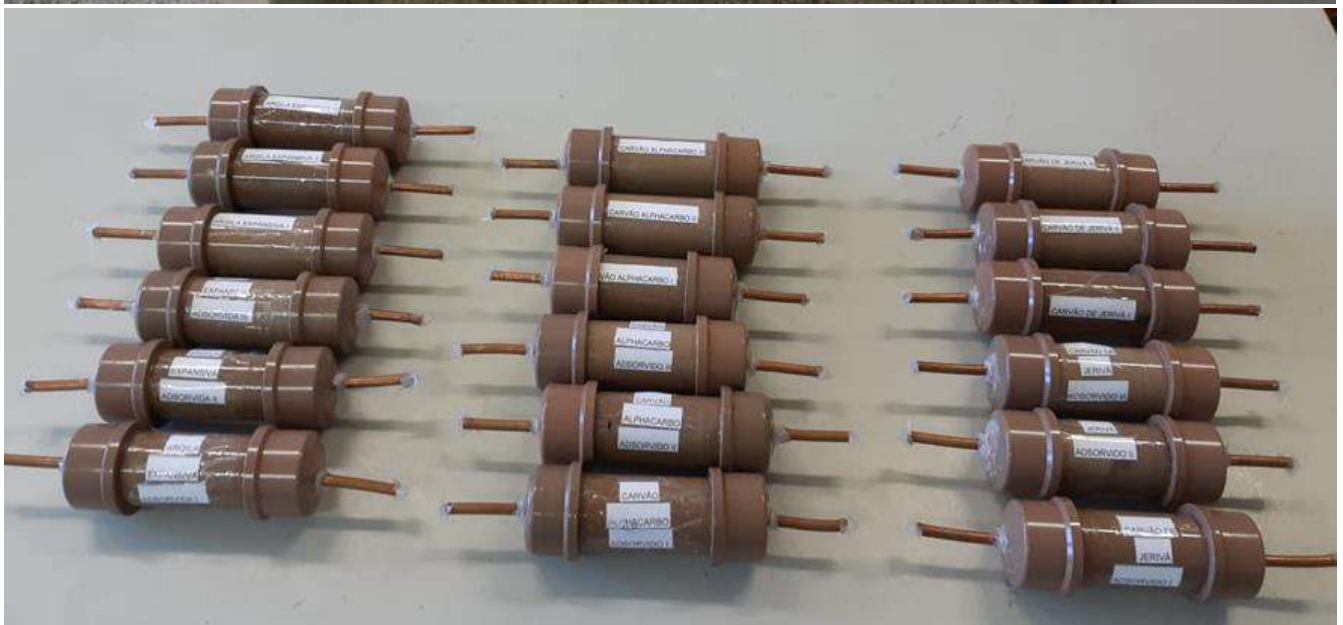


Fig.1: Filters for removal of  $H_2S$  in gas produced by biodigester fed with residue of bovinoculture, State University of Ponta Grossa, Ponta Grossa (PR-Brazil), 2018.

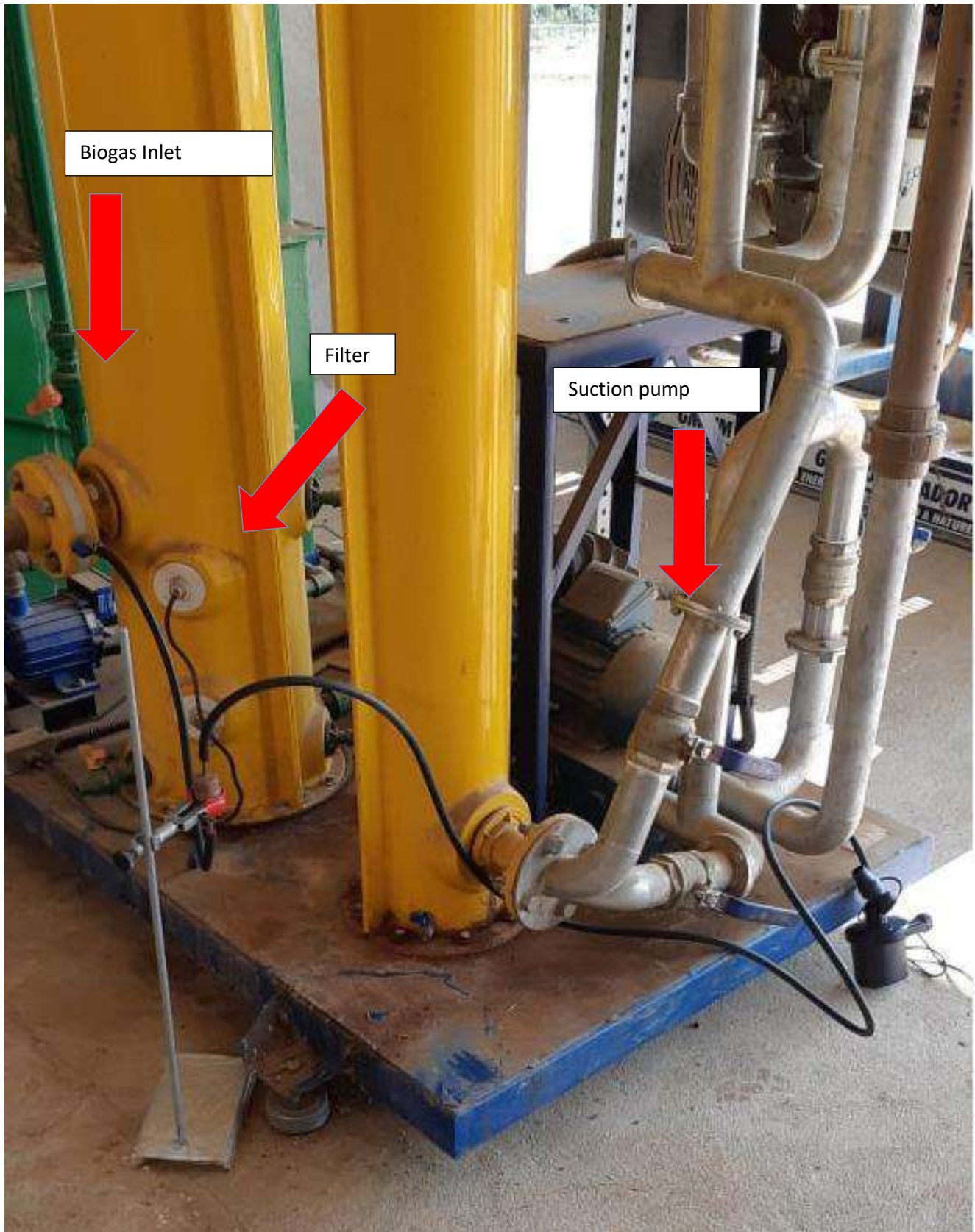


Fig.2: System assembled with the filter and the pump to keep the biogas passage in a constant flow, Carambeí (PR – Brazil), 2018.



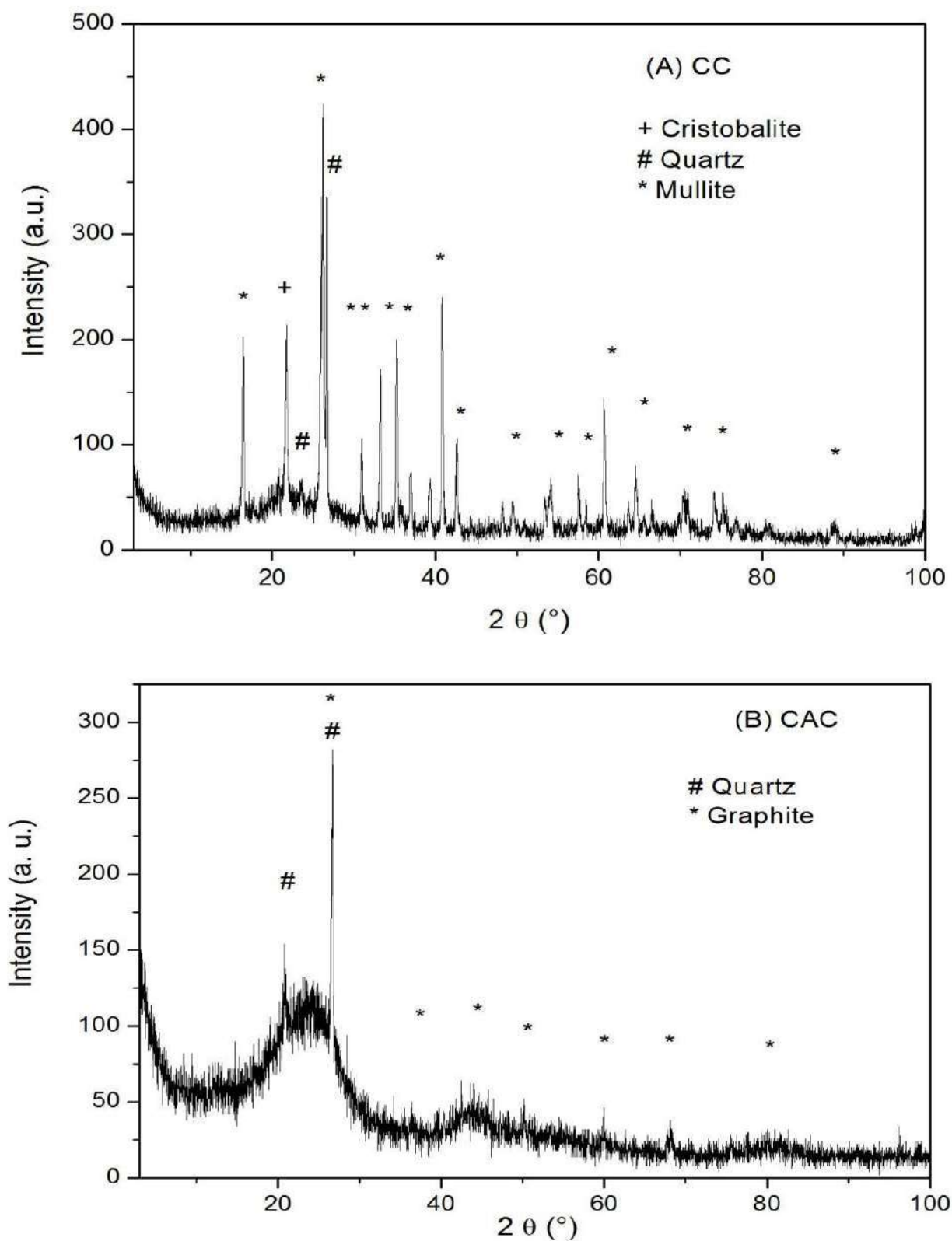


Fig.3: Calcined clay diffractogram (A) and commercial activated charcoal (B), State University of Ponta Grossa, 2018 (Brazil).



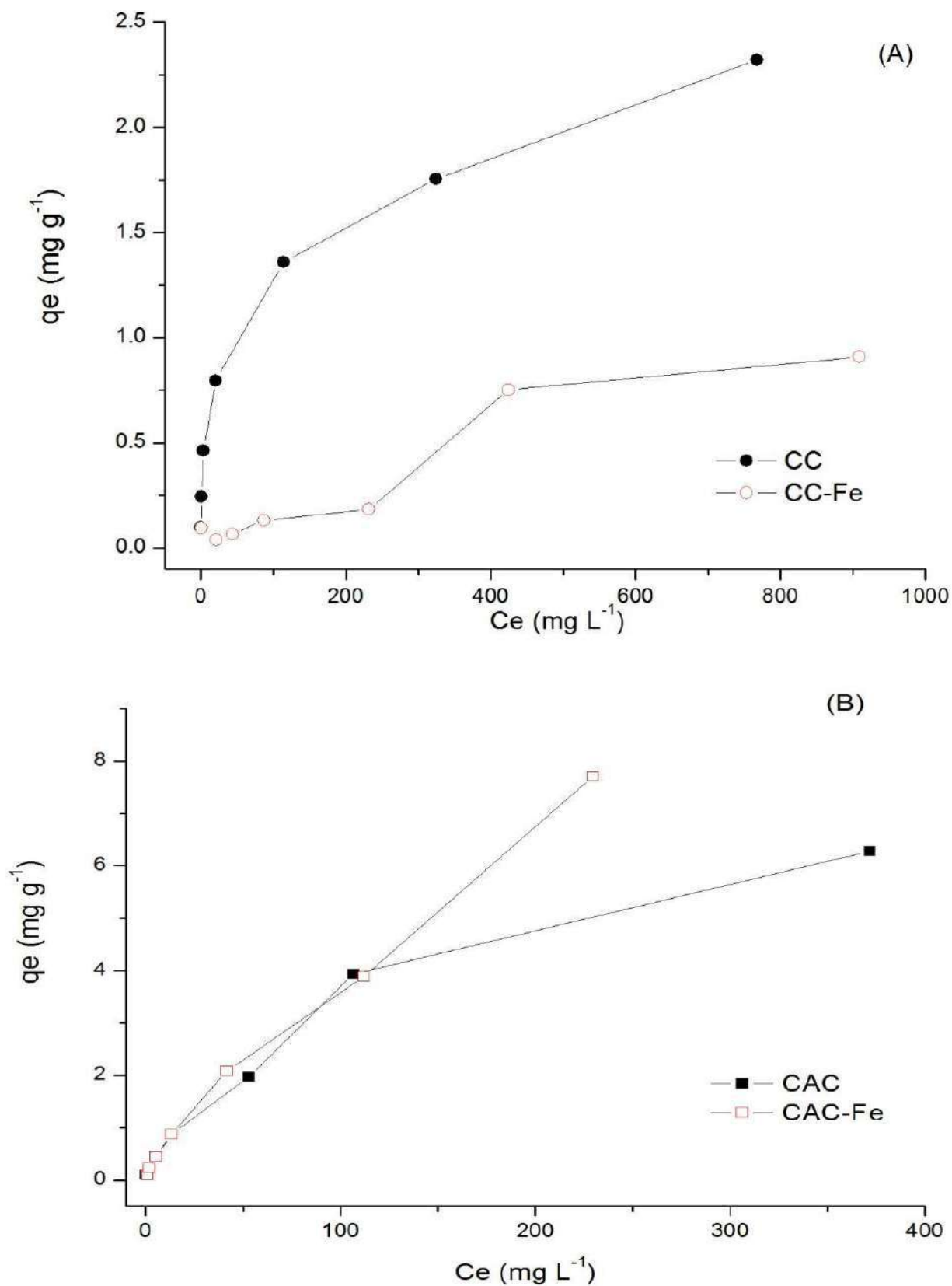


Fig.4: Adsorption isotherms of methylene blue solution for calcined clay (A) and commercial activated charcoal (B), adsorbed (with iron impregnation) or not, State University of Ponta Grossa, 2018 (Brazil).

Table.1:  $q_{max}$  and KL values obtained from the adsorption isotherms of methylene blue, according to the Langmuir model, for adsorbent materials used as filters for the reduction of  $H_2S$  in biogas, State University of Ponta Grossa, 2018 (Brazil).

Adsorbents	$q_{max}^1$ ( $mg\ g^{-1}$ )	$K_L^2$ ( $L\ mg^{-1}$ )
Calcined clay	0.6828	7.7138
Calcined clay adsorbed with Iron	0.1050	12.5901
Commercial activated charcoal	18.5620	0.4545
Commercial activated charcoal adsorbed with Iron	11.3084	0.008

1- $q_{max}$  are maximum adsorption values per gram of adsorbent material.

2 –  $K_L$  corresponds to the interaction constant adsorbate/adsorbent.

Table 2 - Quantity of  $H_2S$  in parts per million (ppm), determined after passage of biogas generated by biodigestion of residue from dairy cattle by different types of filters coupled in a gaseous circuit, for 1 hour, 2018, Carambeí (Paraná – Brazil).

FilterMaterials	$H_2S$ (ppm)
Control (without filter)	100 A <sup>1</sup>
Iron mesh filter (standard)	100 A
Calcined clay	95 B
Calcined clay adsorbed with iron	62 D
Commercial activated charcoal	67 C
Commercial activated charcoal adsorbed with iron	28 E
Coefficient of variation	1.9 %

1-averages followed by the same letter in the column do not differ by the Tukey's test ( $P > 0.05$ ).

# *Je'ne-Je'ne Sappara ritual- Analysis of its history and existence as a subsystem of trust in the Liukang Tupabbiring fishing community in Pangkep Regency*

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**Abstract**— *This study aims to analyze the history, symbolic meaning and existence of the rituals of je'ne je'be sappara as one of the subsystems of belief in the fishing community of Liukang Tupabbiring in Pangkep district. This research is an inductive-descriptive study using discourse analysis as a research method.*

*The results showed that socio-economic activities and behavior are influenced by the system of fishermen's trust. the manifestation of their social activities and socio-economic behavior is a reflection of their appreciation, understanding and knowledge of the rituals of je'ne-je'ne sappara. the existence of a fishing community in this region is determined by the reflection of deep beliefs and their relevance to the dynamics of their lives. The degree of the value of this ritual is largely determined by dynamism in all aspects of the life of the fishermen themselves.*

**Keywords**— *Je'ne-Je'ne, Sappara ritual, socio-economic activities.*

## I. INTRODUCTION

Ethnic diversity in all its aspects is a national asset. In the entire territory of the archipelago there are at least 656 ethnic groups where a number of these tribes cause approximately 300 variations of local / local languages (Pitoyo and Triwahyudi, 2017). The implication of the geographical and ethnic facts that inhabit the archipelago territory is that each ethnic group consists of a number of individuals who have been united by emotional ties, and sees themselves as a separate type. A further consequence is that the diversity of ethnic groups causes them to foster language, culture and beliefs that vary according to their own background as one ethnic group.

Various kinds of ethnicity, religion and culture that grow and develop in a society is not impossible to have implications for the development and progress of that society (Geertz, 1973). In primitive or simple societies for example there is a match between the level of religious life and beliefs with their civilization. This means that the level of advancement in science and technology, religion and beliefs is also very simple too. In addition, a belief system in a particular society is also impossible not to have implications for social

(economic) structures and behavior for the community (Beilharz, 2003).

In the district of Pangkep, South Sulawesi, there is the Sappara Jene-Jene Ritual in the fishing community of Liukang Tupabbiring as a system of belief, which also has implications for the development and progress of the community. This ritual still exists today in the fishing community of Liukang Tupabbiring (Tashadi, 1997). Though it is known that the majority of the fishing community Liukang Tupabbiring is Muslim. It was even in the Liukang Tupabbiring area that the famous ulama pesantren had once stood. Therefore, it is interesting to analyze the rituals of jene 'sappara' in terms of the history of birth and its existence in the fishing community of Liukang Tupabbiring

## II. REFERENCES OF LIBRARY

### 1. Character Education

Character education according to Thomas Lickona (1991) education for one's personality through character education, the results of which show a person's real actions, namely good behavior, honest, responsible, respecting the rights of others, hard work, and so on. According to Elkind and Sweet (2004) Character education in essence aims to form a nation

that is tough competitive, noble, tolerant, mutual cooperation, patriotic spirits developing dynamically, oriented to science and technology which are all inspired by faith and piety to an almighty God based on Pancasila. A strong character will form a strong mentality while a strong mentality will give birth to a strong spirit, never give up dare to wade through a long process, and hit the waves that are bumpy and dangerous. Strong character is a prerequisite for becoming a winner in the field of strong competition like when it comes , which is famous for the hypercompetitive era( Tohari, 2014)

## 2. The Meaning of Local Wisdom

Wisdom is the process and product of human culture, used to preserve Geertz's life (1973). Local wisdom is a system of values or behavior of local people in interacting with the environment in which they live wisely. Naritoom (Wagiran, 2010) formulates local wisdom with the definition, *"Local wisdom is the knowledge that discovered or acquired by lokal people through the accumulation of experiences in trials and integrated with the understanding of surrounding nature and culture. Local wisdom is dynamic by function of created local wisdom and connected to the global situation."* (Pitoyo dan Triwahyudi, 2017)

## 3. Implementation of Local Culture-Based Character Education

The development of science and technology occurs very rapidly which has resulted in changes in the culture of society, these cultural changes result in changes in education itself. Both culture and education will always change with the times, the rapid development of education brings changes to people's lives. This can be seen from the changing patterns and lifestyles of people today. Both culture and education cannot be separated, because essentially education is the process of civilization. The relationship between education and culture is very close, they both influence one another.

Community life certainly cannot be separated from cultures that have long been preserved, preserved, and preserved. A nation's culture becomes a benchmark in the life order of its people (Weber, 1958). Without a solid culture a nation cannot be a civilized human being, a man of noble behavior, a human being who can uphold the noble values of his people. In order to maintain the cultural value of a society, a means is needed to channel and convey culture and the values contained therein, one of the means is education. Through education, delivery and distribution of culture and cultural values will be easily implemented (Robertson, 1993). Education at school, at home and in the community must be able to provide understanding to students that the importance of maintaining cultural noble values.

## III. RESEARCH METHODS

This research is a qualitative descriptive study using Critical Discourse Analysis (CDA) as an analysis tool. Data collection techniques were carried out by examining documents sourced from various media, including television media, newspapers, magazines, and portal sites circulating on the internet related to the Sappara Jene rituals in the fishing community of Liukang Tupabbiring as one of the subsystems of trust also has implications for the development and progress of the community. The locus and unit of analysis in this study are discourses from various reports in the media.

The use of critical discourse analysis (CDA) in this study is inseparable from the purpose of CDA itself. Still referring to Purbani (2013), it is explained that CDA has an agenda to reveal politics that are hidden in or behind social discourse / discourse in society, such as belief systems, religions, customary rules and interpretations or people's views on the world.

## DISCUSSION

The tradition of sappara geniuses was initially carried out by the Bajo (Malay) Community, which were mostly Muslim. The tradition of early sappara genes originated from the Bajo community, namely the Malay people in ancient times. It is said that on every Wednesday in Syafar they carry out the event bathing in the sea, and then they write prayers on a leaf of view. Leaves of sight that have been written do'a then brought to a well and then put into a well so that it blends with the leaf earlier with well water (Mitchell, 1984). At the same time all residents in the neighborhood showered together from the well then after all the residents bathed in the well filled with leaves of sight inscribed with prayers, then subsequently all residents in the island environment the island for one full month, to be exact, every wednesday bathe together in the sea.

Rasiduddin, author of the book Jami 'at-Tawarikh (historical encyclopedia), concluded that in the Pre-Islamic era, the world was geographically divided into seven regions, namely; Roman, Turkish, Chinese, Indian, Arabic, African and Iranian regions. The Persian region in the past as a trade route between East and West. Thus, the existence of trade routes that are so crowded, the trade relations between Iran and the Kingdom of Srivijaya in Sumatra, Indonesia is strongly established, (Iqbal, 2006).

The trade route that had been pioneered with Iran and Sriwijaya, the various possible impacts and implications of trade between the two countries at that time actually also caused the religion and culture of the two parties to interact

with each other. The historical fact that before Islam entered Indonesia (the Archipelago) actually Hinduism and Buddhism had already developed. The Iranian merchants who have embraced Islam directly or indirectly will be introduced to the people of the archipelago.

Some evidence of how powerful Iran's influence in religion and culture in Indonesia is. Aspects of the spread of Islam and culture in Indonesia, many are under the influence of Islamic traditions brought by the Arabs and Iranians from their respective countries. The recitation of mantras in the tradition to avoid danger is known as the "reject reinforcements" in Indonesian society more or less influenced by Iran which is mostly Shi'ite. When Malay society faces fear of an epidemic, Malay society sometimes chants the following prayer; "Li khamsatun uthfi biha harral waba-i al khatimah al-Mushthafa, wa al-Murtadha, wa ibnahuma wa al-Fatimah". the meaning; "For me five, with it I extinguish the disease, the chosen Prophet, the blessed Ali, Fatimah, and their two children (Hasan and Husain)."

From the aspect of the spread of Islam and cultural aspects it is undeniable that the influence of Iran's trade caravans and preaching in particular the Shi'ism is so great and visible in Indonesian society today. For Iranian Shiites religious warnings are very important and sacred in their lives. Even in all corners of the world until now, Shi'a every year, especially in the two months that are very special in their beliefs arrived, then the bustle and excitement is always directed in their lives. Muharram and Syafar are two very important months for Shiites.

This is due to the month of Muharram and Syafar in connection with the commemoration of the Imam Husayn's Shahadah. Where the death of Imam Husain was not only for the Shiites but also as one of the greatest events in the history of Islamic civilization. In the month of Muharram for the Shiites each year is commemorated as a commemoration of mourning the accident of the killing of Imam Husain in Padang Karbala. In the first days until the tenth day of Muharram various traditional rituals were performed by the Shiites. They made boxes, pictures, buildings in the form of fortresses, tomb cages, coffins, and nakhl (large tree-shaped ark made of wood and iron and decorated with glass and cloth) then, under the name of the ark of the martyrs Karbala, they paraded all that on the streets, in various places, and markets. Bringing the ark and reading the poems of sadness and this is a religious legend of the Shiites everywhere.

Every time entering the 1st of Muharram the Shi'ites everywhere make what they call takhzhiah associated with warnings or performances of various tragedies in history

(Robertson, 1993). For the Shiites the takhzhiah is influenced by their beliefs, especially in the case of the tragedy of Karbala. Therefore, the Shiite takhzhiah made by them have the characteristics of a square or box-shaped roof that is given the leaves of a type of tree and is similar to the tomb covers that have been decorated with paper, flowers, and sometimes the takhzhiah is decorated with poems of sadness. At the end of the Imam Husain's commemoration ceremony which falls on the day of Aza (10 Muharram) or also known in the tradition of the Shiites as a remembrance of Imam Husayn Arba'in, these takhzhiahs are then thrown or washed into rivers or into the sea .

The Iranian Shiite tradition is not only practiced by the Shi'ites in their country, that is, in Iran but also Shi'ites in any part of the world where there are Shi'ites. Even according to Mir. Abdullatif Khan Syusyati pointed out the fact that the warnings of Muharram and Syafar had been seen in India in 1203 AH. He stated in his writings "it is truly amazing that in Jay Nagar, a city which did not smell of Muslims and did not hear the voices of Muhammad's followers. (almost all inhabitants of this city are non-Muslims, namely Hindus) but there are also takhzhiahs that are considered by the city community to have high value in their lives.

The fishing community perpetuates the tradition of sappara geniuses with various purposes and objectives. For this reason, it can be seen from the following description of how this tradition has meaning / purpose for the fishing community. For them, the implementation of the sappara rituals is related to the atmosphere in the month of Muharram, which is to cool the hot atmosphere in the month of Muharram. The fishing community has confidence in the month of Muharram. The fishing community realized that in the month of Muharram a huge and extraordinary event had taken place. The incident occurred on the 10th of Muharram (yaomu Ashura) today for the fishing community he called "Jepe Shura". Because on that day the fishing community made "Jepe" (rice which was cooked until destroyed). After cooking, the "jepe" is served on a large plate to "read".

The implementation of ma'Baca (ma'pisabbi) was carried out by serving as many as 41 plates of jepe placed on a mat. After that, take one large glass of water and embers to burn kemenyam (incense). When all has been provided, it is called "Anrong Pa'Baca teacher" to recite the prayer of salvation in a position facing the Qibla and in front of Arong the Pa'Baca teacher is placed 41 plates jepe, one glass of water and embers to burn "incense" . The reading that was echoed by Anrong Pa'Baca teacher is sequentially preceded by reading ta'uwdz, basmalah, praise to Allah. Peace to the Prophet



Muhammad. Then read the prayer of salvation / protection from all danger after it is closed by inviting family members present to read together surah al-Fatihah and end by reading amen (accept) together as well (Manyambeang, 1983)

The tradition of the fishing community in songkabala activities is carried out every Muharram Month precisely on the 10th of Muharram. The reason is that on that day events such as; Allah (swt) accepts the repentance of the Prophet Adam, Allah raises the rank of Prophet Idris, Noah's boat landed after the world was drowned by Allah as a punishment of his people and his family who did not want to follow the teachings of Noah.

These events numbered 10 and occurred on the 10th of Muharram. Jepe is a symbol for the fishing community to express their belief and belief in these extraordinary events which all occurred in the Muharram Month. Meanwhile, for the fishing community, the expression was continued in Syafar Month. The fishing community believes that Muharram Month is a bambang bambang (hot month) because of these events. The belief of the fishing community that considers the month of Muharram bambang bambang and the month of syafar is dinging month. These two months have important meanings in their lives so that each coming of the two months always receives great attention for the fishing community. Attention to the two months they said is very related to their work as fishermen. For them, mining and dinging determine the level of success in carrying out their work for the next year.

It has become a habit for old people to start a job when they first look for good days. They look for signs of the good day on; the signs in his body, the signs in the universe as a gift of Allah. Signs of self / body such as the flow of breathing, from nature such as the position of stars in the sky, eclipses of the moon and sun and earthquakes. In addition, they found signs of good days from the Qur'an.

Signs obtained from the three things above with a very hard effort, really paying attention and experience become a very important part because sometimes they are experienced and that have happened to them, then studied and concluded their meaning. Subsequently written or recorded and used hereditary to date. Many traditions are related to determining the good days passed down by parents to the next generation orally or in writing (lontara). Determination of good days is done mainly to do things, such as; building a house, going down into rice fields and gardens, starting a business, leaving home, earning a living at sea and others.

The place of implementing sappara genes, if seen from its order systematically, can be described as follows:

#### a). Balla (House)

The implementation of the tradition of sappara genes cannot be separated from the stages of preparation and implementation with the house. The fishing community prepares several things at home. fishing communities are of the view that the implementation of the je'ne-jene sappara tradition must be well prepared. The implementation of sappara genes at the home of each fisherman is a stage of preparation. Things prepared at home related to this tradition include; usually every fisherman family first holds the Appisabbi ritual which is to hold songkabala. Songkabala is usually done with ma'Baca several banana combs. There is also an appisabbi / songkabala by serving food which is called Paja 'which is food consisting of several types such as rice, vegetables, side dishes which are then placed on top of Kappara (large tray) which is then "read". There is also the appisabbi fishing community with special foods such as; lappa-lappa, burasa, katupa, tekolo, gogoso, mandura, which are also placed on a plate which is then "read".

#### b). Bujung (Well)

Bathing in a well that has been inserted in a leaf that says 'prayers' is not without purpose and purpose. There are so many people who bathe in the well, there are also many purposes and objectives. Fishermen who daily catch and search for fish in the sea certainly expect fortune by praying facilitated and multiplied by their catch. Also sometimes coupled with prayer so as to avoid danger when he carries out his work of catching fish and returning safely. The fishing community who work as traders certainly pray for their merchandise to be sold and get a lot of profit. The fishermen girls have prayers so that they can quickly match and can mate quickly. Male / young man to be facilitated by fortune so he can get a girl in accordance with his dreams and of course can immediately marry to the level of marriage. Meanwhile, the fishing community who work as boat builders / boat makers pray in order to carry out their work in completing the boats they make quickly without any obstacles and obstacles encountered and also pray that the boats they make sell quickly. Thus information from local residents.

#### c). Anggerang Bunga (Siarah Kubur)

The implementation of sappara genes in the fishing community cannot be separated from the grave direction. Two worlds that humans will live in make fishing communities always have a concern with the supernatural. These two worlds are the natural world, which they are experiencing to run their lives and the afterlife that they understand that the grave (death) is the door to go to or cross

into the afterlife. Fishing communities who have their livelihoods as fishermen are well aware that the work done to carry out their lives on this world is full of risks and even danger is always close to them.

The awareness that arises in the fishing community about the dangers and risks in their work is expressed by always remembering the grave. This expression is sometimes when they are going to sea or when they have returned with a lot of catch and or returned safely then their thanksgiving and thanks to Allah SWT is by coming to the grave direction (Geertz, 1973).

#### d). Island (Gusung)

The small islands are home to fishing communities in the three archipelago districts in Pangkep Regency. The three districts are Liukang Tupabbiring, Liukang Tangayya and Liukang Kalmas Districts. There are approximately 117 islands in these three sub-districts. 37 of them are still empty islands that are uninhabited and are islands that have not yet been named at the time of this research. This is because the island is still in the process of forming a new collection of sand as part of the coral accumulation process that is still continuing to perfect its shape. An unnamed and uninhabited island, including certain plants or animals that have not lived or lived there, is called gusung.

The implementation of sappara genes on the four islands, especially the first two islands namely Cambacambang Island and Pannambung Island according to the fishing community has an impression and atmosphere more specific than other places (islands or Gusung). This is due to the implementation of sappara genes on the two islands which are considered by the fishing community to have an atmosphere of satisfaction and an inner impression.

The tradition of sappara genes carried out by the Fisher Community in the Liukang Tupabbiring District has its own uniqueness. The uniqueness is mainly in the aspect of implementing. Traditions carried out in various places and regions in the homeland in each implementation are usually always implementing or committee. The organizer or committee then organizes and prepares everything related to the implementation of a tradition until it is finished.

The Jene-Jene Sappara tradition contains a value of solidarity. The Liukang Tupabbiring fishing community is spread over several small islands. Therefore, gatherings between fellow fishermen in a place rarely occur, unless there are family events and even then can not be expressed to express their gratitude and happiness more relaxed. The marital atmosphere is not entirely the fishermen community to be present depending on the circulated invitation.

Solidarity that arises from a wedding tendency / generally only limited to mechanical solidarity.

In the traditional sappara jene-jene ceremony, besides mechanical solidarity is built up from every implementation of this tradition, but organic solidarity can also be witnessed and grow together. The fishing community considers the implementation of the sappara traditional jene-jene ceremony to be followed. It is this kind of understanding that motivates the heads of fishing families to jointly invite their wives and children to attend the implementation of the tradition of sappara genes every year (Tashadi.1997)

The implementation of the sappara genius tradition every year on every Wednesday for one full month in Syafar Month is a medium of socialization for fishing families. The activity of going to sea which sometimes takes months (assawakung) causes longing and fatigue to blend into one (Hamid, 1997). The media of the Sappara Jenny tradition as a means to reinforce solidarity among the members of a fishing family. In addition, the meeting of almost all fishing families in one place and time at the same time and the atmosphere full of intimacy is evidenced by giving each other or tasting anything that is under the guidance that can always be witnessed in every implementation of the tradition. Not only that, anyone who comes or attends the sappara jene-jene ceremony must be willing to be doused with water or bathed by anyone and must not be angry. This is the breath of implementation every year of this tradition. This attitude and behavior to not get angry easily when watered or bathed by fishermen as an attitude and personality that builds their mechanical solidarity as fishermen so far.

#### IV. CONCLUSION

Liukang Tupabbiring is a fishing community. This is evidenced through his descendants approach, work approach, religion, ethnic background and belief system. The five approaches strengthen the building material of their social structure as a fishing community. On the other hand, although blood and bloodline are not directly related, they are aware of the similarity of the profession and the geographical similarity of the place of residence as an adhesive to their social structure as fishermen. As a result of this gave birth to a collective awareness that views similarities in the elements of their lives as a community that is different from other communities but they are harmonious and mutually reinforcing in social and economic structures.

The relationship between sappara genes and the socio-economic behavior of fishing communities is very close. Sappara genes are the basis of fishermen's social economic

behavior. Socio-economic activities and behavior are influenced by the fishermen's belief system. The manifestation of their socio-economic activities and behavior is a reflection of their appreciation, understanding and knowledge of the sappare rituals that grow in the lives of fishing communities.

The existence of sappare species in a fishing community is determined by the reflection of deep beliefs and their relevance to the dynamics of their lives. The perspective, attitude and positive contribution of the belief system in the fishing community determine the existence of sappare genes. The value of sappare species is very much determined by the dynamics in all aspects of the fishermen's life. Therefore, it becomes an impossibility that fishermen can survive without being perceived as a real benefit in the survival of their community.

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# Active methodologies with the use of integrated mock-ups to the teaching of the logistic subject

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**Abstract**— *This report is about the use of an active methodology by means of practical activities in a preexisting multimodal mock-up that serves as a teaching instrument. It happened in the night business management technology undergraduate course in the fourth semester. The logistic and practice subject involved the integration of the logistic knowledge and the mock-up by the means of the use of QR CODE tags that could send the visitor to the mock-up to a website where there is an explanatory text for each situation of the mock-up. Concomitant with this activity the student also can insert the company that they created in the course integrator project (CIP) in the mock-up in a way that was coherent and credible with the context. The goals had been met successfully in a way that students could not just integrate knowledge, but also theoretical and practical aspects.*

**Keywords**— *active methodology, integration, logistic teaching, QR CODE, technological teaching.*

## I. INTRODUCTION

The place where this work started was in Fatec Indaiatuba. Fatec Indaiatuba “Dr. Archimedes Lammoglia”, located at Dom Pedro I Street, 65, in the Cidade Nova neighborhood, in Indaiatuba, SP, Brazil, is an undergraduate courses unity of State Center of Special Technological Education “Paula Souza” – CEETEPS, known as “Centro Paula Souza”, a linked local authority (autarchy) to the Economic Development, Science, Technology and Innovation Department (SDECTI) from São Paulo State Government, that rules 73 Technology Colleges (FATECs) and 223 Technological Schools (ETECs) (CENTRO PAULA SOUZA, 2018).

Fatec Indaiatuba was founded in 1993 and Paula Souza Center was founded in 1969 aiming to make skilled labor to the job market. The name Paula Souza was given to pay homage to the professor and engineer Antonio Francisco de Paula Souza (1843 – 1917) that founded the Polytechnic School of the University of São Paulo (Poli-USP) and always defended the school part as a mean of making professionals (CENTRO PAULA SOUZA, 2018).

Curious it, it was in the early 70s of the 20th Century, when employers in North America and in Occidental Europe begin to look for professionals specialized in logistics, this interesting management area, and the first concepts of the business supplies chain had been based. The current undergraduate courses (Fatec Indaiatuba, Dr.

Archimedes Lammoglia, 2018) of Fatec Indaiatuba are business management, services management, foreign trade, computer network, analysis and development of systems and airport logistics. All of them three years length.

The undergraduate course in which this report happened is the business management technology in the night shift.

The subject was logistics with four hours per class every week and in this semester (the first of 2019) it was divided in two days with 2 hours per class for the week. The total workload to twenty school weeks is of 80 hours per class.

The class’s practice was active methodology, having the professor as a facilitator and the mediation tool was a lab where there is a multimodal mock-up, teaching instrument resulted from a study project that had the use of the mock-up to the improvement of the logistics teaching (Junior, 2014). Professor counted with the orientation of his doctor’s degree guide to the execution of the activity.

## II. CLASS PURPOSE AND DEVELOPED SKILL

Class purpose is the improvement of the logistics teaching through activities semiautonomous with academic challenge providing to the student, more autonomy in the process of the knowledge achievement, in a way that is capable of identifying, relate, and plan what they are going to do and in this process the search for knowledge

(research) in view that not all subjects or texts to subsidize what is done is given prior, these come up.

Another skill is the capacity of working in group, understand differences and organize the different perspectives and views to a common goal, cooperate, congregate and organize.

### III. A MOCK-UP AS AN INSTRUMENT

In the process of teaching, it is ensured by the studies of Vygotsky (1991) that the process of assimilation is through signs, as it was already approached previously. Despite signs and instruments being different, they can be used in the same way in processes of learning.

One of the possible ways is the use of mock-ups as teaching instruments. This is not an unknown way, in the doctor's degree thesis of Francischett (Francischett, 2001), the author corroborates the viability of this instrument in Geography teaching and uses not only Vygotsky, but also uses Pierce's work to explain that the use of signs in teaching uses the triad = relation, relativity and intermediation. Semiotic is, necessarily, triadic: when relation gets into experience.

It is established the relation of the interpretant, respective and consequently, a third party (terceiridade) (Silveira, 1989). A representation is an object and can be an instrument.

As it has been described, mock-up can be an instrument to teaching, and when it comes to mock-ups, it can contain icons, like replaced signs or a set of signs, or even it can be a sign. Although it can be presented as a model, a scale representation, even as a project draft, that's why traditionally it has been linked to architecture and civil engineer, it can be used in other areas, as in the work of Bergatin (2013) that uses tactile mock-ups to teach chemistry. Therefore, instrument of teaching mediated by the teacher.

This meets Vygotsky's studies (Vygotsky, 1991) where he says that social activities, the relationship with the environment shape the formation of the individual.

The use of representative models of a construction idea comes since Antiquity (Salmaso & Vizioli, 2013), it's some kind of construction doll. It was the mean that existed that got closer to simulation virtual models by digital means (Seel, 2017).

Before drawings made with the help of a computer, mock-ups were the ones that worked as a study model or an idea presentation, both of real estate constructions and boats. They were the main of modeling for analysis not only of architectonic aspects or behavior but also to illustrate or exemplify execution processes still in the phase of project.

Until the last quarter of the 20th century, they were the main mean of modeling and representing until computers acquired a capacity of enough processing to be able to reproduce in a virtual way views and aspects of behaviors that it was possible with mock-ups only (CREATIVE MECHANISMS STAFF, 2019).

It is important to highlight that these mock-ups had lots of limitations in representations due to miniaturization, of construction materials and the difficulty of represent aspects as load or structural weight. Over time, the mock-ups, besides being used in architecture and engineering, also went to other areas, the miniaturization and the imitation of elements and pieces in real-size awake the ludic, among the most popular there are model railroading, ship models, model aircraft and car models.

These models, in all of their ways, are not just a hobby, but an interesting educational instrument. One of the most interesting is the Lancashire & Yorkshire Railway School of Signaling (Brook & Munthe, 2009), it's a railway model in reduced scale built in 1912 to the teaching of railway signalization, it has the registry 1995-7856 from the Science Museum Group of UK and it's part of the permanent collection (THE SCIENCE MUSEUM GROUP, 2019).

In this process of digital world emerge the virtual mock-ups and the process of miniaturization also goes through printing in 3D printers making the virtual object becomes real and like this, the assisted and helped by computer projects not only provide a bigger dynamic in the application of the simulation as virtual representations with complex mathematic models that simulate extreme situations or explore flaws in the project, making the fabrication of prototypes not only faster and more economic but also more reliable since the beginning because it anticipates the technical difficulties of accomplishment (Lirola, Castañeda, Lauret & Khayet, 2017).

The simulators can create and operate virtually production systems very complexes and these simulators when adapted to the game, create virtual environments that simulate historical, commercial, military contexts, exploring with great complexity strategical aspects and like this, create and reproduce virtual worlds based on credible aspects when technically grounded (Himma & Tavani, 2008).

The telic paratelic engagement in these situations is very big due to the fascination that they exert, like it was commented previously, adults are the biggest buyers of electronic games (Deterding, 2013).

However, even with the advance of the virtual, of the digital, mock-ups find their space inside education, like



something plastic, palpable, especially if they count with the planning and construction by the students. To explore this palpable part of the process, modeling with the hands, drawing, tracing, measuring, cutting and gluing provide a feeling of accomplishment, of construction. Mock-ups can be made of a various number of materials easily found in people's daily basis, technical materials only are not necessary in the world of professional mock-ups if the goals were didactic and ludic to engagement and learning (Junior, 2018)

#### IV. ACTIVE METHODOLOGIES

In the teaching of teenagers and adults the traditional methodologies, that were developed and applied over time, where the student assumes a passive part and all the unfolding of the class is focused on the teacher or the subject, doesn't have so much effect compared to previous generations. Although it's about adult literacy, the work of Faoto & Dias (2014) has in its reflections the heartwood of teaching to adults.

In contemporary times, the processes of schooling that wish and give opportunity to the emancipation demand interdisciplinarity, where the educator can see the whole picture, not by the simple summation of parts that make it, but for the perception of that must be allowed that the thought and the learning happen based on dialogue among the several areas of knowing.

(Faoto & Dias, 2014, p. 399)

Social and technological factors have been altering the behavior and expectations of students, especially among the young adults (Abi-Raad, 2018). That's why active methodologies of learning where the student is put in an active position have been studied. The active methodologies are many, but they have this main characteristic: putting the student as an agent of their own learning (Rocha & Lemos, 2014).

These social and technological aspects had already been explored previously and we're given a few tips or ways to these active activities applied on the teaching. The most common are inverted class, games, problems method, projects method, hybrid teaching, study and method of case and group activities. The mobile devices is another

example that can be used in this social and technological context. (Pereira & Dinis & Gouveia, 2019).

There are a lot of ways to explore the active methodologies (Committee on Developing a Framework for an International Faculty Development Project on Education About Research in the Life Sciences with Dual Use Potential, 2013, p. 29) and it is not intended to run out of the subject, it is intended here to explain two concepts that justify themselves by related aspects in this work and its conduction: Learning Based on Problems and Learning Based on Projects.

According to Sankey and Hunt (2003) the active methodologies are justified by the following aspects:

Search for knowledge with technologies.

Stimulation of curiosity.

Doubt point—the academic challenge.

Process of facilitation by the professor.

Preparing and planning of the professor, the students and the resources.

Feedback about the process to the students.

For that to be possible, a change of posture or work, putting the student as central point and actor in the search of their knowledge, demands an educational project and this educational project might be confused with the learning process.

Therefore, it is important to understand how these methodologies intertwine.

According to Davis and Wilcock (2004, p. 51) the study of case or the method of case (Sharma, 2006) is a popular way and plays a very important part in the development of abilities and skills. However, Sharma (2006) explains that study of case is used in teaching, may or may not have some practice involved and method of case refers to real life cases, therefore, it is understood that modified cases by the teacher aiming certain aspects are study of case. According to the same author, study of case was created in 1880 in Harvard (Sharma, 2006, p. 51) in Law School by Christopher Langdell. After that, the method was extended to other areas of education, highlighting health/medicine area, besides, of course, the area of law itself.

By the reading of the authors (Davis and Wilcock, 2004 and Sharma, 2006) it is noticed that is a method well documented, because as a method it doesn't apply when the problem is identified soon (or given soon). Davis and Wilcock (2004, p. 51) consider the study of case an activity centered in the student.

In this method of case there are multiple views or approaches to the problem, fact that students learn in a more effective way when these are involved in the case, involved in processes of learning so they can approach the

case by multiple ways or lines of approach, which can also be found in Hiller (2002, p. 208) when she explains that the more details the case has, the more students can develop and learn and Sharma explains that the key to success to the method of case is the choice of the right situation-problem (Sharma, 2006, p. 195).

An important detail is about the difference of the study of case or method of learning based on problem (problem-based learning – PBL), because PBL encourages the student identifying their own learning goals and the study of case (Davis & Wilcock, 2004, p. 51) has more elaborated and outlined parameters in the case that it is introduced to include scientific principles and specific programmatic contents that the teacher wishes working to develop the learning inside the menu or research line.

Here I would like to explain the difference of problem-based learning (PBL) from project-based learning (PjBL), in the project-based learning usually there’s something that needs to be done or elaborated (Uden, 2006, pp. 38-39), can be a product (Farenga, 2005, p. 189), artefact or a process. And as it has been said in the problem-based learning, all the focus is in the problem. Project-based learning is closer to study of case. (Davis & Wilcock, 2004, p. 51).

Project-based learning results in more engagement of the participants and provide more experience and in this kind of learning, the critical thought and cooperation are more developed (King, 2017).

Board 1 – Comparison of the methodologies

Method of Case/Study of Case	Problem-based learning	Project-based learning
Guided by the case offered by the teacher. The case is already prepared to reduce the possibilities of solution.	Guided in the activity offered by the teacher.	Problem is given, but how it will be approached is defined by the students.
Teacher supervises	Teacher supervises	Facilitator teacher.
Students must analyze and point out the possible solutions and define the best solution or strategy to work the case out.	Students must produce a solution or strategy to work the situation out.	Work the problem out must be part of the task, but the focus in on management, but there isn’t barriers or limits.
It demands	It demands	The students

study and the solution is based on prior knowledge	study and the solution is based on prior knowledge	are the ones who define what will be needed to work the problem out.
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Based on: (Davis & Wilcock, 2004, p. 52); (Uden, 2006, p. 38) and (Moallem, Hung, & Dabbagh, 2019, p. 91).

These forms of active methodologies now begin to intertwine with TICs, forming new arrangements, like the blended learning and also forming what concepts as a flipped classroom and are methodologies or processes still in transformation (Reidsema, Kavanagh, Hadgraft & Smith, 2017, pp. 6-10).

The work of Trevelin, Pereira and Neto (2013) introduce an interesting study of case with flipped classroom with a duration of two years and involved 148 students, in this work, using active methodologies they managed to reduce failure rates comparing to traditional methodologies

By the data presented, it is possible to see that there was a quantitative improvement of results because the number of failed students decreased and also there was a qualitative improvement because the great majority of students, that is, 90% of them say through the questionnaire having preferences by the new applied methodology.

(Trevelin, Pereira & Neto, 2013, p. 12).

The authors (op. cit.) took care of mentioning that other variables must be taken in consideration in the analysis of these results. What meets other work, with application of the learning based on projects, in this one, authors Santin and Ahlert (2018) highlight that the time dedicated to studies and prioritization or not of this time might affect the yield, in this work 90% of the students worked.

In the work of Piva Jr. and Cortelazzo (2019), authors report that they used in 20% of the classes (the most difficult topics) of the subject of TI Fundamentals. The methodology of the flipped classroom and the results were very interesting: “Results indicate a significant improvement in learning, superior to 65%, and a better global learning from students, expressed by the reduction of the standard deviation of its averages” (Jr. & Cortelazzo, 2019, p. 34).

Another interesting work about active methodologies is Freeman’s (Freeman et al., 2014 a) that had analyzed 225

studies and identified that active methodology in these studies were 1.5 times more efficient than traditional methodologies. However, the authors were also cautious regarding the results about the universalization of results because of heterogeneity.

Even though, Freeman et al. work (op. cit.) receive critics in relation to what they determine passive methodologies, because they use the term “lectures”. Among other issues, the critic was that it didn’t occur a way of distinction or categorization these classes or expositive methods (Hora, 2014), which became necessary an explanation by the authors (Freeman et al, 2014 b) that the analysis didn’t make no distinction of methodologies purely expositive and some other ways combined, which it could elevate even more the efficiency of active methodologies from those purely expositive.

This is for demonstrating how difficult it is to determine by quantitative means, processes so complex that involve learning and its methodologies. However, we can’t deny that time and perseverance in healthy and consistent teaching strategies improve teaching.

## V. USED ACTIVE METHODOLOGY AND ITS JUSTIFICATION

The used methodology was the flipped classroom one by a mediation instrument that is a complete mock-up that represents a supply chain with all the modals and other actors in the supply chain, including a city with approach to urban mobility, like a freight village with many primary and secondary business. Active methodologies are a very interesting teaching method, an example large used is the beer game, a complex game used to apply knowledge to solve logistics problems (Lau, 2015).

The students from the business management course have course integration projects (Projeto Integrador de Curso - PIC) that is elaborated in group, and in the fourth semester they must develop the business (product, commerce or service) of the company already created in third semester. This project continued in every semester involve the subjects of the semester in a way they integrate as the work advances. For this accomplishment, this is organized in groups about six students, may vary for more or for less, in a way that adjusts to the reality of each semester (Fatec Indaiatuba – Dr. Archimedes Lammoglia, 2017).

Parallel to this integrator course project (PIC) in the subject of logistics, it was offered the opportunity to students to integrate the integrator course project in the mock-up or the accomplishment of other activity suggested by the teacher in the mock-up, being able the

students to use their own PIC group or other form of organization.

When the student’s choice was to use what they had been developing on PIC, practice is the inclusion of the business, commerce or service inside the representative structure of the mock-up, for example, the installment of a commerce in the mockup’s city and this commerce must be both representative to PIC and the mock-up’s context (coherence and likelihood).

The suggested activity by the teacher was the identification of parts, pieces, situations, setting and/or installments in the mock-up related to the logistics and supply chain. The interdisciplinarity context create a complex situation and challenge opportunity for the students to apply the knowledge (Power & Handley 2019).

For both options, it must be also elaborated an explanatory text, the recording of this text in the mock-up’s blog and a making of a QR CODE (Prass, 2011) to be fixed next to the representative item that the text describes/explains. This way, through an app that can be downloaded from the internet, it is possible to read QR CODE and this will send directly to the text already recorded in the blog that explains that detail or aspect of the mock-up.

What justifies both suggestions are the use of the ludic (mock-up) as a stimulation element to young adults, the academic challenge that the suggestion represents and at the same time not deviating from the content of the classes in the subject of logistics and the integration of that inside the context of the integrator course project, that already contain subject aspects, but also makes the extrapolation to other logistics aspect and the supply chain.

The higher education sector is constantly changing for its modernization and adaptation. The main challenges or challenges of the university derive from new scenarios and agents in addition to the emergence of educational alternatives. Thus there is an increase in demand with diversification by age and needs, both territorial and social, higher levels of internationalization, new processes (Open Learning or the appearance of the mooc), restructuring of the teaching offer, as well as the need to face economic, financial or

technological challenges, in addition to the formation of university spaces, such as the appearance of the European Higher Education Area, among other initiatives (Neave and Veiga, 2013; Espinosa-López, 2015; Lu-que et al., 2015).

(Doña Toledo, L., & Luque Martínez, T. 2019, p. 2).

Another strand is the connection of the activities with social media, in this case, a blog (fatecid.wordpress.com), the software use, in this case a generator of QR CODE and the first steps into the internet of things – IOT (Behmann & Wu, 2015). This involves both the research necessity for the text elaboration and practice activities, print the signs, glue, fixate and other decisions that involve coordination and activity planning from students.

An interesting aspect is the overcome of the virtual world paradox (digital) and physical world, the challenge (Abrantes & Gouveia, 2011), with cut processes, collage, painting therefore very handwork and at the same time with the academic challenge to represent themselves in models, in this case, mock-up, the likelihood and the coherence with the concepts worked in the academic area without leaving aside the cyberspace, whether it's a simple use of a digital media, but with the use of a kind of icon, a sign that works almost as portal, in this case, QR CODE.

Picture 1: 4th semester students from the business management course elaborating the mock-up of their business to be inserted in the city.



Source: Authors (2019).

*Picture 2: 4th semester students of the business management fixating the QR CODES that send to explanatory texts.*



Source: Authors (2019).

*Picture 3: An example of QR CODE used, which sends to the indicated address for the text elaborated by the students.*

**Porto fluvial**

<https://fatecid.wordpress.com/2018/12/11/porto-fluvial/>



Source: Authors (2019).

## VI. LEARNING EVALUATION

The Integrator Course Project it is already worth 20% of the student global grade, already harmonized with all the teachers and inside its competence and with rules, when the student chooses the additional activity with the mock-up, both in the choice of integrating PIC, the mock-up or the activity suggested by the teacher in the mock-up. There's an addition of even 2 points inside the traditional evaluation grade of the logistics' subject. Since it's optional, it's made a division between who chose and who didn't.

Like this, the traditional individual evaluation might worth more (who didn't choose = 10) or less (who chose = 8+ 2 from the activity). So it stays like this: P1 – presentation of the PIC logistic work, P2 – traditional test and P3 – PIC, whose formula is  $((P1*0,4)+(P2*0,6))*0,8+(P3*0,2)$ . When the choice is made for the complementation, the calculus is made inside the P3 grade with the note in the own evaluation to the student's control in a way that is doesn't change the formula in SIGA – Integrated System of Academic Management.

If the student stays in activity in the lab outside their regular schedule, there was also the emission of the certificate referring to extracurricular activities that is a



report of the Complementary Autonomous Activity. The activities criteria are: cooperation, assertiveness, likelihood and coherence, in a way that places the 0,5 points in each one of the 4 areas.

It was solicited to the participants that they answer a little questionnaire about the activity and about the questions, these ones focus in relation to the activity, what they liked most, what they less liked, difficulties and suggestions to improvement.

## VII. RESULTS

A In relation to the participating students, it was found that occurred an elevated engagement, and this happened by the bigger frequency, because there was a purpose, they managed to negotiate their own time, even those who worked got a few minutes more in college in the pre-class. Related to the grade, these ones reached the 2 points very easily, given that the professor as a facilitator gave tips and also made the evaluation of the process and the results.

In comparison with other classes and groups that didn't accomplish the activity in the averaged, without the inclusion of additional points, there was an increase of 19% presenting 1 more point in the grade: point average of who participated = 9,09 and the point average that didn't participate = 7,57. However, there are intrinsic and extrinsic factors among the classes and groups that don't allow to universalize these results.

Another issue was freedom, if the PIC group didn't wish to make the activity, the student individually could make the activity in the mock-up and/or join another group, the and/or is by the fact that occurred parallel activities and generated transverse knowledge (electric, electronic, measures, calculus, several mechanic solutions, etc.) unclaimed or in the domain of the subject menu.

In relation to the cooperation, this one could be observed through work organization, they shared the tasks and since it's a mock-up, they should reunite the parts or integrate the tasks, because there was both a need of coherence and likelihood. The direct observation from the professor, also in activity, allowed to hear the conversations among the group, intergroups and that are: when and how they arrange what they are going to do, the material and tools selection and the way of doing it.

In the subject of the logistics, the students' exposure to the mock-up environment, which is very complex, allowed to make connections and interactions of their own texts that elaborated with other texts from previous years and with the representative elements in the mock-up. The effectivity, fulfillment of the tasks as well as the cooperation aspects, assertiveness, likelihood and coherence were totally accomplished by the students.

The QR CODE use to generate a link in a blog with explanation about what QR CODE indicates may seem little in relation with the internet of things, however, it's an interesting relation between a manual and a digital activity, also having the text and yet it must be considered that the blog is accessed by a smartphone or another mobile media technology.

The answers given by the students and their impressions about the task execution were unanimously aligned with the results and with the impressions, in relation to the difficulties pointed by them were exposed in the next part.

## FOUND DIFFICULTIES

The biggest difficulty was that it wasn't possible to include the whole classroom, out of 39 students, 18 agreed to do the activity. In their allegations, there was lack of time and/or there was already too many activities (like PIC), however, talking to those who accepted, it's that the ones were having a very abstract idea of what would be executed, this way, the whole class should inserted in the context from the beginning.

The students pointed as the biggest difficulties: lack of time to the task's execution, more space to the execution of the manual activities besides the need of more organization of materials and tools.

## VIII. CONCLUSION

It's possible to conclude that the goal of the activity was accomplished with success in view of the obtained results, the perception of the professor and the impressions collected from the students both talking to them or by means of questionnaire.

The use of the mock-up as an instrument mediated by the professor was an effective and interesting active methodology and provided an opportunity in the logistics teaching using ludic elements and clear and well defined goals, the conjunction of texts elaborated by the students and the identification of parts and situations in the mock-up or the insertion of a mock-up of an integrator course project had brought the needed element of academic challenge.

From the difficulties pointed out, that doesn't stop the continuation of this practice, it's up to the professor to insert in the logistics' class the integration of the mock-up to the students' PIC, giving indications of what can be done and at the same time, exploring students' creativity. The space issues can be solved with fixed boards on the backrest of the desks in the classroom to activities of pre-montage to assemble, as well as including the classroom arrangement and the organization of the goals, actions that



can be done over classes, putting together practice with content.

Now, the use of the digital brought an interesting dynamic, the QR CODE is now used to interact knowledge about logistics inside the mock-up with students' own devices, therefore, putting together the medias with something more traditional, that is the mock-up itself.

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# Comparative Analysis of Metal Structure and Reinforced Concrete, Comparing the Systems for a Commercial Enterprise

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**Abstract**—This work brings the proposal of a comparative analysis of metal structure and reinforced concrete, comparing System for a commercial development that would be metal structure and reinforced concrete structure, from the beginning comes to the history of concrete and its origin after that of steel. Preparing the reader for what is most relevant in this investigation, which is the research proposal of how it was performed, which vertically deals with it. Reinforced concrete and metal structure have their advantages following construction, both are of great use, if they stop to find out both structures are present in the daily life of humans. So, comes to the curiosity to know, which structure is most useful and economical when it comes to construction? The answer to this question lies in the conclusion of this research.

**Keywords**—Reinforced concrete; Metal structure; Construction.

## I. INTRODUCTION

Over the years the human being, looking for new alternatives to improve life, leaving their cave dwellings, then houses made of wood and stone. By linking with greda, lime and among other ligands, the Egyptians and Romans, along with other peoples, began the construction of pyramids and temples. These constructions are still addressed today.

Thus, man has been benefiting from the development of the means of apparatus within the construction industry, always seeking a new innovation within the construction sector and outside it.

Therefore, the following work has been addressing two relevant creations of the human mind, which greatly help the development of the search for ways to build, thus leading to the creation of concrete and steel. Since concrete due to its strength has become an object significant for human progress, it can be observed that it is present in everyday life. In concrete sidewalks, hard paved streets, buildings and dwellings, the concrete of the following extremely important in the development of civilization.

The steel to complement in construction, because besides being very versatile is also the most notable when talking about metal alloys conceptualized by man. For this reason, the most regular aspect of ferrous metals is steel, cast iron

and wrought iron, with steel being the most respectable of the three today.

Finally, throughout this work will be presented a comparative analysis of these two structures, reinforced concrete and steel structure, as they play an extremely important role for the development of civilization.

## II. THEORETICAL REFERENCE

### 2.1 History of reinforced concrete

The ancestors used stone as an object to build their houses and as the human mind developed, the material began to be used in fortification buildings, leading to overcome river gaps or to develop temples used for worship of their Gods.

From this, (5) it is clear to man that the stone is an excellent construction tool, as they observed that it was durable and capable of withstanding this when used with pillars.

The Romans who pioneered the construction of stone arched bridges, when it was not possible to use this art using beams to overtake wider spans, used a stratagem as arches to study the pieces that would work in compression (5).



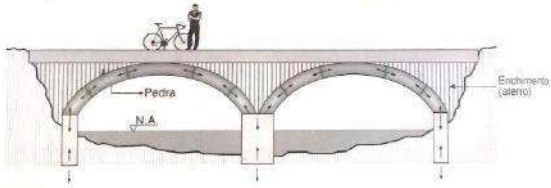


Fig.1 - Study of the stone in compression  
 Source: Botelho (2015)

### Benefits of Reinforced Concrete

When we talk about reinforced concrete, analyzing it with the other materials of civil construction, they follow from their proper characteristics and consist of the inherent contingencies in which the works are discussed (8).

- Building economy
- Resistance to environmental chemical aggression
- Resistance to physical aggression of the environment

### Steel

Steel is very eclectic and is the most important alloy known to man. (12) As such, the first steel material operated within the building was cast iron, which in the mid-1780s and 1820s when arched or truss bridges were made, with properties in cast iron working in compression (11).

Wrought iron came to be used in eighteenth century outcomes in bar chains, forming the supporting elements of suspension bridges. A relevant example showing the use of wrought iron bars is the Menai Suspension Bridge in Wales, construction was made around 1819-1826 (11).

The steelmaking process shows how the production of steel is carried out, its production is derived from iron ore, by conversion of pig iron, or semi-integrated, in which steel is obtained through scrap. Figure 2 brings this process in a more visual way that is easy to understand (7).

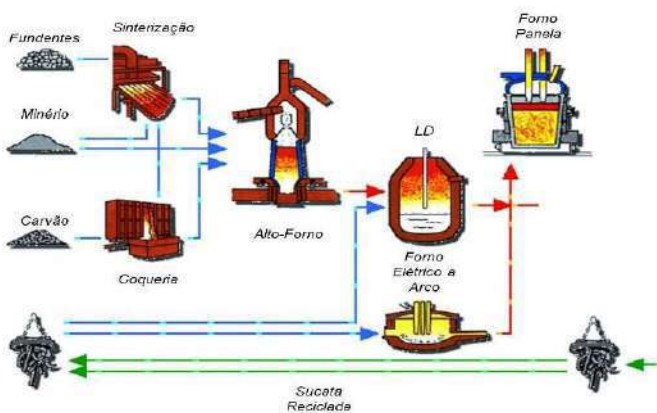


Fig.2 - Steelmaking Process

Source: <http://aciarianews.blogspot.com/2012/12/forno-elétrico-arco-fea.html>

### Advantages of Structural Steel

- Freedom in architectural design;
- Larger floor area;
- Flexibility;
- Compatibility with other materials;
- Shorter lead time;
- Rationalization of materials and labor;
- Load relief on foundations;
- Quality assurance;
- Anticipation of the gain;
- Organization of the construction site;
- Constructive accuracy;
- Recyclability;
- Preservation of the environment.

### III. METHODOLOGY

For the following work the quantitative method was used in order to bring two assumptions that, from interference, a third, called conclusion, is drawn. Thus it is important to note that the following reasoning does not offer new knowledge. But a comparative analysis of two applications. The exploration outline and the information extraction tool succeeded in a documentary way, as (5) documentary research is performed through origins by about tables of results, opinions, software outcomes, minutes, presentation, projects and unpublished works of any kind. nature. Document analysis offers a significant method within the context of this research.

This work compares an analysis focused on building systems of a commercial enterprise. Figure 3 below shows the flowchart of how the research was carried out for its construction.



Fig.3 – Flowchart

Source: Own authorship, 2019

According to the various researches and readings that speak of reinforced concrete and metallic structure, from authors known in the following. When it comes to building, the first step to good project execution is planning. Because with all that has been seen, for good



planning the choice of the project is fundamental for success in choosing which structure will meet the needs of the project, since the chosen method will greatly influence the physical schedule, cost and other factors. (9).

In the course of the investigation that was carried out to analyze the reinforced concrete and metallic structures, it can be verified that both are of great relevance, however as it was said before a planning, that demonstrates or that can give an assumption of which structure would be left. more feasible for the construction of the project, since the choice of the structure goes far beyond the price, because the structure that seems to be more feasible in one place may not always be executed in the same proportion in another, for example some interiors of the In the state of Amazonas, due to its difficult to reach logistics, the cost of the material becomes much more expensive.

However, what worries the most about civil construction is to avoid the generation of waste and waste, making the profit of the work even higher and the environmental impacts will be increasingly minimized. Thus, having notions of the land also enters the subject of planning, because where the construction will be made is fundamental to reduce the cost of the work. This is because, with the arrival of the material in the construction site, it is necessary to have temporary facilities such as material storage, housing, bathroom and office. The image in figure 4 shows the example of how the site is optimized in a reinforced concrete construction.



Fig.4 - Construction Site Optimization

Autoria: Naback, 2008

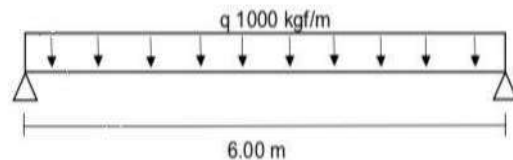
Legend of Figure 4	
1. Warehouse and Tooling	8. Ordinance
2. Yard or Warehouse Truck	9. Toilet and changing room
3. Raw Material Stock Area	10. Refectory
4. Central Frame	11. Surveillance Office
5. Shape Center	12. Pointing
6. Areas for Benefited Material Stock	13. Medical Clinic and Safety at Work
7. Concrete and Soil Laboratory	14. Technical and Administrative Office

To be more agile the flow and logistics of the construction site it is important to evaluate the conditions of the construction site and how the materials will be transported. Proper handling of equipment for safe, fast movement of loads and workers is important for safety. In the analysis carried out from the construction site, when it comes to the small space, the metal structures are advantageous because the steel parts have already reached the construction site, which makes the work free of improvisations that only makes costs increase (10).

To get a sense of the cost dimension of a metal frame and a reinforced concrete frame, comes the pre-dimensioning of a two-girder beam of both frames.

**Pre-dimensioning reinforced concrete beam**

The following beam is supported, is 6 meters long.



In beams, the initial element to be dimensioned is the height, and this is given in relation to the span length. Which looks like this:

$$\frac{L}{10}$$

With the entered values you get the value of the beam height:

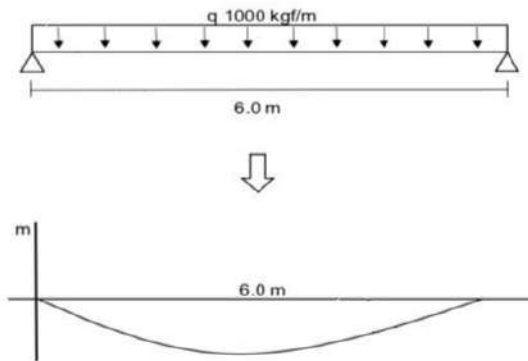
$$\frac{600}{10} = 60$$

So with the pre-sizing of:

$$20 \times 60$$

**Pre-dimensioning metal-supported bi-beam**

Pre-dimension a 6 m free span beam of a metal structure.



Solution:

$$M_{max} = \frac{P \times L^2}{8} = \frac{0,10 \times 600^2}{8} = 4500 \text{ kN cm}$$

Bending moment value  $M_y = 4500 \times 1,55 = 6975 \text{ kN cm}$

**Physical and Financial Schedule**

Evaluating concrete using an example as a part

Table 1 – Price

Financial Physical Schedule

Total Cost of Reinforced Concrete Beam

DESCRIPTION	AMOUNT	UNIT COST	TOTAL COST
Steel CA-50	16.5 kg	R\$ 4.00	R\$ 66,00
Steel CA-60	2.90 kg	R\$ 5.30	R\$ 15,37
Annealed wire	1.00 kg	R\$ 10,00	R\$ 10,00
Concrete 25 Mpa	0.48 m³	R\$ 375.05	R\$ 180,02
Forms, E= 18 mm	6.00 m²	R\$ 45.72	R\$ 274,32
Total cost			R\$ 545,71

Source: Own authorship

Values used for execution and metal beam

Table 2 - Price of the metal beam

Financial physical schedule

Total cost of the beam in metal

Description	Quantity (m)	Nominal Mass (kg/m)	Weight (kg)	Cost Unitary	Cost Total
Type "H" Profile, Laminated steel, W 310 X 38,7	6,00	38,7	232,2	4,69	R\$ 1.089,18
Total cost					R\$ 1.089,180

Source: Own authorship

(9) Work schedule results from the adequate sizing of the work teams, as well as the times and the sequence of execution. Thus, the Figure 6 shows the demonstration of the Bar Schedule, done in Ms Project.

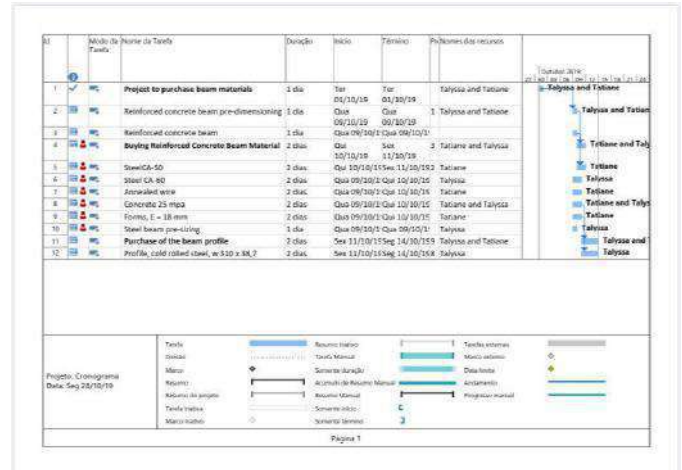


Fig.6 - Bar schedule

Source: Own authorship, 2019

**IV. CONCLUSION**

The following research was carried out in order to study two premises, which start from reinforced concrete and metallic structure. In order to bring an analysis of them during the investigation, it can be seen that both are of great relevance, however, when the subject is construction has another important point, to highlight that is called planning.

Planning is a key part in choosing the best structure to use, as as research progresses one can see how much is needed. This is because it is not enough just to build, have to be aware of other factors, such as construction site, collaborators, initial capital for construction, the project to be executed, materials, others and finally the most viable choice that will meet the requirements of the client.

At the end of this paper it is concluded that it is not a smart view to report that the reinforced concrete structure is much more accurate than the steel structure, as both have many advantages, but what will determine which is the best for a given construction is the planning, because it brings all the terrain, cost and time analysis so on.

Further exploring the reinforced concrete structure and metal structure, comes the idea of pre-sizing a beam of each structure, to get a sense of how much would be the cost of both, thus obtaining the result that the beam Reinforced concrete is cheaper than metal.

I leave here exposed that it was just a pre-sizing to get a sense of values, but to get exact values you need a detailed sizing. That is not the case with this research.

Finally, the research achieved the desired conclusion, because the intention was to analyze two structures made of reinforced concrete and one in metal structure, respecting the NBR 6118 that deals with concrete and the NBR 8800 that talks about steel and reach a finalization. To determine which one is most feasible, but at the end of

all research shows that the most useful is that I was able to meet the requirements of the project.

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# Strategy in the selection of corn genotypes for their efficiency and response to nitrogen

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**Abstract**—Corn is of great importance in the national economy, being one of the most produced and exported cereals in Brazil. With the growing concern of producing food for the population, the search for new corn genotypes is increasingly intensified in order to obtain efficient seeds with an adequate response to the particularities of each planting region. In this sense, the present work aims to identify genotypes of corn efficient and responsive to the use of nitrogen for grain production in the Cerrado biome. The studies were carried out in two maize trials at the Federal University of Tocantins Agricultural Center (UFT), Campus de Palmas - Brazil, with planting in the 2017/18 crop, with nitrogen (BN) ( $0 \text{ kg ha}^{-1}$ ) and another in high nitrogen (AN) ( $150 \text{ kg ha}^{-1}$ ). The experimental design was a randomized block with three replicates and 20 treatments with an analysis of the response of these effects on grain yield. The methodology of Fageria & Kluthcouski (1980) was used to identify efficient and responsive genotypes. The genotype UFT-M12 was classified as efficient and responsive regarding the use of N for grain yield.

**Keywords**—fertilization, productivity, Zea mays.

## I. INTRODUCTION

Brazil is the third-largest producer of corn, with a production of 79,877,714 tons in 2014, behind only the United States and China. Being one of the three most produced crops in Brazil, thus assuming prominence in the national economy (FAO, 2014).

Corn has multiple uses, highlighting human consumption because it is an important source of carbohydrates, it is used in the food industry to transform various products. It is also important for animal production, as it is an important energy source in the diets. And since the world population has grown significantly and for food production livestock herds have also increased, the demand for this cereal grows

proportionally (GARCIA et al., 2006).

In the Tocantins state, the maize crop obtained an average yield of  $5,360 \text{ kg ha}^{-1}$  in the harvest 2018/19 (crop), which was lower than the national average of  $5,355 \text{ kg ha}^{-1}$  in the harvest 2018/19 (Conab). This is due to climatic conditions, the scarcity of regional maize breeding programs, the lack of selection of genotypes for the technological level of the properties and for the efficient use of nutrients (COUTO et al., 2017) (SANTOS et al., 2016).

Currently with the concern to increase production to feed the growing population, reduce its costs and at the same time build a system of sustainable agriculture,

obtaining genotypes with greater efficiency to the use of nitrogen (EUN) has been a goal pursued by researchers and producers (SANTOS et al., 2016) (SIMIONI et al., 2017).

In order to obtain more efficient genotypes, several studies have been conducted. However, it is necessary to further deepen these studies mainly for maize crops in the Cerrado conditions. In this sense, the study was carried out with the objective of identifying efficient and responsive corn genotypes for the use of nitrogen for grain production in the Cerrado biome.

## II. MATERIALS AND METHODS

The experiments were conducted at the Agrotechnological center of the Universidad Federal of Tocantins – UFT, municipality of Palmas – TO - Brazil, in a dystrophic yellow-red Latosol type soil, in the geographic coordinates  $10^{\circ} 45' S$  e  $47^{\circ} 14' O$ , at an altitude of 220m. Being a representative area of the Cerrado biome. In soil preparation, the operations of burning, grading, and furrow were performed. Seed planting and fertilization in the sowing furrow were performed manually. Pre-planting fertilization was performed using  $300 \text{ kg ha}^{-1}$  of NPK and Zn for all assays.

The nitrogen fertilization used in coverage was 0 and  $150 \text{ kg ha}^{-1}$  of N, providing a total of 15 and  $165 \text{ kg ha}^{-1}$  of N, for the environments of BN and in, respectively.

The evaluations of the genotypes were performed in two contracting levels of nitrogen availability, being one installed in high N (AN) ( $150 \text{ kg Ha}^{-1}$ ) and another under low N (BN) ( $0 \text{ kg ha}^{-1}$ ), in the Harvest 2017/18. The experimental design used was randomized blocks in both assays with 20 treatments and three replications. The experimental plot consisted of four lines of 5.0 m long, spaced by 0.90 m between the rows. The spacing between plants was 0.20 m, which after thinning, totaled a booth of  $55,555 \text{ plants ha}^{-1}$ . For the evaluation, only the cobs of the central lines of each plot were harvested, discarding 0.50 m of the extremities.

The 20 genotypes were called: UFT-3, UFT-8, UFT-9, UFT-11, UFT-12, UFT-13, UFT-14, UFT-16, UFT-18, UFT-19, UFT-2B, UFT-EA, UFT-ED, UFT-3E, UFT-M1, UFT-M10, UFT-M12, UFT-M18, UFT-M5, UFT-M9. From genetic breeding programs at Universidad Federal of Tocantins.

The cultivation system used urea as a nitrogen source in two applications. The first in the phenological

stage of four leaves (V4) and the second in the Eight (V8). The doses used for both environments correspond to the smallest and highest grain yield expected by the maize crop. The cultural tracts were carried out whenever necessary, according to the technical recommendations of Francelli and Dourado Neto (2004) for the maize crop.

In the two central rows of each experimental plot, all the ears were harvested when the plants reached the physiological maturation stage (R6). Next, they were tracked, and the grains were packed and identified, each genotype, in a single paper bag, where the grain mass of each plot corrected to 13% of moisture was calculated and transformed into  $\text{kg ha}^{-1}$  to obtain the grain yield.

For the differentiation of the genotypes, the methodology proposed by Fageria and Kluthcouski (1980), that suggest the classification of the genotypes regarding the efficiency in the use and response to the application of N. Where the nutrient utilization is defined by the average grain yield at low level. The response to nutrient utilization is obtained by the difference between grain yield in the two levels divided by the difference between the doses using the following formula:  $An = (PNN-PBN)/(DEN)$ , where:  $an$  = response index; PNN = Production with optimum nutrient level; PBN = Production with low nutrient level; DEN = difference between the doses applied ( $\text{kg ha}^{-1}$ ).

A graphic representation was used in the cartesian plane to classify the genotypes. In the abscissae axis (x), there is the efficiency in the use of N and the axis of the Ordinates (y), the response to its use. The point of origin of the axes is the average efficiency and the average response of the genotypes. In the first quadrant are represented the efficient and responsive genotypes; In the second, the non-efficient and responsive; In the third, the non-efficient and non-responsive and in-room, the efficient and non-responsive.

The data obtained for grain yield were submitted to normality test and ANOVA for each test with joint analysis following the criterion of homogeneity of the residual mean squares of the assays. The efficiency and response indices of the genotypes were also submitted to normality and analysis of variance for each of these.



The means of the genotypes, environments, and indices of efficiency and response were compared by the Scott and Knott Group test (1974), to 5% significance, using the SISVAR program.

### III. RESULTS AND DISCUSSION

Analysis of variance (Table 1) had a significant effect ( $p < 0,05$ ) for assays, genotypes and interaction in grain

yield. The latter indicates a differential behavior of the genotypes at different levels of fertilization. The coefficient of variation (CV) was from 7,5%, less than those found by Godoy et al. (2013), and Cancellier et al. (2011). This CV indicates good accuracy in the conduction of the experiments, is considered low because it is less than 10% according to the classification proposed by Pimentel-Gomes (2009).

Table 1. Summary of the joint variance analysis for grain yield of 20 corn genotypes cultivated in two assays (different nitrogen levels).

Source of variation	Degree of freedom	Square Middle
Tests	1	89268750,00*
Genotypes	19	2455998,45*
Interaction	19	977031,23*
Blocks (assays)	4	274342,92
Error	76	93262,44
General mean		4070,58
CV%		7,50

\*, ns = Significant and not significant, respectively, by the F test to 5%.

Grain yields (Table 2), Ranged from 1835 kg ha<sup>-1</sup> (BN) a 6246 kg ha<sup>-1</sup> (AN). In the group with the highest mean, the genotypes are UFT-13 (6034 kg ha<sup>-1</sup>), UFT-19 (6246 kg ha<sup>-1</sup>), UFT-M10 (5739 kg ha<sup>-1</sup>) and UFT-M12 (5963 kg ha<sup>-1</sup>) in AN. And in the group with lower mean are the genotypes UFT-13 (1835 kg ha<sup>-1</sup>), UFT-18 (1984 kg ha<sup>-1</sup>), UFT-EA (2274 kg ha<sup>-1</sup>) and UFT-3E (2107 kg ha<sup>-1</sup>) in BN.

Grain yield (Table 2), was significantly higher in

the assay of AN Comparing to that of BN, with mean 4933 kg ha<sup>-1</sup> and 3208 kg ha<sup>-1</sup>, respectively, being 35% lower in the low-test N. What shows a general increment of RG as a function of nitrogen fertilization. Cancellier et al. (2011) and Souza et al. (2008) evaluating tropical populations of corn have found an increase in 23% and 30 % productivity in high-performance assay N, respectively. Only the UFT-M5 showed a statistically equal mean grain yield in both environments.

Table 2. Mean grain yield (kg ha<sup>-1</sup>) of 20 maize genotypes cultivated under two levels of N.

Genotypes	High N	Low N/efficiency	Answer
UFT-3	4220 Ac	2784 Bd	10
UFT-8	4944 Ab	4168 Bb	5
UFT-9	5027 Ab	3373 Bc	11
UFT-11	4904 Ab	3679 Bc	8
UFT-12	4138 Ac	3052 Bd	7
UFT-13	6034 Aa	1835 Be	28
UFT-14	4828 Ab	3636 Bc	8
UFT-16	5113 Ab	3851 Bd	8
UFT-18	4511 Ac	1984 Be	17
UFT-19	6246 Aa	5060 Ba	8
UFT-2B	5041 Ab	3372 Bc	11
UFT-EA	3903 Ac	2274 Be	11
UFT-ED	4212 Ac	2573 Bd	11

UFT-3E	4589 Ac	2107 Be	17
UFT-M1	5227 Ab	3633 Bc	11
UFT-M10	5739 Aa	3996 Bb	12
UFT-M12	5963 Aa	3544 Bc	16
UFT-M18	4489 Ac	2543 Bd	13
UFT-M5	4405 Ac	3948 Ab	3
UFT-M9	5132 Ab	2753Bd	16
Mean	4933A	3208B	12

Mean followed by the same lowercase letter in the column and capitalized in the row, belong to the same group, by the grouping criterion of Scott and Knott (1974), the 5% of significance.

The tests in AN showed three groups of mean (Table 2), varying from 3903 kg ha<sup>-1</sup> a 6246 kg ha<sup>-1</sup>, in the group with the highest mean are the UFT-13 (6034 kg ha<sup>-1</sup>), UFT-19 (6246 kg ha<sup>-1</sup>), UFT-M10 (5739 kg ha<sup>-1</sup>) and UFT-M12 (5963 kg ha<sup>-1</sup>), in the group with the lowest mean are the genotypes UFT-3 (4220 kg ha<sup>-1</sup>), UFT-12 (4138 kg ha<sup>-1</sup>), UFT-18 (4511 kg ha<sup>-1</sup>), UFT-EA (3903 kg ha<sup>-1</sup>), UFT-ED (4212 kg ha<sup>-1</sup>), UFT-3E (4589 kg ha<sup>-1</sup>), UFT-M18 (4489 kg ha<sup>-1</sup>), and UFT-M5 (4405 kg ha<sup>-1</sup>).

The BN assays showed five groups of mean (Table 2), with RG ranging from 1835 kg ha<sup>-1</sup> a 5060 kg ha<sup>-1</sup>, in the group with the highest mean is the genotype UFT-19 (5060 kg ha<sup>-1</sup>), in the group with the

smallest medias are the genotypes UFT-13 (1835 kg ha<sup>-1</sup>), UFT-18 (1984 kg ha<sup>-1</sup>) and UFT-3E (2107 kg ha<sup>-1</sup>). Only the genotypes UFT-18, UFT-EA and UFT-3E showed lower averages for both BN and AN. The genotype UFT-19 was the only one that presented the highest mean for the two levels of N.

According to the methodology of Fageria and Kluthcouski (1980) (Figure I), the genotypes were identified UFT-M12, UFT-M10, UFT-2B, UFT-M1, UFT-16, UFT-11, UFT-14, UFT-19, UFT-8, and UFT-M5 as being efficient to N. Thus, they were considered for obtaining grain yield in BN higher than the mean of the genotypes of 3208 kg ha<sup>-1</sup>, these genotypes are found in quadrants I and IV.

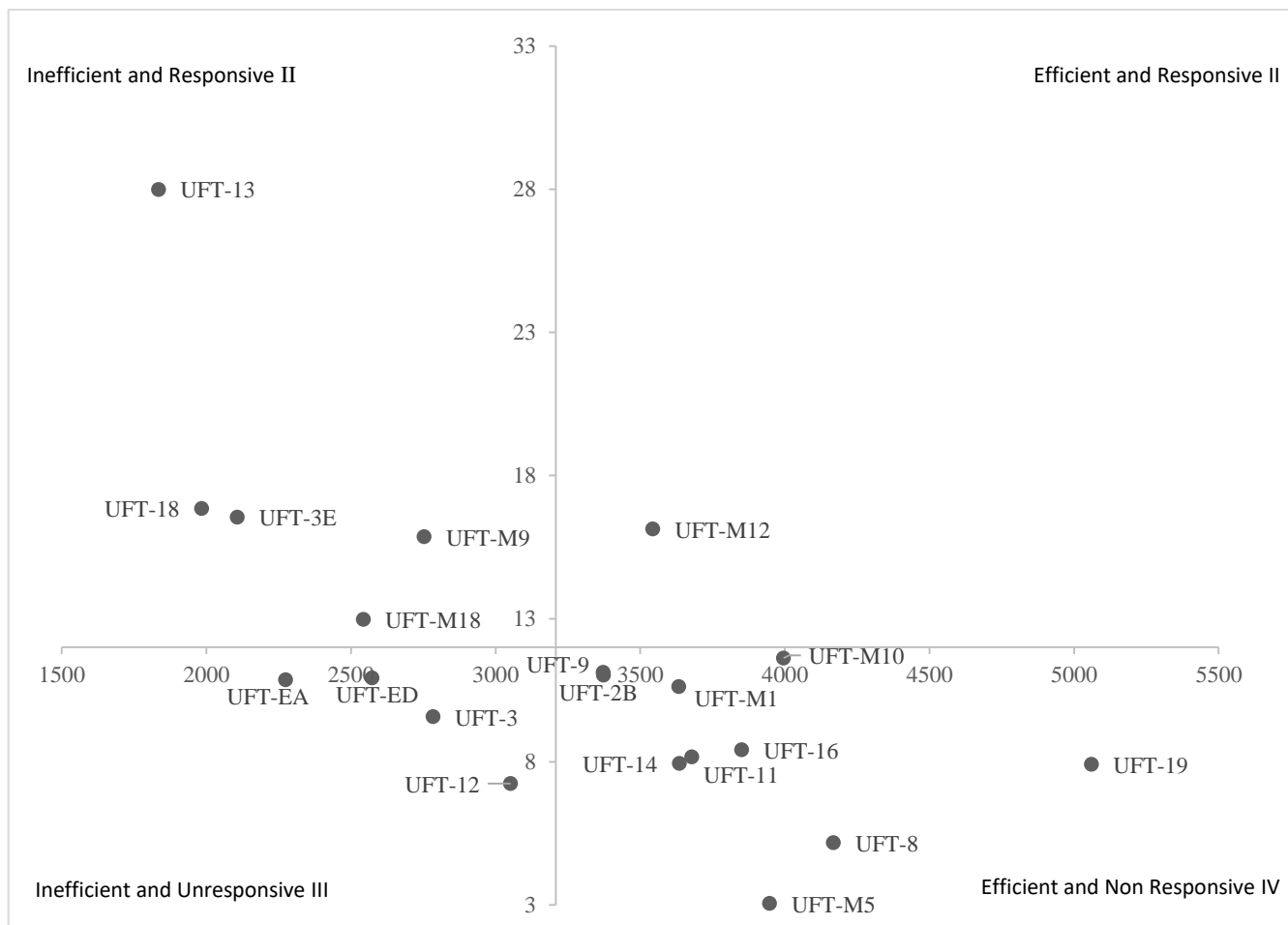


Fig.1. Efficiency in the use and response to nitrogen application in maize genotypes, by the methodology of Fageria and Kluthcouski (1980).

The genotypes UFT-M12, UFT-13, UFT-18, UFT-3E, UFT-M9, and UFT-M18 were considered as responsive to N, values found in quadrants I and II (Figure 1). They were classified to obtain a higher response than the mean of the genotypes, which was 12.

It is noteworthy that the genotype UFT-M12 in addition to efficient was also considered as responsive (Quadrant I). The genotype UFT-M12 and the most indicated, for cultivation using high or low fertilization, providing greater economic return. Second Passos et al. (2015) efficient and responsive genotypes, ie, responsive, because nitrogen fertilization, significantly increased their productivity, efficient because they achieved good yields in the absence of fertilization.

The genotypes UFT-13, UFT-19, UFT-3E, UFT-M9, and UFT-M18 are responsive, by presenting low RG down are considered non-efficient (Quadrant II). These genotypes are recommended for producers of high technological level because they are not efficient in conditions of low nitrogen fertilization, respond well to this fertilization with gains in productivity (PASSOS et

al., 2015).

The genotypes UFT-EA, UFT-ED, UFT-3, and UFT-12 are considered as non-efficient and non-responsive (Quadrant III), not being indicated for planting for economic purposes (SANTOS et al., 2017). For having presented low grain yield in an environment with N deficiency (lower to the mean of the genotypes, ie, 4070 kg ha<sup>-1</sup>) and for having presented low rates of response to the application of N (below 12).

In quadrant IV are the genotypes UFT-M10, UFT-2B, UFT-M1, UFT-16, UFT-11, UFT-14, UFT-19, UFT-8 and UFT-M5 that are regarded as efficient, however, because they have a low response to N (below 12) are classified as non-responsive. Genotypes of this quadrant are indicated for producers of low technological level (SANTOS et al., 2017).

#### IV. CONCLUSION

For the grain yield characteristic, the methodology of Fageria and Kluthcouski (1980), proved to be effective in classifying efficient and responsive maize genotypes.

The UFT-M12 genotype was classified as efficient and responsive for the use of N for grain yield, indicated, for cultivation at high or low technological level.

The genotypes UFT-EA, UFT-ED, UFT-3, and UFT-12 are considered as non-efficient and non-responsive, are not indicated for planting for economic purposes.

### ACKNOWLEDGMENTS

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# The characterization of population displacement for early diagnosis of osteoporosis: a study on the performance of X-ray and DXA exams in northern Brazil

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**Abstract**— DXA is the gold standard for bone density measurement. Brazil is divided into 5 regions (North, South, Southeast, Midwest and Northeast). The northern region has some peculiarities (difficult outpatient access and imaging diagnosis, in addition to the low Human Development Index – HDI) that precludes the rapid diagnosis of diseases. Radiographic Densitometry is a technique that allows the measurement of bone density by means of radiographic images. The aim of this study is to characterize population displacement for DXA and X-ray examinations for osteoporosis diagnosis. To perform the study, quantitative information on the number of DXA and X-rays was extracted. With this, it was possible to design through the Tableau software execution of the algorithm, a model visualization. For the realization of the DXA, the displacement occurs in approximately 426 municipalities in northern Brazil. For radiographic examinations, the dislocation is summarized in 150 municipalities. It can be concluded that the ANS allowed observing the displacement of people between cities to perform the examinations. X-ray and DXA, aiming at the diagnosis of osteoporosis.

**Keywords**— Social Network Analysis, DXA, X-ray, people movement.

## I. INTRODUCTION

Osteoporosis is a chronic disease affecting men and women, characterized by the gradual loss of bone mineral content. Although incurable, osteoporosis has good treatment options, prolonging the quality of life of its patients.

In the United States, Brixen, Abrahamsen and Kassem (2005) reported that hip fractures affect about 300,000,000 Americans, with a death rate of approximately 25%. It is notorious that the difficulty of specialists in early diagnosis of the disease has raised such statistical indices. According to Merino (2006), in Brazil it is estimated that about 75% of patients discover the disease after bone fracture, that is, already in the advanced stage of the disease.

The Brazilian territory is divided into 5 regions: Midwest, Northeast, North, Southeast and South. The northern region of Brazil has the largest territorial extension of the country, covering 42.27% of the national territory, and being formed by seven states: Acre (AC), Amapá (AP), Amazonas (AM), Pará (PA), Rondônia (RO), Roraima (RR), e Tocantins (TO). Although not a populous region (about 8% of the total population), it concentrates much of the low-income population, with

54% of children under 14 living in this region living in poverty. (IBGE, 2010).

Since bone density testing has been indicated for certain groups in general for people over 50; demand for these exams increases as population increases. The states of the northern region have shown an increase in this target population (figure 1 and figure 2), according to the extraction of quantitative data from the last two demographic censuses conducted by the Brazilian Institute of Statistical and Geographical – IBGE.

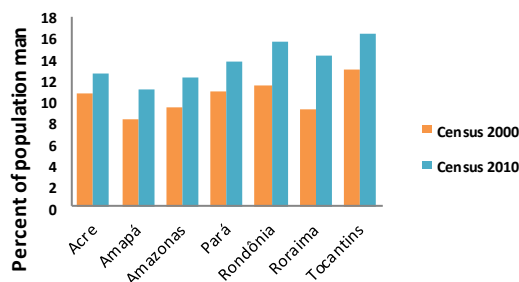


Fig 1: Percentage of man's population  $\geq 50$  years of age.



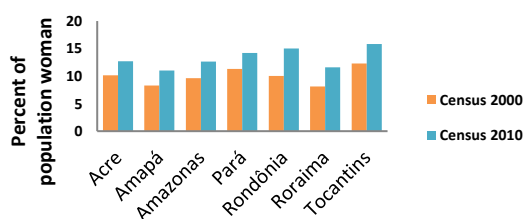


Fig 2: Percentage of woman's population  $\geq 50$  years of age.

In addition, the region has an unusual feature with other regions of Brazil, the fluvial transport of passengers between cities. Surrounded by rivers and with few paved roads, much of the population displacement is carried out by water (sea and/or river).

In 1994, the World Health Organization – WHO proposed the criteria for the diagnosis of osteoporosis using the values obtained by the T score. Conventional radiography is not sensitive to detect bone loss, but only after a significant reduction – around 30 to 50%, and is therefore not effective for early diagnosis of osteoporosis. Different techniques have been used to quantitatively analyze bone mass. Among these, we can mention: Dual-Energy X-ray Absorptiometry (DXA) and Radiographic Densitometry - DR. (Louzada, 1994; Macedo and Araujo, 1997; Meirelles, 1994)

### 1.1. Radiographic Densitometry – DR

Scientifically, the first use report of this technique was elaborated by Price (1901), to estimate the bone and dentin density using a copper-made densitometric reference. Already Louzada (1994) used a specific alloy aluminum ladder (material with bone-like x-ray absorption characteristics) in its bone density assessments. Oliveira and Gouveia (2018), proposed a polynomial selection algorithm to measure bone density by radiographic densitometry.

### 1.2. Social Network Analysis – SNA

Graph theory, including social network analysis, has been widely used in the fields of social science, computer science, biology, chemistry, public health and other fields of knowledge (Arora, 2019, Alamsyah, 2019, Jacomy et al., 2014; Hongyi et al., 2019; Saheb, 2019; Zhao, 2019).

Aragão et al. (2018) used a graph network through social network analysis to characterize the displacement of the bovine population in the state of Pará – Brazil, in 2017. Already Oliveira et al. (2019) used the model to determine the population displacement of people in the northern region for mammography.

The objective of this study is to characterize population displacement for DXA and X-ray examinations for osteoporosis diagnosis.

## II. MATERIALS AND METHODS

### 2.1 Study AREA

Northern Brazil extends over an area of approximately 3.853,575,6 km<sup>2</sup>. According to IBGE region is estimated to have about 18.430.980 million, of which 17% of citizens are over 49 years old, distributed in about 450 municipalities. (IBGE, 2010)

### 2.2 DXA and X-ray Equipment Quantitative.

The study was conducted in the states of Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantins. Through the program of access to information of the Brazilian Ministry of Health, it was possible to obtain the information on the quantity of equipment (DXA and X-ray) by municipality and the operating situation of the device (in use or not). With the aid of spreadsheet data were grouped into: Source-Destination; Latitude; Longitude; Total appliances in use and municipality.

With the Tableau® software, the municipalities were included in the state map. Through the line filter it was possible to project the displacement of people to the nearest location of the equipment.

## III. RESULTS AND DISCUSSION

Figure 3 and Figure 4 show the results of population displacement performed in the state of Acre-AC for imaging (DXA and X-ray). It is observed that the population displacement occurs in twenty-one municipalities for DXA (Figure 3). To perform the X-ray examination, person movement occurs in only five municipalities (Figure 4).



Fig. 3: Geographic map of population displacement for Dual Energy X-ray Absorptiometry - DXA examination in the state of Acre-AC.

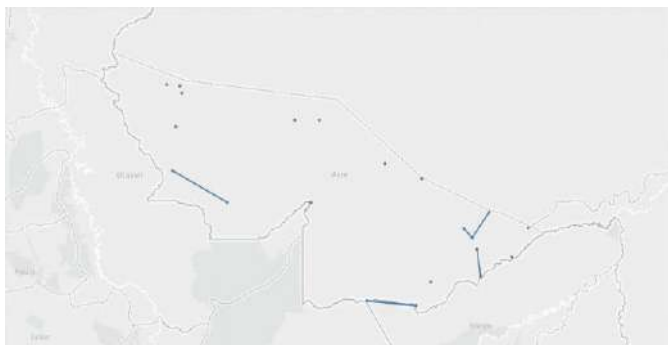


Fig. 4: Geographic map of population displacement for X-ray examination in the state of Acre-AC.

Figure 5 and Figure 6 show the results of population displacement performed in the state of Amazonas-AM to perform imaging exams (DXA and X-ray). It is observed that the displacement occurs in sixty municipalities for DXA (figure 5). Considering the X-rays exam, people's displacement occurs just in two municipalities (figure 6).

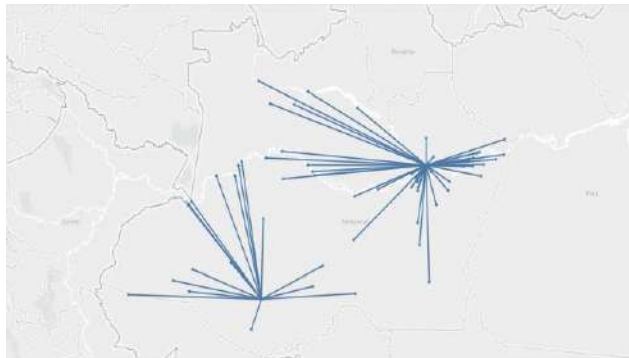


Fig. 5: Geographic map of population displacement for dual energy X-ray Absorptiometry – DXA examinations in the state of Amazonas-AM.

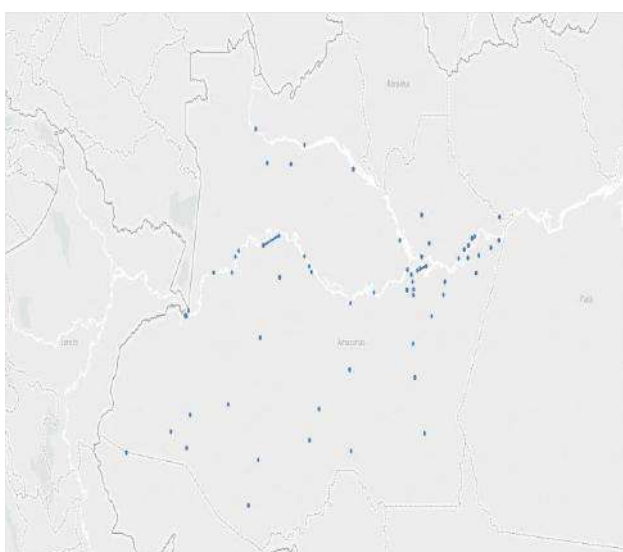


Fig. 6: Geographic map of population displacement for X-ray examination in the state of Amazonas-AM.

Figure 7 and Figure 8 show the results of population displacement performed in the state of Amapá-AP for imaging (DXA and X-ray). Population displacement occurs in fifteen municipalities for DXA (Figure 7). To perform the X-ray examination, the movement of people occurs in only nine municipalities (figure 8).



Fig. 7: Geographic displacement map for Dual Energy X-ray Absorptiometry – DXA examination in the state of Amapá-AP

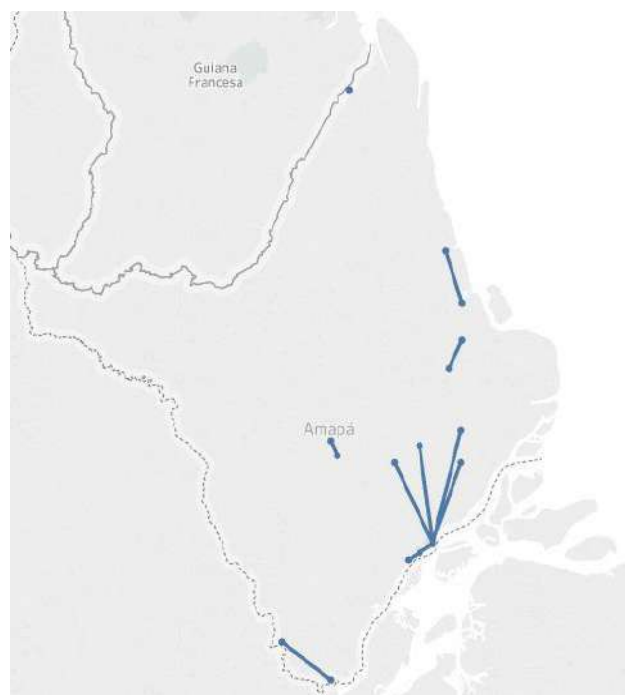


Fig. 8: Geographic map of population displacement for X-ray examination in the state of Amapá-AP

Figure 9 and Figure 10 show the results of population displacement performed in the state of Roraima-RR for imaging (DXA and X-ray). Population displacement occurs in fourteen municipalities for DXA (Figure 9). For the X-ray examination, the movement of people occurs in only seven municipalities (Figure 10).

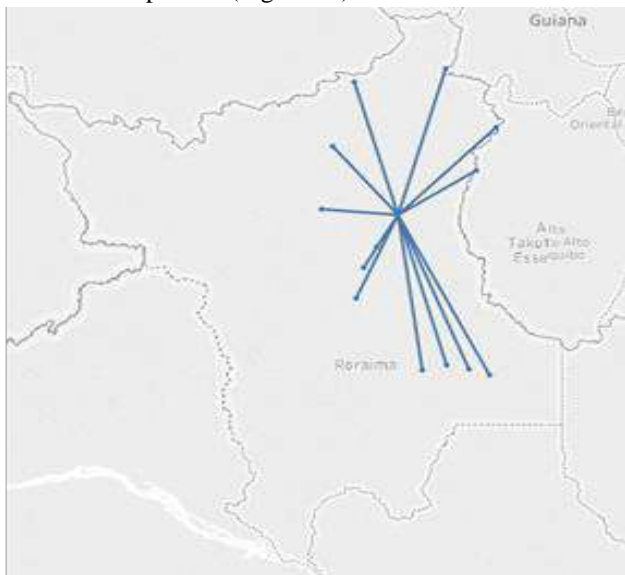


Fig. 9: Geographic map of population displacement for Dual Energy X-ray Absorptiometry – DXA examination in the state of Roraima-RR

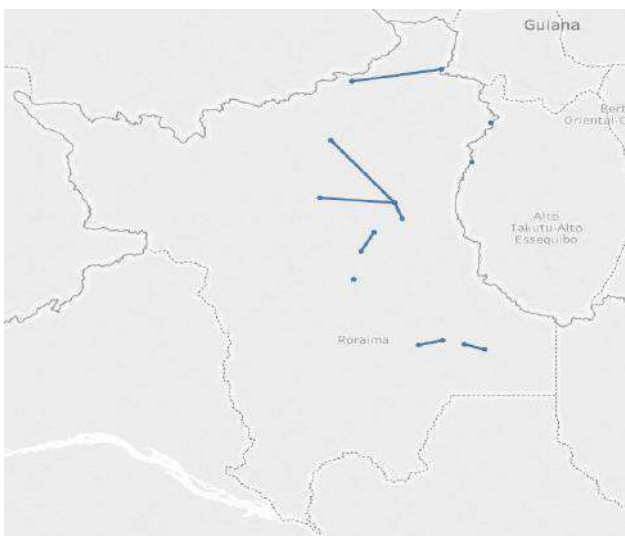


Fig. 10: Geographic map of population displacement for X-ray examination in the state of Roraima-RR.

Figure 11 and Figure 12 show the results of population displacement performed in the state of Pará-PA to perform imaging examinations (DXA and X-ray). Population displacement occurs in one hundred and seventy-three municipalities to perform DXA (Figure 11). To perform the X-ray examination, person movement occurs in only twenty-one municipalities (figure 12).

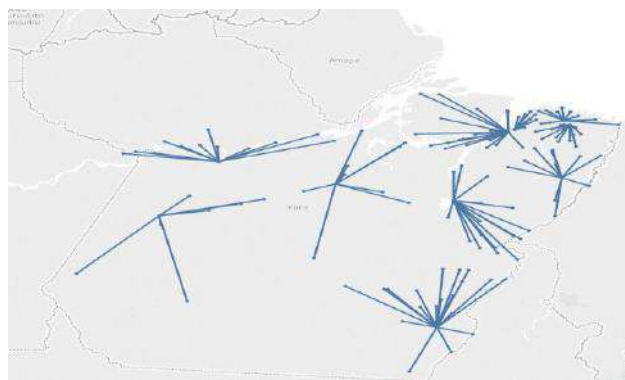


Fig. 11: Geographic map of population displacement for Dual Energy X-ray Absorptiometry (DXA) examination in the state of Pará-PA.



Figure 12: Geographic map of population displacement for X-ray examination in the state of Pará-PA

Figure 13 and Figure 14 show the results of population displacement performed in the state of Rondônia-RO to perform imaging examinations (DXA and X-ray). Population displacement occurs in one hundred and thirty-five municipalities for DXA (Figure 13). To perform the X-ray examination, person movement occurs in only thirty-two municipalities (Figure 14).

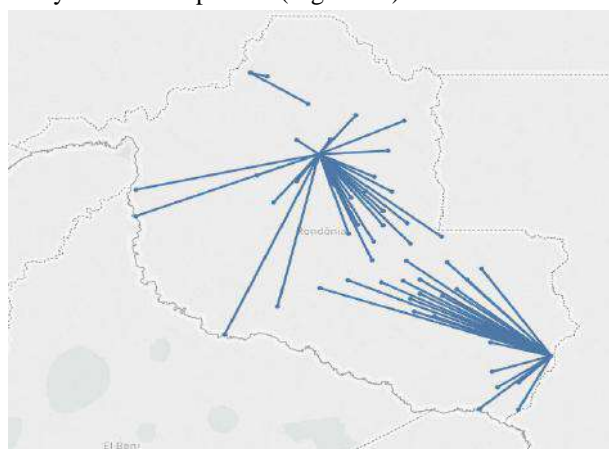


Fig. 13: Geographic map of population displacement for Dual Energy X-ray Absorptiometry (DXA) examination in the state of Rondônia-RO



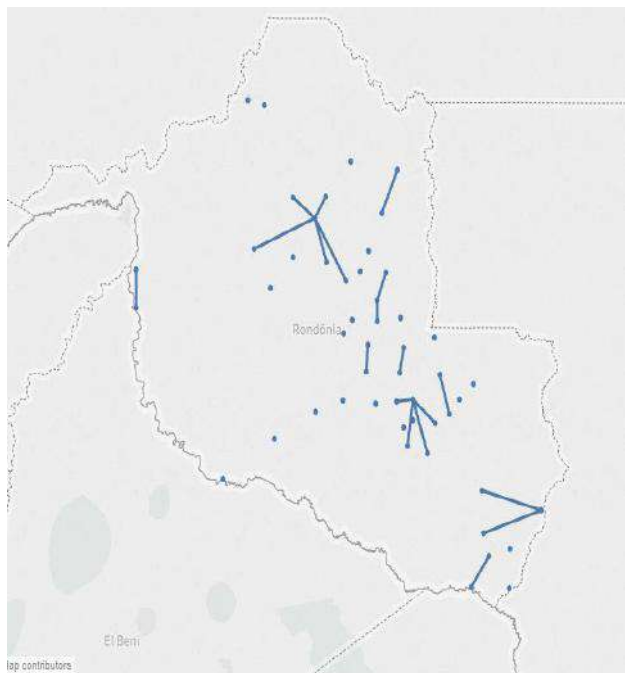


Fig. 14: Geographic map of population displacement for X-ray examination in the state of Rondônia-RO.



Fig. 16: Geographic map of population displacement for X-ray examination in the state of Tocantins-TO.

Figure 15 and Figure 16 show the results of population displacement performed in the state of Tocantins-TO to perform imaging exams (DXA and X-ray). Population displacement occurs in one hundred and thirty-five municipalities to perform DXA (Figure 15). To perform the X-ray examination, person movement occurs in only thirty-two municipalities (Figure 16).

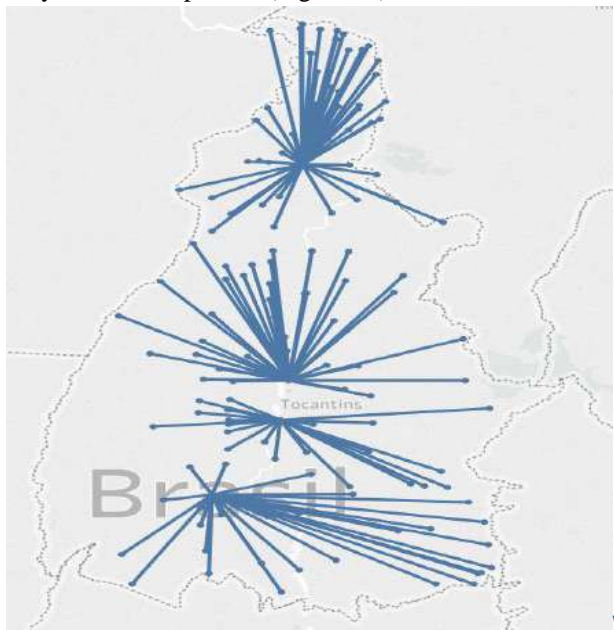


Fig. 15: Geographic map of population displacement for Dual Energy X-ray Absorptiometry (DXA) examination in the state of Tocantins-TO.

#### IV. CONCLUSIONS

We can conclude that the movement of people for X-ray examination is relatively lower compared to DXA, as shown by Social Network Analysis. However, in order for X-ray equipment to be used to measure bone density, such devices need to be configured / adapted for this purpose. This upgrade to X-ray equipment will allow for such, an increase in the quality of health service provided for the affected populations and thus improve their quality of life. Also, further research can be conducted, based on this study, to provide a value for the economic impact of using X-ray based Osteoporosis diagnosis. This impact can be considered taken several dimensions. The two of them are the distance for people displacement and the amount of time wasting on displacement. The scale of both will allow for considering as a good public investment, the adoption of X-ray equipment upgrade for osteoporosis diagnosis.

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# Level of Physical Activity and Quality of Life: A Study with Elderly from Coredes Alto Jacuí and Alto Botucaraí, Rio Grande Do Sul

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**Abstract**— Brazil is currently undergoing an important change in its demographic pyramid, with progressive and accelerated aging of the population. Guaranteeing quality of life and functional longevity for this population has been pointed as a solution to the problem of the autonomy of the elderly in society. Thus, this study aims to analyze the relationship between quality of life (QL) and level of physical activity (LFA) in elderly individuals assisted by the Family Health Strategies (FHS) of the municipalities of Coredes Alto Jacuí and Alto Botucaraí - RS. This research was characterized as a descriptive cross-sectional study and the sample consisted of 1378 elderly (over 60 years old) representing 10% of the population assisted by the FHS of these municipalities. For evaluation of QL, the WHOQOLOLD questionnaire was used, and to determine the LFA, the International Physical Activity Questionnaire (IPAQ) was used. Data were analyzed with the support of descriptive statistics, absolute frequency distributions and measures of central and inferential tendency, Mann Whitney U test and Spearman correlation, considering significant values  $p < 0.05$ . The present research could infer that the quality of life levels were better for those elderly classified as active. It is concluded that there is a relationship between the two variables and the observed pattern is that the more active the higher the quality of life.

**Keywords**— Aging. Health. Quality of life.

## I. INTRODUCTION

Human aging deserves attention, especially considering the National Household Sample Survey - NHSS 2015 (IBGE, 2016), The participation of people aged 60 and over increased from 9.8% in 2005 to 14.3% in 2015. Pointing to the demographic aging trend, which corresponds to the increase in the percentage participation of the elderly in the population. This number leaves Brazil among the countries with the largest number of elderly in the world, occupying the sixteenth position in the number of elderly. By 2025, Brazil is expected to move to sixth place. This change will lead to a reduction in the percentage of young people from 42.6% to 20.6% and an increase from 2.7% to 14.6% in the elderly population. (CRUZ; ALHO, 2000).

According to Mazo *et al.* (2005), the rapid growth of the elderly population, has had a major impact on the country's economy and aggravation of problems in the

socioeconomic and health sectors. In addition, the aging process is most often accompanied by an inactive lifestyle that favors disabilities and dependencies by showing how much professionals in various fields should be concerned with providing older people with the means by which to associate longevity. to a good quality of life, thus rescuing their autonomy.

The term quality of life can be considered as the condition resulting from a set of individual, socio-cultural and environmental parameters that determine how human beings live (NAHAS, 2001; SILVA; REZENDE, 2006; PIMENTA *et al.*, 2008). For the World Health Organization quality of life is “[...] an individual's perception of their position in life, in the context of the culture and value system in which they live, taking into account their goals, expectations, standards and your concerns ” (WHOQOL, 2008, p. 23). There is no unanimity of opinion related to good quality of life, but the

most commonly found elements are: health, safety, happiness, leisure, stable financial condition, family, love, aesthetics and work (MINAYO, HARTZ, BUSS, 2000; GONÇALVES; VILARTA 2004; SANTOS; SOUZA, 2015; ENTRINGER *et al.*, 2018).

Although a large body of knowledge, among them, Bauman (2004), Moraes *et al.* (2007), Castro *et al.* (2007) and Azevedo Filho *et al.* (2019) evidence the role of physical activity as one of the decisive elements in the promotion of health and quality of life, these levels remain low. According to United States Department of Health & Center for Disease Control and Prevention, 40% of adults did not perform physical activity in their free time, and only 15% performed moderately for 30 minutes or more, with weekly frequency of five to seven days a week (DHHS, 2001). To be physically active you need to do at least 150 minutes a week of moderate physical activity. (MONTEIROL, 1996-1997; HALLAL, 2005) or 60 minutes a week of vigorous physical activity (HALLAL, 2005).

Studious say that physical activity improves the performance of older people in activities of daily living and reduces the risks of various chronic diseases such as heart disease, hypertension, obesity, diabetes mellitus, osteoporosis and some cancers (NAHAS, 2001; ALLSEN; HARRISON; VANCE, 2001; ALMEIDA *et al.*, 2018; SCIANNI *et al.*, 2019). Physical activity is also associated with well-being and quality of life, especially in middle age and old age, which is in this phase as a consequence of consolidating inactivity (NAHAS, 2001). However, there are still few studies that include a representative sample of a given population comparing the practice of physical activity in the elderly and the relationship with physical inactivity, the functionality in daily tasks, quality of life and other variables (LOPES 2015).

Thus, considering that epidemiological studies involving the elderly are important so that their results may direct health promotion programs, especially regarding the more active behavior of this population, which may result in positive impacts on the quality of life related to health. This study aims to analyze the relationship between the quality of life and the level of physical activity in elderly individuals assisted by the Family Health Strategies (FHS) of the municipalities of Coredes Alto Jacuí and Alto Botucaraí - RS.

## II. MATERIAL AND METHODS

This research was characterized as a descriptive cross-sectional study and the sample consisted of 1378 elderly (over 60 years) living in the municipalities of Coredes Alto

Jacuí and Alto Botucaraí - RS, which represented 10% of the population served by the FHS of these municipalities. Were excluded from the study and replaced by another subject the elderly who did not have mental and / or physical conditions to respond to the instrument; those who did not sign or stamp the Informed Consent Form; and those who were not registered with the municipality's FHS.

As a research instrument, we used a form, which was applied as an interview, consisting of three questionnaires: a) Personal information questionnaire, containing information such as: gender, age, marital status, education and monthly income, with the purpose of characterizing the socioeconomic and demographic situation of the sample;

b) WHOQOL-OLD Quality of Life Questionnaire, Brazilian version, standardized by Fleck *et al.* (2003). This instrument assesses the quality of life in the elderly. It started in 1999, as a scientific cooperation of several centers. The aim of the project was to develop and test a generic measure of quality of life in older adults for international / cross-cultural.

Taking as a starting point the quality of life measure for younger adults (WHOQOL-100), its original version was published in 1998 (WHOQOL GROUP, 1998) and the Brazilian version in 2003 (FLECK *et al.*, 2003). The WHOQOL-OLD consists of 24 Likert scale items assigned to six facets: "Sensory Functioning" assesses sensory functioning and the impact of loss of sensory skills on activities of daily living and the ability to interact with others on quality of life. of the elderly.

"Autonomy" refers to independence in old age, describing the extent to which one is able to live autonomously and make one's own decisions. "Past, Present, and Future Activities" refers to past, present, and future activities, describing satisfaction with life achievements and projects, future yearnings.

"Social Participation" refers to social participation, which delineates participation in everyday activities, especially in the community in which it operates. "Death and Dying", which relates to concerns, concerns and fears about death and the dying. And "Intimacy," which evaluates the perception of feeling loved and supported as well as loving. Each of the facets has four items; therefore, for all facets the score of possible values can range from 4 to 20, provided that all items in one facet are filled.

The scores of these six facets or the 24-item WHOQOL-OLD module values can be combined to produce an overall ("global") score for quality of life in older adults, denoted as the "Total score" WHOQOL-OLD (FLECK) score. *et al.*, 2003).

c) International Physical Activity Questionnaire (IPAC), short version (PARDINI et al., 2001) to assess the level of physical activity. This questionnaire was prepared by researchers from various countries, supported by the World Health Organization, as part of a multicenter study involving 12 countries, to know the population's classification in relation to physical activity. Each participating country adapted and validated its questionnaire, taking into account the characteristics of the population. In Brazil, it was validated by the São Caetano do Sul Physical Fitness Laboratory Study Center (CELAFISCS, 2008). It consists of eight questions regarding walking, moderate / vigorous / moderate + vigorous physical activity, whose product is the level of physical activity, in which the individual is classified as sedentary, insufficiently active, active and very active.

The collections took place in the homes of the elderly who were randomly selected in proportion to the number of elderly in each micro area of Coredes Alto Jacuí and Alto Botucaraí - RS.

Data were analyzed with the support of descriptive statistics, absolute frequency distributions and measures of central and inferential tendency, Mann Whitney U test and Spearman correlation, considering significant values  $p < 0.05$ .

### III. RESULTS AND DISCUSSIONS

The 1378 elderly who participated in the study were characterized by gender, age, education, marital status (Table 1) and level of physical activity (Table 2).

Table 1 - Sample distribution in relation to sociodemographic characteristics. Rio Grande do Sul, Brazil.

Variables	Indicator	n	%
Gender	Male	542	39,3
	Female	836	60,7
Age Extract	60 to 69 years	674	48,9
	70 to 79 years	490	35,6
	80 or more	214	15,5
Civil status	Married	807	58,6
	Single or Other	120	8,7
	Widower	392	28,4
	Separate	59	4,3
Schooling	Illiterate	253	18,4
	Incomp. Elementary School	931	67,6
	Complete primary education	118	8,6
	Complete high school	61	4,4
	Higher Education Complete	15	1,1

According to the data presented in table 1, it is observed that the sample consisted of 60.7% of female

elderly and that 48.9% are between 60 and 69 years old. It is also observed that 58.6% are married and that the education level of more than half of the population is low, 67.6% have incomplete elementary school.

Among the factors that explain the higher number of female elderly we can show that life expectancy among women is higher than men. Still, we point to Souza and Siviero (2015) who specify that male mortality is higher than female mortality in all age groups, as well as life expectancy at birth and at other ages are also higher among women, and that the number Deaths due to violent causes, which affect the male population more intensely, have increased in recent years, leading to a reduction in male life expectancy.

Table 2 - Level of physical activity according to gender and age. Rio Grande do Sul, Brazil.

	Sedentary		Active		P
	N	%	N	%	
<b>Gender</b>					
Male	311	22,6	231	16,8	0,054
Female	516	37,4	320	23,2	
<b>Age range</b>					
60-69 years	380	27,6	294	21,3	
70-79 years	296	21,5	194	14,1	0,001
80 + years	151	11	63	4,6	

The results presented in table 2 corroborate what some studies have already proven, that the practice of physical activity in search of health promotion declines over the years of life (ANDREOTTI; OKUMA, 2003; CARVALHO et al., 2010; LOPES et al., 2016). Another study that interviewed 1891 elderly people in the South Region in 2009 showed that 58% of the elderly were sedentary, and that the elderly aged 80 years or older were the least likely to receive counseling on physical activity in primary care units. (LOPES et al., 2015).

The statistical test called Pearson's chi-square test was used to measure the association between the categorical variables gender and IPAQ. The chi-square statistic value was 2.584. The value of  $p = 0.054$ , thus indicating that there is no relationship of dependence between the variables gender and level of physical activity. Different result was found by another study that associated the factors age and sex, with or without physical exercise. The pattern found was that older male elderly are more sedentary when compared to other groups (FLORINDO, 2001).

The statistical test called Pearson's chi-square test was used to measure the association between the categorical variables Age and physical activity level. The

chi-square statistic value was 13.661. The  $p = 0.001$  (bilateral) value found is highly significant at the significance level  $\alpha = 0.05$ , thus indicating that there is some dependence relationship between age and physical activity variables. We found that the higher the age group analyzed, the lower the percentage of elderly people who are active. This tendency has already been observed in similar studies that concluded that as chronological age increases there is a tendency for people to be less active and consequently less functional (MATSUDO, 2002; VECCHIA, 2005).

Table 3 presents the results found by the WHOQOL-OLD quality of life questionnaire regarding the physical activity level of the sample.

Table 3: presents the results found by the WHOQOL-OLD quality of life questionnaire regarding the physical activity level of the sample.

Facets	Active		Sedentary		p
	Average	SD	Average	SD	
Intimacy	74,45	17,23	70,77	17,46	0,000
Present, past and future activities	66,48	15,47	65,86	14,91	0,260
Autonomy	72,91	15,96	66,13	17,37	0,000
Social Participation	70,64	12,94	64,05	16,17	0,000
Sensory Functioning	54,46	30,16	48,50	26,72	0,000
Death and dying	51,60	38,31	45,99	34,59	0,006
Overall Quality of Life	65,09	12,30	60,22	12,14	0,000

Analyzing the results of quality of life as a function of physical activity level, it can be seen (Table 3) that in all six facets analyzed the active group had better quality of life when compared to the sedentary group, highlighting that the death and dying was the only one without statistically significant difference. Other studies, (LOPES *et al.*; 2015), proved that increasing the level of physical activity is an important non-pharmacological treatment regimen for the treatment and prevention of various diseases. Highlighting that the systematic practice of physical exercises improves the general health of the individual at any stage of life (SILVA, 2006). Borges (2009) found that individuals aged 76 to 88 years old who had practiced physical activity at some point in their lives had slightly lower levels of dependence when compared to those who had never practiced, suggesting that physical activity may have influenced this result. It is noteworthy that there are still other scientific studies that associate the practice of physical activities with the general improvement of health, increased muscle strength, aerobic capacity, flexibility, balance, among other abilities, of the individual at any stage of life (SILVA, 2006; ROCHA, 2012; ROWE, 1997; KELL, 2001; CAVANI, 2002; TORAMAN, 2004).

The quality of life assessed by the WHOQOL-OLD showed a higher score for men and women in the intimacy facet (73.53 and 71.41, respectively) table 4. The lowest score for men and women was related to the Death and Dying facet (49.50 and 47.40, respectively). It was found that males had higher Intimacy facet score (71.41;  $p = 0.025$ ) when compared to females, the only variable that showed significant differences in quality of life as a function of gender.

Table 4 – Quality of life according to gender. Rio Grande do Sul, Brazil, 2016

Facets	Female		Male		p
	Average	SD	Average	SD	
Intimacy	71,41	18,00	73,53	16,52	0,025
Present, past and future activity	65,83	14,93	66,54	15,42	0,700
Autonomy	68,27	17,65	69,72	16,30	0,760
Social Participation	66,55	15,32	66,89	15,28	0,078
Sensory Functioning	50,40	28,42	51,61	28,10	0,734
Death and dying	47,40	35,28	49,50	37,61	0,623
Overall Quality of Life	61,65	12,39	62,97	12,47	0,551

It can be inferred that the quality of life of this sample was relatively good, as it is above average, considering the maximum value that could be observed, the average quality of life score was 61.65 and 62.97 for women and men respectively, to a maximum of 100. The worst score for quality of life was related to death and dying. This result can be considered as expected, because people in general, and especially older people, are aware of the finitude of life, and it is not related to certain attitudes or practices they may have (LOPES *et al.*, 2015).

Table 5 clearly shows the decline in quality of life as a result of increasing chronological age, except for the Sensory Functioning and Death and Dying facets, probably because they relate less to physical abilities and more to emotional and psychological aspects. the last to decrease at the end of the elderly's life.

Table 5 - Quality of life according to age. Rio Grande do Sul, Brazil, 2016.



Facets	Female		Male		p
	Average	SD	Average	SD	
Intimacy	71,41	18,00	73,53	16,52	0,025
Present, past and future activity	65,83	14,93	66,54	15,42	0,700
Autonomy	68,27	17,65	69,72	16,30	0,760
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Overall Quality of Life	61,65	12,39	62,97	12,47	0,551

Knowing the linear relationship between the level of physical activity and the delayed decline in body functions (CARVALHO *et al.*, 2010), we highlight the importance of practicing moderate or vigorous physical activity for 150 minutes or more per week for improvement in physical conditions, health maintenance and, above all, quality of life, and a possible and probable attenuation in the reduction of the values presented in table 5. Physical exercises of moderate / vigorous intensity were significantly associated with higher WHOQOL-OLD scores. in almost every domain.

#### IV. CONCLUSION

The present research could infer that the quality of life levels were better for those elderly classified as active. It is concluded that there is a relationship between the two variables and the observed pattern is that the more active the higher the quality of life (CUPERTINO, ROSA e RIBEIRO, 2007).

Thus, considering the effectiveness of physical activity as a prevention of various diseases, and with the increase and prolongation of the working capacity of the elderly, optimizing the performance of activities of daily living and preventing disability and dependence in the last years of life, as well as the positive relationship with quality of life, we point out that being active, performing physical exercises, is today one of the largest, if not the greatest, health promotion and quality of life tool available, easily accessible, low cost, and almost no contraindications.

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# Analysis and Design of a Passively Damping LCL Filter in Three-Phase Converters

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**Abstract**— This article discusses the mitigation of high-frequency harmonics through high voltage converters. First we present a generalized model of the passively cushioned LCL filter and then, the optimization process is implemented, which results in the low consumption of active and reactive energy of the capacitor resistance branch. The output characteristics of the passively amortized LCL filter are determined by three parameters of different combinations with the same output result: total L induction, the damping ratio and natural frequency. In a second time we present the design of a control line of the LCL filter on the referential theory giving rise to a simpler way the calculation of different characteristics or combinations such as peak resonance, impedance as well as certain elements that consume reactive and active energy from the RC branch of our LCL filter. The simulations were performed in the Matlab/Simulink environment. The results show a significant improvement in the harmonic attenuation rate.

**Keywords**—Ractive power, active power, passively damping, LCL filter, RC branch.

## I. INTRODUCTION

The problem of harmonic pollution has become more and more worrying in recent decades. This is because of the increased use of so-called non-linear loads including static converters, computers, electric arc furnaces and many other devices. the LCL passive filter when it is well adapted is widely used to obtain an excellent attenuation of the high frequency harmonics. However, the resonance peak in its impedance characteristic as well as some increased consumption of active and reactive energy is observed in the series-connected RC branch is always generated [1-5]. The LCL passive filter proved to be the most effective solution for the compensation of voltage harmonics. Moreover, its performance depends on the technique used to identify the harmonic reference voltages and the control strategy implemented [6-10].

First we present a general model of the passive LCL filter and then, the optimization process is started, which results in the low consumption of active and reactive energy of the series capacitor resistor branch. The purpose of this article is to evaluate the effectiveness of different harmonic filtering means. As far as passive filtering is concerned, the

configuration of parallel resonant and damped filters is studied theoretically and by simulation with Matlab/Simulink. Many active filter configurations may be encountered, but all are based on an inverter (with power transistors and diodes), a continuous source of voltage or current, and a filtering and coupling circuit.

In the context of this article, to reduce harmonic pollution, several solutions have been developed. However, the LCL passive filter has proved to be the most efficient solution for the compensation of voltage harmonics [11], its performance depends on the technique used to identify reference harmonic voltages and the control strategy implemented. In [12], the prediction model THD was used to replace the current LCL model in order to reduce the total harmonic distortion rate, and the parameters were optimized by experimental design.

The literature [13] discusses analysis and the relationship between the performance of the LCL filter and various parameters, as well as the guiding principles of parameter design. The literature [14] introduced the genetic algorithm in the design of LCL filter parameters to obtain the optimal design. Numerous control strategies for

three-phase grid-connected have been devised to achieve accurate and fast current regulation by controlling inverter currents [10], capacitor currents [15], capacitor voltages and grid currents. However, as pointed out and controlling only one variable (single loop) does not lead to a satisfactory damping performance.

The literature [16] begins with the mathematical model of the LCL filter and proposes an intuitive graphical design method. In [17], the damping loss of the LCL filter is taken as an object of investigation and the influence of the variation of each parameter on the loss of damping is analyzed. For the design of the parameters of the LCL filter, the methods existing ones have proposed different design and optimization ideas, but there are also different degrees of defects.

First, we present a mathematical model of the passive LCL filter with a series RC branch, in a second time we present the design of a command line of this LCL filter on the referential theory giving rise to a simpler way the computation different characteristics or combinations of our LCL filter. In order to validate this study, we have developed a Simulink model, this model has the particularity of integrated parallel passive filters. The simulations were performed in the Matlab / Simulink environment and the results obtained show a significant

improvement in the harmonic distortion rate.

## II. EXTERNAL CHARACTERISTICS AND OVERVIEW OF LCL FILTERS WITH PASSIVE DAMPING

The representation below is the model block containing all the elements of the LCL filter with a set of elements whose mission is to manage the different impulses of the inverter which is the block located just after the power supply.

The diagram of the figures below includes the sinusoidal three-phase power network, the non-linear charge symbolized by resistance and inductance, the tension-structured inverter, built from IGBT transistors. all the work was done on two assemblies, a global assembly so the aim was to set up a signal generator piloting the system, a unified assembly to allow us to bring out the different settings of calculations. to understand how the system works, we will do the calculations on a phase line because the three phases have the same elements, but differ signal but however, the behavior of the curves will differ depending on the load.

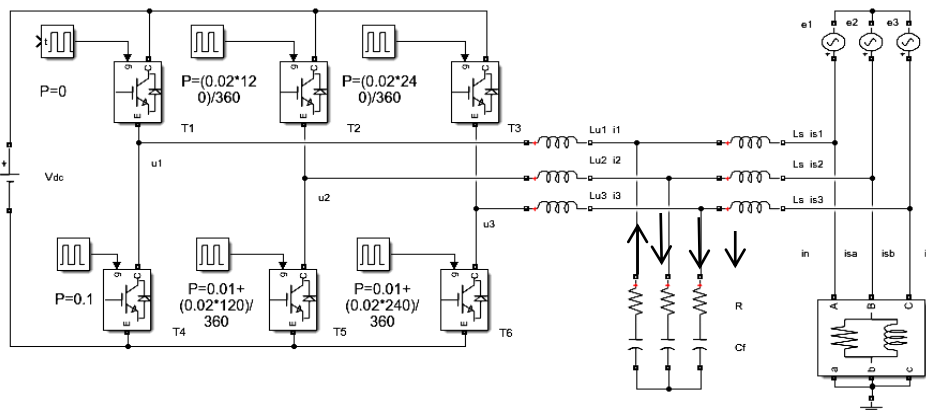


Fig.1: Three-Level overview passively damping LCL filters

### 1 Analysis of LCL Filter

The active countervailing of the RC branch continuously analyzes the current is wavelength form in each of the 3 phases. it deduces the out-of-phase harmonic spectrum made up of the fundamental of each harmonic. the trim

manufactures a waves that result from the difference between the current in the load and the fundamental. This wavelength is the sum of 180 degree out-of-phase harmonic currents that is then supplied to the load.

The polluting charge absorbs a current made up of a

fundamental component and harmonic components. The purpose of passive filtering is the generation of harmonic currents of the same amplitude but in phase opposition to those absorbed by the load. Thus, the current absorbed to the network will be sinusoidal. It is therefore necessary to accurately identify the harmonic currents of the polluting load. The choice of the method used to isolate the harmonic component of the charge current is a determining factor in the performance of the passive filter (dynamic precision).

**2 Minimizing the cost of the inductor and calculate the currents of the filter**

The filter inductor results in a loss of converter output

$$\begin{bmatrix} V_\alpha \\ V_\beta \\ V_0 \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} V_{e1} \\ V_{e2} \\ V_{e3} \end{bmatrix} \tag{1}$$

$$\begin{bmatrix} i_\alpha \\ i_\beta \\ i_0 \end{bmatrix} = \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} i_{sa} \\ i_{sb} \\ i_{sc} \end{bmatrix} \tag{2}$$

The homopolar component of the source voltage is not necessary, we can write then:

$$\begin{bmatrix} V_\alpha \\ V_\beta \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} i_{sa} \\ i_{sb} \\ i_{sc} \end{bmatrix} \tag{3}$$

Note: It should be noted that the neutral  $i_n$  current and the homopolar current  $i_0$  are linked by the relationship below:

$$i_n = i_{sa} + i_{sb} + i_{sc} \tag{4}$$

$$i_0 = \frac{1}{\sqrt{3}}(i_{sa} + i_{sb} + i_{sc}) = \frac{1}{\sqrt{3}}i_n \tag{5}$$

In Concordia is lair, real power and imaginary power are given by the following matrix:

$$\begin{bmatrix} p \\ q \end{bmatrix} = \begin{bmatrix} V_\alpha & V_\beta \\ -V_\beta & V_\alpha \end{bmatrix} \begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix} \tag{6}$$

so we can write:

voltage and a gain in current and frequency. Because the converter is output voltage is limited, total induction is a deterministic constraint. However, the induction has a better performance in changing the ripple current with a larger Inducer. Given the cost, drivers should be reduced as small as possible.

The principle of the method of Real, imaginary and homo-polar instant powers is stated below to determine filtering currents [18]. These are the simple voltages and line currents of a three-phase system with homopolar,  $e_1, e_2, e_3$  and  $i_{sa}, i_{sb}, i_{sc}$ . Concordia's transformation brings this three-phase system from 1-2-3 axes to axes  $\alpha$ - $\beta$ -0, as shown in the following two relationships:



$$\begin{bmatrix} i_{\alpha} \\ i_{\beta} \end{bmatrix} = \frac{1}{V_{\alpha} + V_{\beta}} \begin{bmatrix} V_{\alpha} & -V_{\beta} \\ V_{\beta} & V_{\alpha} \end{bmatrix} \begin{bmatrix} p \\ q \end{bmatrix} \quad (7)$$

To compensate for the harmonics of the current we apply the following mode:

$$p = \tilde{p} \quad \text{and} \quad q = \tilde{q}$$

$\tilde{p}$  and  $\tilde{q}$  Are alternative components of real and imaginary power respectively

So:

$$\begin{bmatrix} i_{\alpha} \\ i_{\beta} \end{bmatrix} = \frac{1}{V_{\alpha}^2 + V_{\beta}^2} \begin{bmatrix} V_{\alpha} & -V_{\beta} \\ V_{\beta} & V_{\alpha} \end{bmatrix} \begin{bmatrix} \tilde{p} \\ \tilde{q} \end{bmatrix} \quad (8)$$

We notice from these equations that in expressions of  $i_{\alpha}$  and  $i_{\beta}$  homopolar power is absent, then:

$$\dot{i}_{\alpha}^* = i_{\alpha} \quad , \quad \dot{i}_{\beta}^* = i_{\beta} \quad , \quad \text{and for homo-polars: } \dot{i}_0^* = i_0$$

Now it is easy to go back to the baseline currents by the reverse transformation of Concordia :

$$\begin{bmatrix} \dot{i}_{sa}^* \\ \dot{i}_{sb}^* \\ \dot{i}_{sc}^* \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & 0 & \frac{1}{\sqrt{2}} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{1}{\sqrt{2}} \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} & \frac{1}{\sqrt{2}} \end{bmatrix} \begin{bmatrix} \dot{i}_{\alpha}^* \\ \dot{i}_{\beta}^* \\ \dot{i}_0^* \end{bmatrix} \quad (9)$$

### III. PASSIVE LCL DAMPING METHODS

In LCL filter, the resonance effect can produce instabilities at the output, especially if some harmonic voltage/current is close the resonant frequency.

To attenuate the possible resonances caused by the high-order power filter, whether an LC or an LCL filter are used the closed-loop inverter system with passive damping or active damping schemes should be adopted [19-20].

In view of the suppleness and the cost, it mainly deals with LCL filter hardware circuit itself, so that sometimes the passive damping method is more attractive than the active damping.

Notice that bandwidth is always limited so that for certain frequencies active damping may not be able to actuate. Nevertheless, it is a challenge to balance the power

losses or to have the satisfactory damping effect and to have the harmonic attenuation when selecting the damping parameters for a high order power filter [21]. Passive damping is achieved by adding a resistance in series or in parallel with the capacitance as presented in next subsections.

The purpose of using damping is to reduce the value of resonance frequency. It is often easy to achieve by inserting a resistance in parallel or in series with the capacitor as shown in the two figures below.

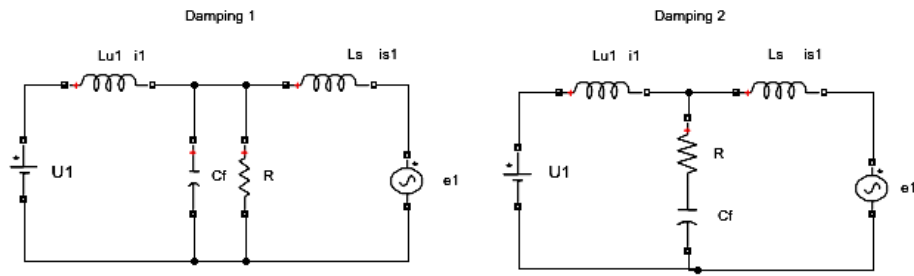


Fig. 2: damping R with  $C_f$  parallel (damping 1) ; damping R with  $C_f$  series (damping 2)

The damped R in LCL filter is inserting to have the resonance, we can write this equation :

$$\frac{1}{2\pi} \sqrt{\frac{L_{u1} + L_{us}}{L_{u1} L_s C_f}} \quad (10)$$

### 1 Maximize Attenuation of Switching Frequency Current

As is shown in Figure 2, The transfer function  $G_{1i}(s)$  related to the converter output voltage  $u_1$  and converter current  $i_1$ ,  $G_{2i}(s)$ , the transfer from  $u_1$  to grid current;  $H_{21}(s)$ , the transfer from  $i_1$  to  $i_2$ , can be described as:

$$G_1(s) = \frac{i_{e1}}{U_1} = \frac{\left(\frac{1}{L_{u1}}\right)(s^2 + \frac{1}{L_{u1}C_f})}{s(s^2 + \frac{L_{u1} + L_s}{L_{u1}L_sC_f})} \quad (11)$$

$$G_{2is1}(s) = \frac{1}{s(s^2 + \frac{L_{u1} + L_s}{L_{u1}L_sC_s})} \quad (12)$$

$$H_{21}(s) = \frac{i_1}{i_{s1}} = \frac{1}{s^2 + \frac{1}{L_sC_f}} \quad (13)$$

The transfer function of converter side inductor from voltage to current is:  $G_1(s) = 1/L_{u1}(s)$ . As is shown in Figure 2,  $G_{2i_{s1}}(s)$  and  $H_{21}(s)$  have the same amplitude and frequency characteristics after the resonant frequency. For high frequency switching ripple current,  $G_1(s) \approx 1/L_{u1}(s)$ , it is extremely important to choose an appropriate converter side inductor  $L_1$ . From the view of circuit, for high frequency current, filter capacitor  $C$  is equivalent to short-circuited.

The switching frequency ripple current is determined by  $L_{u1}$ . Therefore, the inhibition of ripple current is the first issue to be considered when designing the converter side

inductor  $L_{u1}$ .

The LCL filter transfer functions of line side current and inverter input voltage in a grid-connected mode of operation with series and parallel damping resistance are given in equations (11) and (12) respectively. From the transfer functions, by analyzing those equations, larger series resistance values can give better damping, as can be seen from the transfer functions after damping in equation (13).

### 2 Representation of the simulation results

Parameters of damping LCL filter

parameters	Values
$L_s/\mu H$	143
$L_{d1}/\mu H$	540
$C_f/\mu F$	115
$R/\Omega$	0.5
Frequency (Hz)	50
$F_s$ (Switchingfrequency) KHz	3
Voltages V	650/220

Tab. 1: Parameters of damping LCL filter

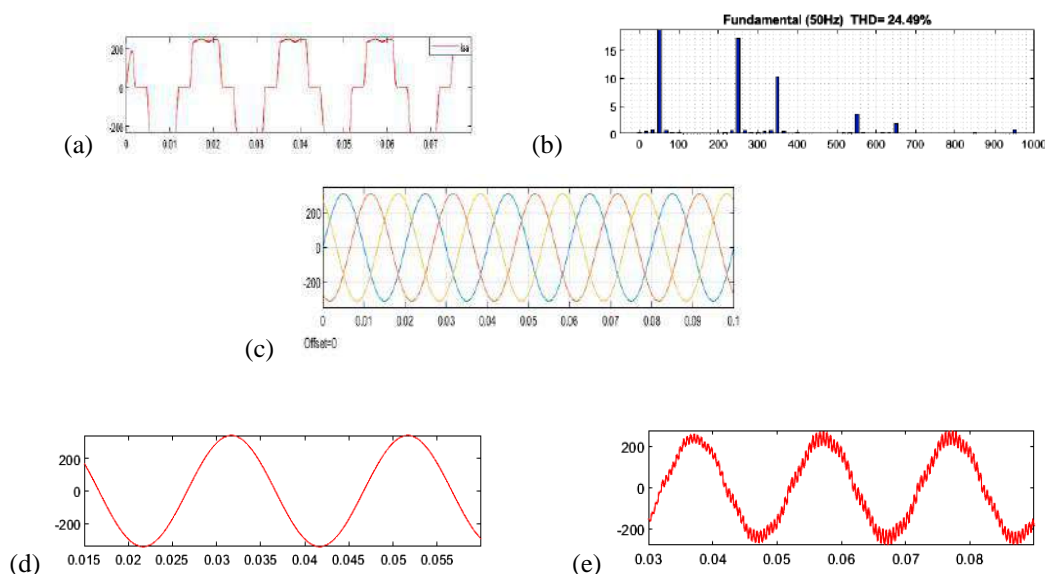


Fig. 3: Harmonic Waveform (a),(b),(c),(d),(e) of LCL Filter

Fig. 3: (a) shows load current  $i_{sa}^*$  whereas Fig. (b) is illustrated that THD of 24.49% is measurable when damping resistance is connected in parallel with LCL filter. It is proved that, the parallel resistance is the bridge effected arrangement, at the inverter-grid connection where this R will help to increase the time constant of the filter. Fig. (c) Show entrance voltage.

The current waveform without damping resistance is high THD due to non-quality signal that is effected on the inductor-capacitor. However, current waveform after filler by LCL filter with the combination of the R has improve the quality of the signal as shown in Fig. 3: (d).

#### IV. CONCLUSION

In this article, we have presented compensation solutions for this harmonic pollution. Several traditional

and modern clean-up solutions were presented. we have shown that the classic solution based on passive filters is often penalized in terms of clutter and resonance. On the other hand, the use of parallel active filters and series with their combinations presents itself as the best solution to date for all types of disturbances that may appear in the electrical grid.

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# Valuation of Environmental Education Applied to Payment for Urban Environmental Services in State of Amazonas Legislation

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**Abstract**— Interest in the economic valuation of environmental resources for remuneration for their preservation demonstrates that Payment for Environmental Services (PSA) is considered the ideal model of sustainability because it understands that ecosystem goods and services are dependent on the economy. In the context of the urban ecosystem, the study of the valuation of environmental education and PES arises as an opportunity to determine the economic value of an environmental resource and to estimate its valuation in relation to other available goods and services, describing to whom they are offered and to whom. are the beneficiaries. The study addressed Law No. 4,286 of December 1, 2015, which establishes the Amazonas State Policy and the Environmental Services Management System, whose focus was the analysis of the PSA of the State Legislation, outlining the criteria and instruments of valuation of urban environmental services emphasizing the valuation of environmental education. In the construction of the environmental education valuation taxonomy, the tabulation model of the economic instruments of the Urban Environmental Services Payment (PSAU) was used to compose the Urban Environmental Services (SAU) matrix applied in the environmental valuation, based on the evaluation model. denominated as Economic Value of the Environmental Resource (VERA). PSA serves as a framework for discussions of participants' conflicts of interest using the taxonomy model of valuing environmental education. Entities involved in public policy and economic decision-makers are recommended to understand the value of environmental goods and services.

**Keywords**— Environmental Resources, Sustainability, VERA, Taxonomy.

## I. INTRODUCTION

With the emergence of large cities and the incorrect disposal of waste, a major environmental problem was triggered, generating mostly negative impacts on the environment due to human consumption. Thus, in order to optimize effective actions to remedy these impacts, the National Solid Waste Policy (PNRS) was created. After years of processing in the Federal Legislature, on August 2, 2010, Law No. 12,305 was approved and entered into force instituting the PNRS [1].

The PNRS establishes principles, objectives, instruments - including applicable economic instruments - and guidelines for integrated management and solid waste management, indicating the responsibilities of generators, public authorities and consumers [1]. Moreover, it has as one of its principles “the recognition of reusable and recyclable solid waste as an economic and social value asset, generator of work and income and citizenship promoter” [1].

Thus enabling the reuse of materials, reducing the extraction of raw materials and reducing the amount of garbage made to the final disposal, with opportunities for income generation and social inclusion, establishing the valuation of a payment for environmental services, which by definition are the activities, products and processes that nature provides to us and that enable life as we know it can occur without higher costs for humanity [2].

Payment for Environmental Services (PSA) is based on the recognition that nature provides a range of services that benefits society and recognizes that technological and scientific advances, despite having taken immense expansion, can complement, but always replace environmental goods and services. It also points out that these services are generally not preserved, given the lack of economic incentives for their provision [3], also mentions that the damage has already been accounted for by some countries by the scarcity of supply of certain environmental services.



The ecological economy approach tried to shape economic institutions to the physical characteristics of ecosystem environmental services, prioritizing ecological sustainability and fair distribution and requiring a multidisciplinary approach [4].

The term Urban Environmental Services (SAU), is already used in the literature focused on urban services that have an interface with the environmental issue. SAU can be associated with public services as well as other urban activities, such as the correct disposal of solid waste and the recycling of municipal waste [5].

The PSAU is associated with activities carried out in the urban environment that generate positive environmental externalities, or minimize negative environmental externalities, from the point of view of the management of natural resources, risk reduction or the enhancement of ecosystem services [5].

The relationship of environmental services is always subject to change, due to the possibility of new environmental problems, and, consequently, new demands for environmental services related to such problems [6].

In the last decade, the PSA market has gained relevance worldwide, being pointed out as a promising instrument for environmental management at different scales and complementary to traditional command and control mechanisms, reversing direct benefits for persons or private and governmental institutions that provide these services [7].

Combined with the PSA, the environmental valuation presents itself with a set of methods that allow quantifying the benefits and harms resulting from the use and modification in the amount of available natural resources, allowing a cost-benefit analysis in the evaluation of public policies [8].

Based on this assumption, the study of the Valoration of Environmental Education and Payments for Urban Environmental Services emerges as an opportunity to determine the economic value of an environmental resource and estimate its valuation in relation to other goods and services available in the economy and describe to whom they are offered and for whom they are benefited.

In the local case, the study will address Law No. 4,286 of December 1, 2015, which establishes the Amazon State Policy and the Environmental Services Management System, in which the focus will be the PSA analysis of State Legislation, schematizing the criteria and instruments valuing urban environmental services with an emphasis on valuing environmental education.

## II. MATERIALS AND METHODS

The methodology used to perform the respective study comprised the bibliographic review through books, theses, dissertations, specialized journals and analysis of legislation in force in Brazil, published between 1988 and 2018. In addition, a study analysis of the application of the PSAU based on the reference research report on payments for environmental services for the management of solid waste was carried out [5].

In order to carry out the survey of concepts on environmental services and the study of the economic instrument of the PSA, the following authors were used: [3], [9], [10], [11], [12], [13] and [14].

The study cited comprises the analysis of Payment for Urban Environmental Services of the IPEA as a proposal for modeling of a taxonomic matrix of environmental education valuation applied to the PSAU under the State Environmental Services Payment stemming legislation from Amazonas.

In the process of elaboration of the taxonomy of valuing environmental education, the tabulation model of PSAU financial instruments was used, using the Microsoft Excel application to compose the SAU matrix by applying the environmental valuation to the environmental valuation of the assessment denominated by Economic Value of the Environmental Resource (VERA) de [15].

$$\text{VERA} = (\text{VUD} + \text{VUI} + \text{VO}) + \text{VE} \quad (\text{eq 1})$$

Where:

VERA: Economic Value of the Environmental Resource

VUD: Direct Use Value

VUI: Indirect Use Value

VO: Option Value

VE: Value of Existence

In the Legislation of Payments for Environmental Services of the State of Amazonas, the definitions and principles of environmental services will be analyzed, which will be confronted with the mechanisms of the economic instruments of PSA proposed by the authors mentioned, aiming at the public interest in achieving a proposal for a model for valuing environmental education applicable to PSAU, demonstrating a VERA taxonomy for evaluation.

## III. RESULTS AND DISCUSSION

Currently, the world tends to exploit natural resources, exceeding the capacity to renew the system and provide environmental services, requiring high investments, so that damage is reversed. Damage can be resolved by advancing

society's awareness of environmental knowledge and establishing proposed regulations of public interest organizations [9].

The mechanisms of Payments for Environmental Services (PSA) have stood out as a complementary economic instrument for the containment of degradation, for the promotion of conservation activities, in addition to the recovery and sustainable use of ecosystems [9].

Based on the synthesis of the Millennium Ecosystem Assessment Report, prepared by the United Nations research programmer on environmental change and its trends for the coming decades, the Millennium Ecosystem Assessment began discussions, which five years later they were readapted by [5], where the main types of environmental services that could be associated with PSA proposals were listed in Table 1.

Table 1 - Main Types of Environmental Services

CATEGORIES OF ENVIRONMENTAL SERVICES			
SUPPOR T	REGULATI ON	PROVISIONI NG	CULTUR AL
These are the natural processes necessary for other services to exist.	Benefits derived from natural processes that regulate environmental conditions that sustain human life	Related to the ability of ecosystems to provide goods.	Intangible benefits obtained from ecosystems .
Example: Soil formation, pollination and seed dispersal.	Example: purification and regulation of water cycles, flood and erosion control, waste treatment.	Example: fruits, fish, honey, firewood, oils, genetic biochemical resources, ornamental plants and water.	Example: Recreation al, Educationa l, Aesthetic, Spiritual, Cultural Heritage Benefits

Source: Adapted from [22].

According to the complementary description on the theme, [5] mentions that most PSA experiences are related to biodiversity conservation, carbon capture, watershed protection and landscape beauty. However, the report indicates that environmental services extend to other perspectives, but plastered by the lack of public policy.

As the approach of the present study is related to urban ecosystems it is necessary to understand environmental services on this perspective. Using [5] it points out the

possible types of environmental services associated with activities in the urban environment that generate positive externalities or minimize negative externalities, and can be summarized as follows in Table 2.

Table 2 - Types of Urban Environmental Services

URBAN ENVIRONMENTAL SERVICES	
TYPES OF SERVICES	SERVICES PROVIDED
Correct disposal of solid waste	Improvement in water quality, reduction of greenhouse gas emissions, reduction of infectious diseases
Urban Waste Recycling	Reduction of water and energy consumption, reduction of water pollution, smaller urban landfill area, greater climate stability
Maintenance of green areas	Increased soil permeability, decreased risk of flooding and landslides
Public transport	Reduction of greenhouse gas emissions
Sewage treatment	Improved water quality

Source: Adapted from [5].

These urban environmental services listed in the previous table clearly indicate actions that mitigate the harmful effects of urbanization on urban ecosystems. Initiatives such as these, as advocated by [5], should be valued and remunerated in the same way that other PSA initiatives are in other non-urban ecosystems.

To set up a schematized PSA mechanism it is necessary to identify and define what types of environmental services provided, so that there is clarity of what will also be paid for by the report from [5].

The focus of Urban Environmental Services and the mechanisms of Payments for Urban Environmental Services (PSAU) are linked recycling activity, waste activities and screening of municipal solid waste made by waste pickers of recyclable materials [5].

Once the focus of the PSAU mechanisms to be proposed is outlined, the assumptions that will guide the instruments are analyzed. The most important assumptions are: (i) payment should go to waste pickers' cooperatives, not waste pickers individually; (ii) payment must be in return for the environmental service provided; and (iii) the mechanisms should reward efficiency in the provision of the environmental service [5].

In order to adapt and ensure the financial viability of PSA mechanisms it is important to seek opportunities to group a large number of environmental service providers,

located in nearby areas, in order to ensure greater scope of actions [9].

The authors above mention that it is necessary to invest in the dissemination of knowledge about methods of economic valuation and its application in a practical way, seeking to sensitize the population and decision makers. In order to adapt this situation, the authors suggest performing information systematizations, knowledge exchanges and training courses in the theme.

The PSA mechanism is the financial payment to private agents as a means to achieve environmental conservation [10]. In view of the problems caused by the exhaustion of natural resources, PSA is an economic instrument that allows to internalize the costs and benefits of preservation between providers and beneficiaries of the contracted services [11].

On this controversy, [10] understands that the basis for the fulfillment of legal duties starts from a more pragmatic argument, such as the lack of effectiveness of the instruments of "command-and-control", but goes through arguments principle such as the notion of the recipient protector, which emphasizes the benefits of conservation for the collectivity, even if due to legally determined practices.

Like all environmental policy, the PSA must have clear and specific objectives so that it can achieve favorable results for both the collective and beneficiaries and providers of environmental services [10]. The principle is to motivate individuals, through cash retribution or not, to execute obligation beyond what the legislation requires, thus representing a plus of what the provider should carry out.

Therefore, the challenge is currently to create strategies for the valuation of environmental services. The environmental valuation consists of giving monetary value to unrecognized environmental goods and services in the markets. [8] defines environmental valuation as determining the economic value of an environmental resource, estimating its monetary value in relation to other goods and services available in the economy.

According to what conventional economic theory, the use of natural resources, almost always generating negative external economies in the economic system. These externalities are not fully captured in the pricing system, as the security of property rights or use of these resources resulting in high transaction costs due to the technical or cultural difficulty of fixing exclusive and rival rights [8].

At the moment a good or service contributes to the economic agent achieving its goal and increasing its satisfaction, it presents valuation, being attributed to

ecosystems two types: intrinsic value and total economic value [9].

Intrinsic values are difficult to measure, as they are associated with the contribution of ecosystems in maintaining the health and integrity of species, regardless of human satisfaction. The total economic value is composed of usage and non-use values. Usage values can be differentiated between direct usage, indirect usage and option values; and the non-use values are composed of the value of existence [9].

Each method of valuing environmental goods or services presents their limitations in capturing the different types of values of environmental resources. The choice should consider the purpose of the valuation, the efficiency of the method for the specific good or service and the information available for each study [8] in Table 3.

Table 3 – Taxonomy of the VERA

ECONOMIC VALUE OF THE ENVIRONMENTAL RESOURCE				
	USAGE VALUE		NON-USE VALUE	
	Direct use value	Indirect Use Value	Option Value	Existence value
<i>Value</i>	Appropriate environmental goods and services directly from resource exploitation and consumed today	Environmental goods and services that are generated from appropriate ecosystem functions and indirectly consumed today	Direct and indirect environmental goods and services to be appropriate and consumed in the future.	Value not associated with current or future use and reflecting moral, cultural, ethical or altruistic issues
<i>Related Services</i>	Provisioning and Regulation Services	Regulatory, support and cultural service	Provision, regulation, support and cultural services not yet discovered	Cultural services

Source: Adapted from [8].

[14] states that interest in the economic valuation of environmental resources, for the purpose of remuneration for its preservation, in reality, reinforces the intersection between law, public policies and economics, because it considers that the attempt to approximation to an ideal model of sustainable development permeates the recognition, that economic productive activity is dependent on goods and services provided by ecosystems.

Despite the existence of funds and financial incentives for the environmental market, there are still obstacles to the advancement of this sector namely: i) high tax burden; (ii) environmental licensing and supervision; iii) access to specific credit lines to the environmental area; iv) ignorance on the subject, such as concepts and classification in accordance with national codes of economic activities; v) lack of organization of the sector; vi) access to technologies; and vii) cultural and market aspects in general [16].

Considering this situation, it is understandable that there are several existing methodologies, and that these are the function of the peculiarities of each situation. It is important to emphasize that, due to local realities, other steps can be inserted to the executor's need, as is the case with an Amazon IAN PSA model, which highlights the importance of valuing environmental education.

The valuation of environmental education precedes the principle of Sustainable Development provided for in Art. 170, item VI, of the Federal Constitution, in which it provides that protection to the environment and economic development must live harmoniously, that is, while seeking development, the rational use of resources should be taken into account described, with the improvement of the quality of life of man [17].

No Art. 1st Of the Brazilian National Environmental Education Policy, operationalized by Law No. 9,795 of April 27, 1999, defines Environmental Education as the processes through which the individual and the collectivity build social values, knowledge, skills, attitudes and skills focused on the conservation of the environment [18].

In this sense, local, national and international strategies have been created over the years to enable the implementation of the valuation of environmental education in all sectors, requiring accountability and transparency during the execution of practices procedures, preparation and application of resources, generating benefits for this system [19].

In the context of the protection of natural resources, it must be recognized that repressive norms and educational actions (environmental education), have not been sufficient and effective to curb the high levels of degradation resulting from enterprises and anthropic activities [14].

The strategy adopted by Brazilian environmental legislation in recent years is marked almost exclusively by the use of command and control instruments, of a repressive and punitive nature, which have not proved sufficiently effective, practical results obtained. Thus, there is an imperative need to complement these instruments, with the creation of awards and incentives, in

order to shape human conduct to be conducted in favors of sustainable development [13].

Payments for Environmental Services break out as a possibility of induction to positively valued behaviors, from the implementation of bonus arrangements to those who, from performing super conforming behavior, corroborate not only with the reversal of environmental damage already occurred, but with the maintenance or increase of ecosystem services understood as direct and indirect benefits provided by nature to man and other species [14].

It is within this context that Payments for Environmental Services emerge as a new tool and innovative alternative through the principle of the provider-recipient, economically efficient and environmentally valid, that can complement instruments of command and control, directing investments and public policies, effectively contributing to achieving the objectives of promoting a quality and sustainable environment for the current and future generations [13].

On December 1, 2015, the law that states the State Policy of Environmental Services of the State of Amazonas was approved (Law No. 4,266/15). After a long process of more than 4 years of preparation and consultation, Amazonas now has a legal device that provides for the collection of resources for the socioeconomic development and the conservation of natural resources. In the same, the law still needs to be regulated for its programs to go into operation with recognition [12].

In the Amazon IAN legislation on PSA in its Art. 1st, item XXIX is mentioned the urban environmental services, in which they must be aligned with Art. 3, items II and XI, which deal with the principles of sustainable development and the receiving provider, respectively [20].

Based on [5], [15] and [12], it was proposed the preparation of the description of the Valoration of Environmental Education and the type of Payment for Urban Environmental Service in the VERA model (Table 4).

Table 4 - Valoration of Environmental Education

<i>Appreciation of environmental education</i>	<b>Mitigation</b>	<b>Awareness</b>	<b>Formation</b>	<b>Tradition</b>
	Dumpers	Biodiversity	Education	Patrimony
	manufacturers	Resource	Technology	Experience
	Consumers	<b>Maintenance</b>	<b>Qualification</b>	<b>Protection</b>
	<b>Recovery</b>			
<i>Type of</i>	<b>Reduction</b>	<b>Alliance</b>	<b>Instruction</b>	<b>Association</b>

<i>urban environmental service</i>	<b>n</b> Reuse Recycling <b>Reverse logistic</b>	Developm ent Harnessing <b>Agreements</b>	<b>n</b> Optimizati on Remediati on <b>Solution</b>	<b>n</b> Preservatio n Conservati on <b>Diffusion</b>
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Source: Adapted from [5], [8] and [12].

Scored in the studies of [12], [13] and [14], it was proposed to elaborate the identification of possible sources of appeal, the applicable economic instrument and the estimated time of return in relation to the Valoration of Environmental Education in Table 5.

Table 5 - Economic Instrument in the Valoration of Environmental Education

VALUATION OF ENVIRONMENTAL EDUCATION APPLICABLE TO THE ECONOMIC INSTRUMENT				
<i>Appreciation of environmental education</i>	<b>Mitigation</b> Manufacturers Consumers <b>Recovery</b>	<b>Awareness</b> Biodiversity Resources <b>Maintenance</b>	<b>Formation</b> Education Technology <b>Qualification</b>	<b>Tradition</b> Patrimony Experience <b>Protection</b>
<i>Resource Source</i>	Private initiative Social initiative	International fund Union fund	Encouraging science Technology incentive	State fund Municipal fund
<i>Economic instrument</i>	Compensation Behavioral	Pactuation Collaboration	Awards Innovation	Intellectual property recognition
<i>Estimated time</i>	Months	Decades	Years	Years

Source: Adapted from [12], [13] and [14].

From the analysis presented, it was observed that payment for environmental services is a recent management instrument, being incorporated into public policy discussions with innovative potential to restore, conserve and preserve environmental resources, warning those involved in public policies and economic decisions not to ignore or neglect the value of environmental goods and services [21].

Based on this assumption, the study of the Valoration of Environmental Education and Payments for Urban Environmental Services emerges as an opportunity to determine the economic value of an environmental resource and estimate its valuation in relation to other

goods and services available in the economy and describe "who are they offered?" and "who are they benefited from?". Thus, serving as a basis for discussion in public hearings as a way to guide conflicts of participation interests, being able to use the Taxonomy model of the Valoration of Environmental Education in Table 6.

Table 6 - Taxonomy of the Valoration of Environmental Education

VERA TAXONOMY WITH A PSAU ENVIRONMENTAL EDUCATION VALUATION				
	USAGE VALUE		NON-USE VALUE	
	Direct use value	Indirect Use Value	Direct use value	Indirect Use Value
Value	Appropriate environmental goods and services directly from resource exploitation and consumed today	Environmental goods and services that are generated from appropriate ecosystem functions and indirectly consumed today	Direct and indirect environmental goods and services to be appropriated and consumed in the future.	Value not associated with current or future use and reflecting moral, cultural, ethical or altruistic issues
Related Services	Provisioning and Regulation Services	Regulatory, support and cultural services	Provision, regulation, support	Cultural services
Appreciation of environmental education	Mitigation Dumpers Manufacturers Consumers Recovery	Awareness Biodiversity Resource Maintenance	Formation Education Technology Qualification	Tradition Patrimony Experience Protection
Type of urban environmental service	Reduction Reuse Recycling Reverse logistic	Alliance Development Harnessing Agreements	Instruction Optimization Remediation Solution	Association Preservation Diffusion



Who are they offered for?	?	?	?	?
Who are they benefiting for?	?	?	?	?
Resource Source	Private initiative Social initiative	International fund Union fund	Encouraging science Technology incentive	State fund Municipal fund
Economic instrument	Compensation Behavioral	Pactuation Collaboration	Awards Innovation	Intellectual prop. Recognit.
Estimated time	Months	Decades	Years	Years

Source: adapted from [5], [15], [12], [13] and [14]

#### IV. FINAL CONSIDERATIONS

Payments for Environmental Services are of economic value, since their lack of availability changes the levels of comfort and production of society. Stressing that the implementation of this environmental management instrument should be carried out considering ecological principles and understanding of the detailed functioning of each component.

It is also noteworthy that it is necessary to expand investments in ecological infrastructure made by government organizations in the federal, municipal and state levels, in order to encourage sustainable Environmental Education practices, through economic incentives, operating with social control in partnership with the instruments of command and control with civil society.

The Valorization of Environmental Education is an important awareness-raising tool, which, if combined with the principle of the provider-recipient, can stimulate and enhance environmental conservation actions, encouraging more providers of environmental services in the optimal maintenance of sustainability.

Considering sustainability regarding the way environmental services are calculated, there is still a non-explicit condition to actually assess its value from resource collection to the end of the production chain by adding Environmental Education as awareness-raising instrument,

which is still difficult to value by presenting itself as something that is not feasible the reality of a PSAU.

Thus, this brief study added relevant information, understanding the need for exhaustive discussions so that in fact the valuation of environmental services occurs in order to promote sustainability, in addition to the inclusion of the PSAU fairly, so that they can public and private policies are implemented conducive to better management of services related to the urban environment.

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# Inventory Process Cost Reduced With RFID, Simulation and Open Source Technologies

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**Abstract**—One of the possibilities for companies to seek cost reduction is through the improvement of their processes. RFID (Radio Frequency Identification) can make this possible for its traceability of company assets, as well as the development of IoT projects, which are characterized by the generation of large amounts of unstructured data. RFID is widespread worldwide and research on the subject has grown in Brazil. However, the implantation of this technology, in Brazilian companies, faces its associated costs. Based on those arguments, this paper presents the development of a system based on RFID technology and open source tools (NodeJs, Python and MongoDB), as well as simulating RFID antennas in a virtual environment (Rifidi). Indeed, it is possible to reduce the costs on the development of the system, since it was not necessary to purchase any equipment or software licensing.

**Keywords**—Data Engineering, Data Science, Internet of Things, Inventory Management, Radio Frequency Identification.

## I. INTRODUCTION

Nowadays, humanity has lived in a technological advancement never seen in history. In this context, the Internet of Things (IoT), Internet of Objects aims to allow the full connection between the real and virtual worlds [1][2].

IoT is the mix of technologies such as radio-frequency identification (RFID), sensors, Global Positioning Systems (GPS) and mobile devices. Figure 1 shows a relation among those technologies associated with IoT.

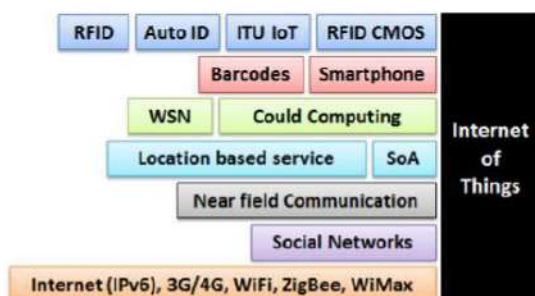


Fig.1 – Technologies related to IoT. (Source: [3])

As shown in Figure 1, IoT can be represented by a set of technologies such as RFID, ITU (International Telecommunications Union), CMOS (Complementary Metal-Oxide-Semiconductor), WSN (Wireless Sensor Networks), SoA (Service oriented Architecture), NFC (Near Field Communication), Social Networks, etc.

IoE, as shown in Fig.2 compasses Internet of Everything, whereas IoT is only composed of “things”. Besides that, IoE also extends to business and industrial processes [1].

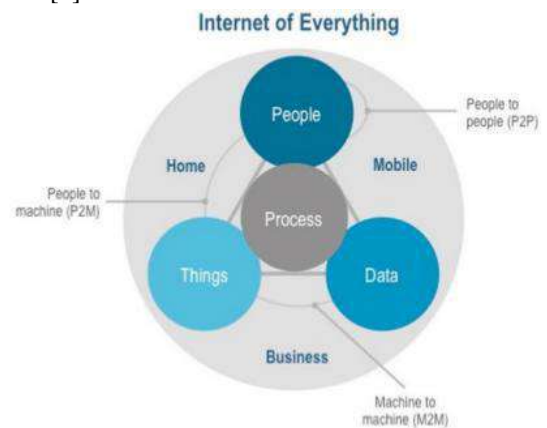


Fig.2 - Internet of Everything (IoE) [1].

Also, cities may use IoE along with ‘Big Data’ processing systems for controlling road traffic flow, monitoring agricultural growth, education and healthcare, making it as ‘Smart Cities’ [1].

IoNT concept (Internet of Nano Things) arises when nano-sensors are embedded in several objects through the use of nano-networks [1], it was introduced by [4], using nano-antennas based on graphene operating at Terahertz frequencies [5].



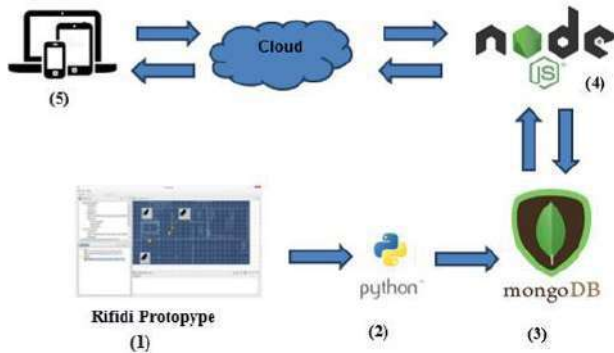


Fig.5 – Proposed system architecture

First, an interface was developed in Python (2), which reads the simulated data (RifiDi) (1) of RFID equipment. After reading the data, they are stored in a MongoDB (3) database. The web system was developed in a NodeJS server (4), which can be accessed through any mobile device (5), since the screen design must be responsive.

The code developed for the web environment was based on the MVC standard. Figure 6 shows this project directory structure:

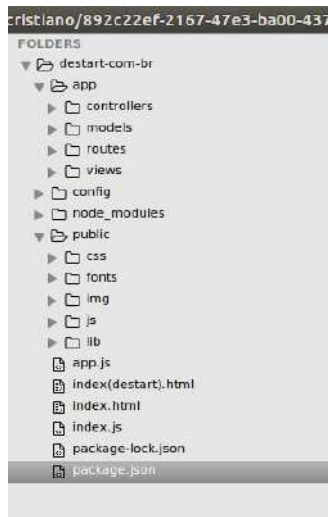


Fig.6 – Folders structure of a web project ()

The starting point of the system is the "app.js" file, by which the system is initialized, as shown in Fig. 12, where the "nodemon" command is executed by the Ubuntu operating system terminal.

The web system, as previously said, the backend was developed in NodeJS and the front-end through Bootstrap (version 3.3.7), which made it possible to prototype responsive screens quickly. The following screen shows the login screen (Fig. 7), the dashboard (Fig. 8) and the Products register (Fig. 9):



Fig.7 – Login system screen

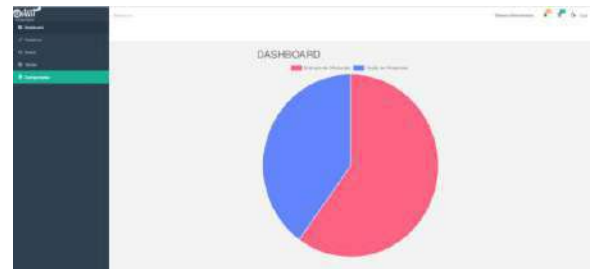


Fig.8 – Dashboard screen



Fig.9 – Products registration screen

As previously explained, for the simulation of RFID devices in a storage environment, the RIFI-prototyper system is used, as can be seen in Fig. 10:

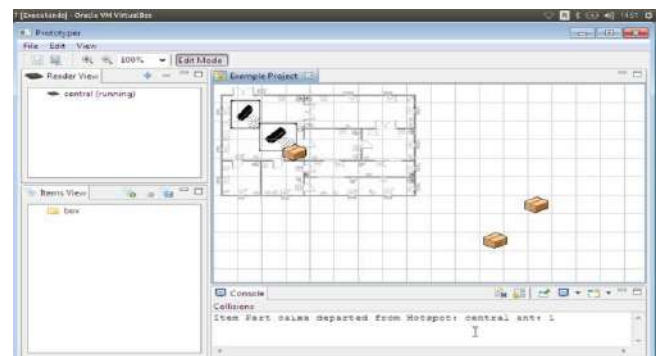


Fig.10 – Storage place simulated by RIFI-Prototyper

To implement this system, it was necessary to simulate another operating system (windows7), since RIFI-



prototype could only be executed through Java in version "1.6.0.29".

The connection with the environment in simulation, as well as the sending of the respective data was made through the Python language. The source code in Python can be accessed at:

[github.com/cristianomoliveira/rifidi-python](https://github.com/cristianomoliveira/rifidi-python)

An example of the resulting simulation data can be seen in Fig.11:

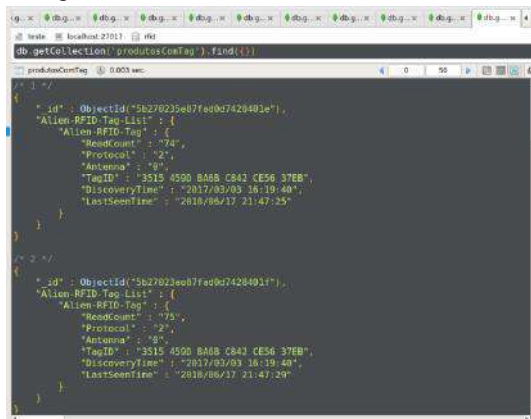


Fig.11 – Data obtained from simulation stored on MongoDB

### III. DISCUSSION AND RESULTS

Table 1 shows a comparison of project costs, where open source tools were used, with other platforms, some of the costs are available in dollars, so they depend on the currency price, the conversion was done on 07/15 / 2018 with a US dollar quotation of R\$ 3.89497.

Table 1 - Tools costs comparison

	Open Source		Proprietary software		
	Tool	Cost (R\$)	Tool	hosting cost (R\$)	License (R\$)
<b>Editor</b>	Sublime	0	Visual Studio	0	0
<b>Databases</b>	MongoDB	0	SQL Server	103	0
<b>Web Server</b>	NodeJs	0	Windows Server 2016 Essentials	118	1,300
<b>Cloud</b>	-	19.25	-	-	-
<b>Total (R\$)</b>		<b>19.25</b>		<b>221</b>	<b>4,300.00</b>

Table 2 - Comparison of labor cost with staff human resource

	Open Source		Proprietary software	
	Labour cost	Cost (R\$)	Labour cost	Cost (R\$)
	Developer (NodeJS)	5,975	5,975	Developer (Net)
<b>Total(R\$)</b>		<b>5,975</b>		<b>5,700</b>

The data in Tables 1 and 2 are estimated, made from queries conducted on the internet, on 07/15/2018. It can be observed that the hosting cost in the cloud generates a reduction of costs in the order of 94%.

The labor force did not suffer a breakdown of around 5% on the date of the survey, and may present larger changes of costs depending on the region of the country and the demand. The workforce related to the Python language was not calculated because the code developed for the project was small and it was made available.

Regarding software licensing, a few comments should be made. For example, in the case of Visual Studio and Sql Server, free versions may be used as shown above, but if purchased, licenses may have the cost around:

- **SQL Standard** - server + CAL - \$ 931 (R \$ 3,854.35);
- **Windows Server 2016 Essentials** (25 users e 50 devices) - \$501 (R\$ 1,928.85);
- **Visual Studio Professional** - R \$ 3,460 (first year).

These licensing costs serve only a basic small business application, but because the project is related to IT, as discussed earlier, the volume of data is huge due to the large number of connected devices.

This can be bypassed if the project is hosted on a server in the cloud. Especially, this project uses a server with Ubuntu operating system, with the cost of \$ 5 (19, 25).

If there is a need to increase the server resources, the relation of costs is shown in Table 3.

Table 3 - Comparison of labor cost with staff human resource

Memory	CPUs	Disc	Cost
2 GB	1	50 GB	\$5 = (R\$ 19.25)
2 GB	2	60 GB	\$10 = (R\$38.50)
4 GB	2	80 GB	\$20 = (R\$76.99)
8 GB	4	160 GB	\$40 = (R\$153.99)
16 GB	6	320 GB	\$80 = (R\$307.98)
32 GB	8	640 GB	\$160 = (R\$ 615.95)
64 GB	16	1.288 GB	\$320 = (R\$ 1.231.90)
128 GB	24	2.560 GB	\$640 = (R\$ 2,463.81)
192 GB	32	3.840 GB	\$960 = (R\$ 3,695.71)

In this way, a financial chart was developed for a project with a duration of 6 months for the development of the system, comparing an Open Source architecture and with Proprietary Software:

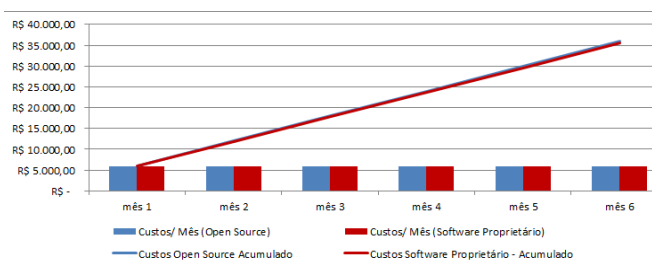


Fig.12- Costs only with labor and hosting.

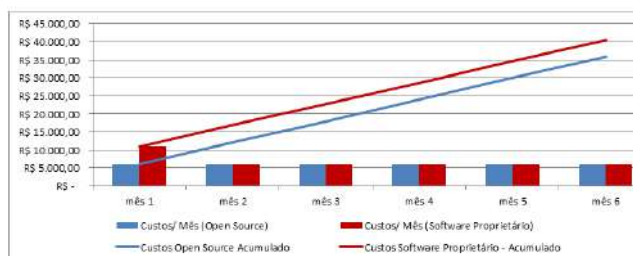


Fig.13- Labor costs, hosting and acquisition of RFID equipment.

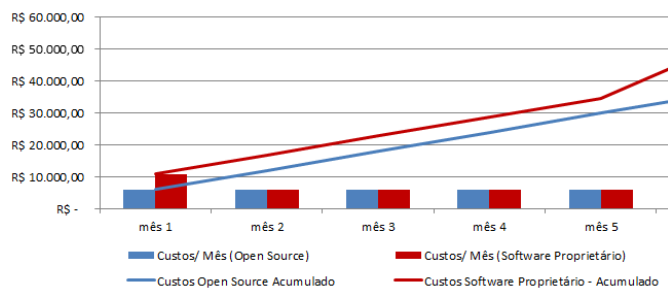


Fig.14- Graph of labor costs, hosting, acquisition of RFID equipment and licenses.

As can be observed in Fig. 11, comparing only the labor and the host costs, the difference is insignificant (increase of 0.1%), in which the Open Source project cost is higher related to the project. Proprietary Software, noting that this variation may change more or less depending on market demand and the region of the country.

Analyzing Fig. 12, there is an increase in costs at the beginning of the Proprietary Software project due to the acquisition cost of RFID equipment (R \$ 5,000) at the beginning of the project, in which the Proprietary Software Project would exceed the other project in 11 , 53%, remembering that depending on the equipment to be purchased this variation may be higher or lower.

The last case to be analyzed is Fig. 13, where software license costs were added, i.e., acquisition of licenses: SQL Standart. Windows Server, Virtual Studio Professional.

Therefore, the cost of the Proprietary Software Project would exceed the other by approximately 27.9%.

Remembering that the licenses of these servers were the most economical found such as Windows Server that is aimed at small businesses (only 50 devices).

MongoDB really proved to be efficient with regard to the storage of IoT project data. The negative point related to the use of this database would be the greater complexity, and difficulty in maintaining the code, when there are more relationships between the objects.

Because of this difficulty, in a team development environment, it is suggested that a code layer that consists of validating the data before its persistence is performed by an experienced developer.

#### IV. CONCLUSION

RFID technology is widespread worldwide, especially in developed countries due to its applications in many areas such as industry, livestock and health throughout the supply chain and on tracking of assets, people and animals. In recent years the technology has received new applications in Brazil, still few compared to the mentioned countries. Although the notable improvements RFID brings to organizations, the development of this type of system in the country it is considered a great obstacle for its high implementation cost of the equipment involved.

The proposed system was developed through open source technologies, which have been used by large corporations around the world such as: NodeJS, Python, Bootstrap, MongoDB. Those technologies have proven to be effective in the rapid prototyping of a scalable and robust system for the use of RFID technology, despite the considerable time taken to learn them.

Besides cost reduction achieved through open source technologies, another reduction was through the use of the RIFIDI-Prototyper system, since it was no longer necessary to purchase RFID equipment, such as antennas, which could make this project impossible to carry out. We reduced the total cost of the project in 27%.

The database was efficient on the storage of the large volume of data read by the antennas, which is common when it comes to IoT related projects.

The negative point on using MongoDB would be the greater complexity and difficulty in maintaining the code, when there are more relationships between the objects. A solution to this problem would be either the use of a specific library, or the use of a hybrid solution, i.e., objects related to sensor data could be stored in MongoDB, whereas other objects in another type relational databases.

Another point to emphasize in this research was the difficulty for the development of the bibliographical review for this paper, due to the great amount of articles

related to the term RFID, since the technology was developed around the Second World War.

Data analysis, from the ones collected in Scopus database, we used R software along with Bibliometrix library, besides Gephi.

In addition to the possibility of accessing the system in mobile devices as a cell phone, it was noticed the need to access the system through desktop devices since the employee needs to wear gloves often, for that, a RaspberryPi 3 was used, in which the Linux, connected to a keyboard, mouse and monitor, thus keeping the cost reduction of the system.

Finally, for a future work, we suggest the development of other systems based on the same architecture approached here, related to smart cities with the persistence of data in the blockchain.

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# Hydrogen generator, an application with internal combustion engines

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**Abstract**— This Paper present the steps to build an hydrogen cell emphasizing the need to use as a renewable energy source, being applied with internal combustion engines, as an efficient result obtained through electrolysis. Data presented in tables and graphs were collected and analyzed, both for urban streets and for highways. The tests in urban streets the vehicle presented 15.5 kilometers per liter of fuel (km/l), with efficiency of 38% compared to ordinary fuel, as well as on highways, made 18.9 km/l, with 33%, respectively acting at 60.5 kilometers per hour (km/h), the gain is due the fact that the system, which is directly linked to the generator currents and voltages consumption, implying that the higher current consumption, greater will be the gas generation. The results of the project show the veracity of achieving economy, yield and efficiency through hydrogen, allowing the possibility of implementation not only in vehicles but, in all varieties of engines available on the market today, and the substitution for other sources.

**Keywords**— *Electrolysis, Fuel, Efficiency, Cars.*

## I. INTRODUCTION

Currently, new ways to obtain a clean and renewable energy source are being sought, as the environmental crisis intensifies each year. Therefore, one of the most questioned cases is car pollution, since they emit tons of carbon monoxide (CO) every day contributing to global warming and the greenhouse effect.

In this condition according to [16], some companies present solutions to reduce or eliminate the emission of pollutant gases, notably Tesla company, with the production of fully electric vehicles, with zero air pollution, and with support for large storage capacity and generation of energy.

Many companies are still using fossil fuels to produce energy, and some of them are not care about environmental degradation or the fact that their materials are depleted, 75% of companies do not seek improvements to eliminate pollutant gases from their cars, or even investing in hybrid cars, to generate savings and less consumption of exhaustible sources [7].

According to [4], the principle of operation of engines is becoming archaic, because the method used still emits many gases in the atmosphere and uses a lot of energy to produce movement, basically the engine works as follows: intake, explosion and exhaust, the energy is released to make movement of the pistons, however, the current way of energy generation is more efficiently when compared to past times.

Hydrogen is a pure and non-polluting element, can be applied in many sectors of the industry, among them, electric power generation, raw materials to heat generation, are also used in the chemical, petrochemical, steel companies and food sectors. There are several ways to obtain hydrogen through electrolysis, solar panels, wind energy and biomass generation [14].

In the mechanical sector, hydrogen can also be applied to diesel engines used for power generation, including river and automobile sectors for fuel production. Studies show that only hydrogen could be used as a single source of energy, receiving power from a renewable source [1].

Consisting of a simple architecture, the cost of production is viable when compared to the amount the consumer would spend in five years using fuel. However, with market competition and scarce raw material, the price of a barrel of oil has been rising each year, causing variation in the final value of fuels and derivatives, pointing to need for robust products that generate more economy [17].

Hydrogen is clean, and do not damage the combustion chamber, its heat level is higher compared to ordinary fuels. Therefore, hydrogen results in a much higher explosion power, reaching up to 80% efficiency and 50% more of yield, with values that vary for each type of implementation, and the type of construction [15].

The hydrogen generator is made up of positive and negative cells, and depends on the power supply of a



battery to make the electrolysis, which is submerged by water. However as it is a natural agent, environmental impacts are reduced by mixing hydrogen and fuel. One of the important point to be mentioned is the formation of electrolysis like the main basis for obtaining hydrogen [18].

The objective of this study is to describe the benefits of implementing the hydrogen generator in engines, seeking economy, durability and performance, without the need to generate impacts for the environment, because it can reproduces itself naturally.

## II. MATERIAL AND METHODS

The research method used was the explanatory and quantitative type relying on data collection. According to [8], explanatory research seeks to record the facts, analyze, interpret and identify their causes, being able to raise theories, logical deductions and define broader laws.

However quantitative analysis is related to numerical data collection, predictable estimates with results able to represent the data collection.

### 2.1 Data collection

The car that has used to this data collection is owned by the manufacturer Renault, with 1.6 and 16-valve engine, acting on 4 cylinders with a power of 110 Horse Power (HP), its fuel consumption is according to the type of road, for which it was developed. The vehicle has autonomy of 8 km/l on urban roads and 10 km/l on highways, using gasoline as fuel.

The prototype was made from 316 L stainless steel plates, measuring 11 x 11 x 0.1 centimeters (cm), with access to two holes in the middle that will be available for water and gas with a diameter of 2 millimeters (mm) (Fig1). The model has 3 plates in total, adhering to 2 positive and 1 negative poles, and the plates are mounted in parallel and separated by seals, so that the liquid does not leak. For generator protection two acrylic sheets are used which measure 120 x 120 x 10 mm.

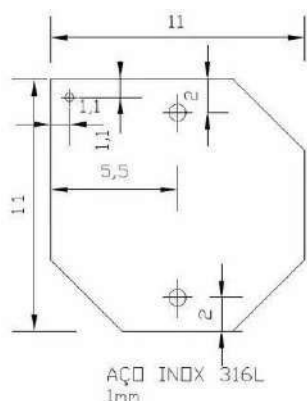


Fig.1: Inox 316l plate measurements.

The explosion system consists of two valves and the spark plug, one open for fuel injection and the other to the oxygen inlet, the valves opening must be at the right time to provide the right operation, oxygen inlet is admitted by the Throttle Body Injection (TBI), where there are a measure of air purity is also made so that the gasoline dosage is appropriate for the mixture.

Therefore, hydrogen is injected through the tube that goes into the TBI, reducing the gasoline dosage as oxygen enters the system, informing to the on-board computer to calculate the new range of kilometers traveled per liter[6].

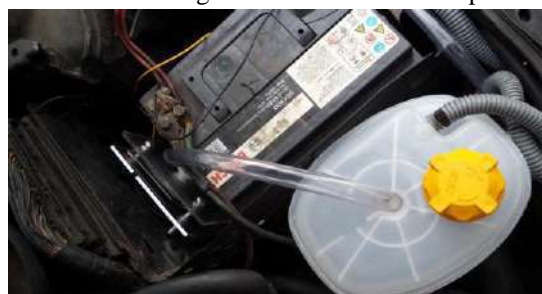


Fig.2: Hydrogen generator installed.

The drive system is made by a relay, whose operation is linked to the ignition signal, when received by the system, releases the generator access to battery power through the electromechanical process of switching terminals, allowing the generator start and inform the signals [2] (Fig3).



Fig.3: Relay drive system

The digital panel inform the current consumption in the full system and the working voltage value for analysis in relation to the trip data. The test starts when the car tank is empty, the fuel is supplied for route data collection, on the road and in urban places, with the generator running, in the panel is informed the amount of fuel consumption in the engine, providing the correct measures for a quantitative analysis [11].

The prototype is related to a digital fuel control concept, where the control unit (UC) receives the data collected by the sensors in the vehicle, and it is calculated to show in the onboard computer. [9] points out that with the advent of electronic injection, improvements in (UC) have enabled more advanced features so that the driver



has more control over his vehicle, obtaining more information about what happens in operation.

The car tunes to km/h averages, where (UC) calculates tire tread to provide information on the digital dashboard, as well as providing km/l, indicating the basis of kilometers driven by fuel consumption [3] (Figure 4).



Fig.4: Digital dashboard showing the consumption

### III. RESULTS AND DISCUSSIONS

The way the TBI absorbs the gas to make the combustion inside of chamber, resulted in small losses due to the isolation of the throttle body, however the obtained data still favors the fuel economy,

The chemical reagent used proposed a great efficiency in the generation of hydrogen dissolved in the solution KOH (Potassium Hydroxide), proving to be effective and harmless in the reaction process. [10], state that there is only efficiency in hydrogen generation in formic acid solution (CH<sub>2</sub>O<sub>2</sub>), able to remedy the oxidation of steel, on the other hands it is stated that by facilitating the release of the acid faster, the material tends to prolong the use time.

The test presented data on mileage gains, and the hydrogen gas mixed with fuel resulted in a reduction in CO<sub>2</sub> emissions into the atmosphere, so was used less fuel in the engine to achieve the goal. [5] claim that the hydrogen cell is much more operative compared to internal combustion, and reduces about 50% of carbon dioxide emissions into the atmosphere (Tab1).

Table. 1: Route data for kilometers driven, with generator and fuel.

Fuel	Street (Km/l)	Highway (Km/l)	Speed(Km/h)
Hydrogen Gas and Gasoline	15,5	18,9	60,5
Gasoline	9,7	12,6	60,5

According to the data obtained, it is easy to see the increase of the path performed per liter, both on the highway and in urban centers streets, the path performed on the urban road with hydrogen and fuel has a 38% increase compared to the use just the standard fuel, while on the highway 33% are obtained, the gain variation becomes high with a difference of 5%, because are factors

that link losses in urban centers in relation to environmental variables, while on the highway the result indicates that the disturbances that influence the system are smaller.

Being self-sufficient in its own generation of complementary fuel, the vehicle has a higher torque, according to [19], the hydrogen in the act of ignition reaches up to 585 °C, being higher than the point which gasoline burns, which default is 257 °C. Analyzing the data, the mixture can reach approximately 842 °C.

The prototype acts in the generation of hydrogen, through the applied voltages and currents, resulting in the temperature variation of the plates, presenting standard ambient temperature at the moment of actuation. The indicated data refer to the energy consumption that the generator needs to supply the engine fuel demand (Tab2).

Table. 1: Current consumption and working voltage in the prototype.

Plate 316L	Current (A)	Voltage (V)	Speed (Km/h)
1 Pole	0,75	12,1	60,5
2 Poles	1,5	6,05	60,5

Current and voltage are directly related to hydrogen generation, resulting in a set of factors related to the mileage gain rate, so when diversifying the number of plates the current will vary because current consumption does not depend on the need of the engine but the number of plates to each type of engine.

If each plate consumes 0.75 amperes totaling 1,5 amperes on average 52% efficiency, it should be noted that gas generation must be attributed to total current consumption. Thus the choice of plate quantity varies according to the diameter of each engine cylinder.

The hydrogen prototype with low current and voltage consumption in the system indicates that if the car were fully hybrid, it would not use the alternator as a secondary source to provide battery power. However it could be replaced, both by a solar panel and [12] states that solar panels are very important for more efficient power generation, calling a direct generation called photo electrochemistry, resulting in prototype and panel interaction, directly feeding the generator with continuous loads.

Due to the production process, when analyzing the gas production management in the reservoir, there was hydrogen accumulation, consequently after removing the high pressure cap of the reservoir, with engine turned off, an accumulated gas content was observed. According to

[20], hydrogen storage is still a factor to be analyzed, this due to temperatures and pressure variables, however it points out that the simplest forms of storing hydrogen are liquid and gaseous forms, where the gaseous form requires that the environment is at high pressures and low temperatures.

Alkaline water was indicated for the use of electrochemistry, as a result of its purity factor, neither contaminating nor allowing the reduction of generator efficiency to decrease. Therefore water from rivers, taps and rain are not suitable for the use of the generator, resulting in contamination and low hydrogen yield. According to [13], the diluting agent KOH, in alkaline water whose temperature occurs between 60 to 90 Celsius degrees (°C), is capable of maintaining the water purity level, allowing to lower, with lower speed, the aqueous solution of the system. Figure 5 presents effective factors in the water yield in the obtained system.

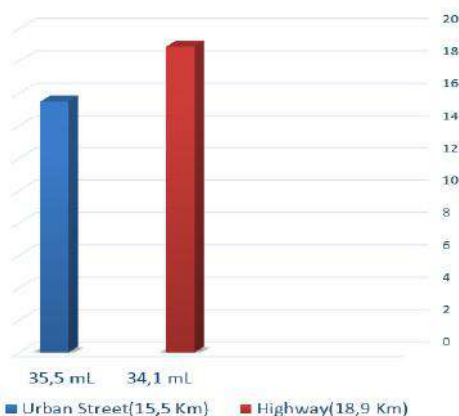


Fig.5: Yield from alkaline water in composition with potassium hydroxide.

Thus the variation and tests made in both situations promoted minimal differences in relation to the total liquid storage, enabling the generator to offer up to 873.23 km in VU and 1108.50 km in RO. With two liters of water, the limit of all consumption of the stored liquid is indicated. Equation (1) urban streets (VU), and (2) to highways (RO).

$$0,0355l - 15,5km \text{ (1) VU} \tag{1}$$

$$0,0341l - 18,9km \text{ (2) RO} \tag{2}$$

Through the rule of three, relating kilometers (km) with water consumption, obtaining the total result (3; 4).

$$x = 2l * \frac{15,5km}{0,0355l} = 873,23 km \tag{3}$$

$$\tag{4}$$

$$x = 2l * \frac{18,9km}{0,0341l} = 1108,50 km \tag{4}$$

The generator presented a total of 71% efficiency and 25% yield, indicating factors that point to a good performance, but the data also reflect on the vehicle power where there was shorter starting time and better track fluidity.

#### IV. CONCLUSION

The prototype model resulted in improvements in the engine system, indicating factors of fuel efficiency, power and reduction of pollutant emissions into the atmosphere. It was realized that for each type of system must have a suitable design, to be implemented in different types of engines.

Noting the difference in water consumption compared to ordinary fuel, it is clear that the need to obtain energy efficiency is totally linked to the economic factor, due to the price of fuel in relation to water, where it is important to emphasize the performance generated by aqueous solution, making it more feasible than gasoline.

The results show that hydrogen has a very high explosion factor, makes it feasible for implementation in engines, creating possibilities to build a hybrid vehicle or totally free of fossil fuel. As an electrolytic generator, it is possible to implement together with solar panels, wind power, and biomass generation, due to direct current operation can also meet the needs of people living in isolated areas using electricity generators.

Finally, this hydrogen generator study presents the importance of efficient and renewable energy generation, aiming at the creation of products with new technologies, considering the environmental factors and reducing the consumption of fossil fuels to ensure future sustainability.

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# Application of surfactants and biosurfactants in the bioremediation of multi-contaminated soils: microcosms and bench scale bioreactor trials

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**Abstract**— In the present study, in order to rehabilitate areas multi-contaminated by oil and metals, bioremediation, coupled with bioreactor technologies, was applied. Firstly, a microcosm trial was performed using two synthetic surfactants, TRITON X-100 and TWEEN 80, and a biological one, JBR210, at two different concentrations (0.1 and 1.0 mg. g<sup>-1</sup> soil) for 42 days to select the two best surfactants of different natures in order to scale up a solid-phase bench bioreactor under controlled operating conditions. The results obtained with the use of Tween 80 and biosurfactant JBR210 at a concentration of 0.1 mg. g<sup>-1</sup> soil, with humidity corrected to 70% of WHC, were a 25.5% and 30.00% removal of THP (Total Petroleum Hydrocarbon), respectively, while control with humidity adjustment alone achieved 20.5% removal. The evaluation of the behavior of microbial activity through next generation sequencing (NGS) of the soil was performed before and after the different treatments in the bioreactor, where the control showed an increase of Actinobacteria population. The treatments with surfactants showed an increase of Alphaproteobacteria and Sphingobacteria in this same period, and a decrease in the abundance of Actinobacteria. The diversity measured by the Shannon index (H') showed a significant decline for the Tween 80 treatment, with no sign of recovery, unlike JBR210 biosurfactant treatment. Therefore, the application of surfactants of different natures has different effects, where both promoted the reduction of diversity, whereas the biosurfactant JBR210 showed a tendency to increase after 42 days, indicating a less intense effect, ie. it is better for the environment.

**Keywords**— Bioremediation, hydrocarbon, surfactant, biosurfactant, bioreactor.

## I. INTRODUCTION

Despite the numerous alternative sources of energy available today, oil is still considered the main source of energy and raw material for various petroleum products, including solvents, fertilizers, plastics, paints, pesticides, among others [1]. Due to the widespread use of these compounds, production, transportation, and storage activities have been identified as the main soil contamination routes, as they inevitably involve the risk of accidental spills [2,3].

Due to the harmful effects caused by the contaminants in question, many research and technologies have been developed and applied in order to minimize their negative effects on the environment and human health [4,5,6,7].

Increasing costs and limited efficiency of physical and chemical treatments have spurred the development of alternative technologies for in situ and onsite application

based in particular on biological remediation (bioremediation) capacity [8,9,10,11].

In addition to the use of biostimulation and/or bioaugmentation to increase the efficiency of the bioremediation process, the use of surfactants has significantly contributed to the bioavailability, and consequent biodegradation, of contaminants [12]. These surfactants can be chemically synthesized or produced by microorganisms, called biosurfactants [13]. Biosurfactants, besides presenting lower processing costs, are considered environmentally friendly substances, since they are based on renewable and sustainable resources, and biologically degradable [14].

In general, biodegradation of oil can be optimized with the application of surfactants by maintaining controlled, process-friendly conditions [12]. One of the technologies that favor this process is the use of



bioreactors, which promote the ideal conditions for microbial activity, due to the control of factors such as temperature, pH, agitation, aeration rates and others. The use of this type of technology seeks to shorten treatment time, as it enhances biological degradation and minimizes abiotic losses [15].

Bioremediation is already a well-established technology, successfully proven in numerous applications for the treatment of hydrocarbon-contaminated areas, but changes in bioavailability as well as the production of interfering metabolites are common. Therefore, when soil contamination occurs, identification of the microbial community can be a valuable tool for predicting the potential efficiency of bioremediation processes. High-performance molecular techniques such as new generation sequencing have now emerged to assist traditional cultivation methods, enabling a more complete assessment of biodiversity and the identification of organisms and essential metabolic pathways related to bioremediation [16,17,18]. Molecular tools applied to contaminated soils before and after treatment can be a complementary tool for verifying the effect of contaminants such as petroleum and other substances added during treatment [16,19].

Thus, the objective of the present work was to evaluate the bioremediation of a multi-contaminated soil with hydrocarbons and metals through the use of microcosm and solid-phase batch bioreactor trials, together with the application of surfactants, synthetic and biological. In the bioreactor soil samples, the microbial activity was evaluated before and after the different treatments using next generation sequencing (NGS).

## II. MATERIAL AND METHODS

### 2.1 Soil

For the present study we used a silt soil multi-contaminated with hydrocarbons and metals, coming from a region near an oil refinery, located in southeastern Brazil. Due to the results of the chemical analysis of the soil, it was not necessary to incorporate nitrogen and phosphorus to maintain the C: N: P ratio of 100: 10: 1. The physical and chemical characteristics of the soil are presented in Table 1.

Table 1. Physicochemical properties of the contaminated soil.

Parameter	Value
(%) silt (weight)	58.78
(%) sand (weight)	25.74
(%) clay (weight)	15.48

Organic matter (mg.kg <sup>-1</sup> )	6.5
Total N (g.kg <sup>-1</sup> )	16.65
Available P (g.kg <sup>-1</sup> )	2.13
pH	6.23
Water holding capacity (%)	44.35
CTC (cmol <sub>c</sub> .kg <sup>-1</sup> )	24.47

### Contaminating metals (mg.kg<sup>-1</sup> of soil)

Cu	Ni	Zn
310	158	2100

### 2.2 Surfactants

The unpurified commercial biosurfactant JBR210® (JENEIL BIOSURFACTANT COMPANY, USA), containing 10% rhamnolipid in its composition, produced by a *Pseudomonas aeruginosa* strain was the surfactant of biological origin. The synthetic surfactants used were Tween 80 and Triton X-100, both from INLAB. Surface tension measurements of surfactants were 27.1 mN.m<sup>-1</sup> for JBR210®, 34.9 mN.m<sup>-1</sup> for Tween 80 and 35.33 mN.m<sup>-1</sup> for Triton X-100 by the Du Nouiy Ring Method at room temperature (25°C) using a Krüss K10T Tensiometer.

### 2.3 Microcosm Trials

With humidity corrected to 50 and 70% of WHC (values defined in preliminary assays), 250 mL flasks containing 50g of multi-contaminated soil were used for microcosm trials. For the tests with synthetic and biological surfactants, two different concentrations (0.1 and 1 mg.g<sup>-1</sup> soil) were used. All assays were duplicated for 42 days to assess the removal of total petroleum hydrocarbons (TPH). The system was aerated with an injection of compressed air at a flow rate of 20mL.min<sup>-1</sup> for 2 minutes and homogenized three times a week. The humidity content was corrected to the value corresponding to each system three times a week.

### 2.4 Bioreactor trial

In the larger scale experiments, a bench type U (13L) bioreactor containing 4 kg of soil was developed by CETEM in partnership with PETROBRAS [20]. Based on the results obtained in the microcosm experiments, three trials were conducted: (1) humidity adjusted to 70% of WHC, and the addition of a synthetic surfactant at a concentration of 0.1 mg.g<sup>-1</sup> soil; (2) humidity adjusted to 70% of WHC, and the addition of a biological surfactant at a concentration of 0.1 mg.g<sup>-1</sup> soil; (3) humidity adjustment to 70% WHC (no surfactant added; control). All assays were duplicated for 42 days, with weekly



humidity correction. Twice a day, the systems were aerated with an injection of compressed air at a flow rate of 20 L.min<sup>-1</sup> for 30 minutes and homogenized for 15 minutes at 4 rpm. Samples were taken at beginning and after 42 days for evaluation of TPH removal by infrared spectrometry. For molecular analysis samples were taken weekly.

### 2.5 Quantification of Total Petroleum Hydrocarbons (TPH)

The quantification of TPH in the soil samples was conducted by Infrared spectrometry using an InfraCal TOG / TPH analyzer, HART-T model (Wilks Enterprise), according to the protocol described by Rizzo et al. [20]. The oil concentration (mg.kg<sup>-1</sup>soil) present in each sample was calculated using a standard curve previously obtained from reading different known oil concentrations.

### 2.6 rrs Gene Sequencing

In order to evaluate changes in microbial diversity in the bioreactor treatments, large-scale sequencing experiments of the gene that encodes ribosomal rRNA from the Bacteria Domain were performed. After DNA extraction using the FastDNA spin kit for soil (MPBio) commercial DNA extraction kit, following the manufacturer's instructions, primers 967f and 1193r were used to amplify the genes encoding Bacteria 16S rRNA [21,22]. High throughput sequencing libraries were prepared using the Ion PGM Template OT2 400bp kit according to the manufacturer's protocol (Life Technologies). Sequencing was performed using the ion torrent PGM system instrument with the Ion PGM sequencing kit 400bp on 316v2 chip. The sequences obtained were analyzed using the Qiime platform [23] following the protocol previously presented [24]. The sequences are available on the MG-RAST website under the mgp375 project.

#### 2.6.1 Data analysis

Non-normalized data were used to calculate Shannon's diversity index (H') by the Vegan package [25]. Comparisons between treatments by ANOVA followed by Tukey HSD post hoc test were performed in the agricolae package [26]. Data transformed in relative abundance were used for the analysis of the principal coordinates, distance-based Bray-Curtis using the phyloseq package [27]. Differences between communities, treatment effects, and time were compared by PERMANOVA of the vegan package [25] with 9999 permutations. The samples were considered significantly

different when the test presented p value <0.05. All graphics were generated in RStudio® using ggplot2 [28].

## III. RESULTS AND DISCUSSION

### 3.1 TPH removal in microcosm and bioreactor assays

The results of TPH removal in the 42-day microcosm trials are shown in Table 2. The initial value of the oil concentration of the soil was 40,000 mg.kg<sup>-1</sup> soil or 4%(w.w<sup>-1</sup>). All the studied conditions presented a reduction of the initial oil content in the soil, the best conditions being obtained with the use of synthetic surfactants Tween 80, Triton x-100, both in the 0.1 mg.g<sup>-1</sup> soil, presenting oil concentration values of 28,610 and 30,100 mg.kg<sup>-1</sup>soil, corresponding to 28.50% and 24.75% of removal. These values were higher than those found in the control trials and in the presence of the JBR biosurfactant, which reached 20.75% and 19.25%, respectively, under the best conditions.

Several works positively address the use of the same synthetic surfactants. In a study by Ramamurthy & Memaryan [29], different concentrations of Triton X-100 and Tween 80 were tested for the treatment of soil contaminated by engine oil. However, they observed that higher concentrations of Triton X-100 decreased the removal values, indicating a possible toxicity to the microorganisms present in the soil, as verified in the present study.

For the control trials, the treatment with humidity correction for 70% of the WHC presented higher removal values, compared to the tests with a lower humidity content (50%), corroborating the results obtained by Taketani et al. [31], including testing this higher level operation of the solid phase bioreactor. Increasing humidity content may contribute positively to the removal of hydrocarbons, as water is critical to microorganisms, affecting osmotic pressure and intracellular metabolism [30,31].

Table 2. TPH results for the bioremediation tests in microcosms during 42 days.

Treatment Condition	Time (day)	TPH concentration (x10 <sup>4</sup> ) (mg.kg <sup>-1</sup> soil)	TPH removal (%)
Moisture 50% WHC	42	3.47± 0.10*	13.25
Moisture 70% WHC	42	3.17 ± 0.50*	20.75
Tween 80-0,1 mg.g <sup>-1</sup> 70% WHC	42	2.86± 0.00*	28.50

Tween 80-1 mg.g <sup>-1</sup> 70%WHC	42	3.29 ± 0.20*	17.75
Triton X100-0,1mg.g <sup>-1</sup> 70%WHC	42	3.01± 0.00*	24.75
Triton X100-1mg.g <sup>-1</sup> 70%WHC	42	3.62± 0.10*	9.50
JBR 210 -0,1 mg.g <sup>-1</sup> 70%WHC	42	3.31± 0.50*	17.25
JBR 210- 1 mg.g <sup>-1</sup> 70%WHC	42	3.23± 0.00*	19.25

Therefore, three conditions were selected to perform a scale-up of bench bioreactors to compare the application of a synthetic surfactant and a biological surfactant, as well as the control, in order to increase the removal of TPH: (1) with humidity corrected to 70 % of WHC, where there is no cost of incorporating surfactants (control); (2) with humidity corrected to 70% of WHC and addition of Tween 80 synthetic surfactant at the lowest concentration (0.1 mg.g<sup>-1</sup> soil) and (3) with humidity corrected to 70% of WHC and added to the JBR210 biosurfactant at a concentration of 0.1mg/g of soil. The lowest concentration of these products was used to reduce costs in both systems incorporating surfactants, since the differences in TPH removal obtained with the use of biosurfactant were too small to justify a 10 x greater incorporation of the product in an enlarged scale.

Table 3 shows the TPH concentration values obtained in soils treated in the bench bioreactors after 42 days, emphasizing that the initial oil concentration value of the soil was 40,000 mg.kg<sup>-1</sup> soil or 4% (w.w<sup>-1</sup>).

In 42 days, we observed that all conditions presented lower TPH concentration values in the soil, being 28,020, 29,900 and 31,880 mg.kg<sup>-1</sup> soil, using the biological surfactant JBR210, the synthetic surfactant Tween 80, and control assay, respectively. Consequently, the oil removal values in the control test (20.50%) and with the addition of Tween 80 synthetic surfactant (25.25%) were very close to the values obtained in microcosm. At a concentration of 0.1 mg.g<sup>-1</sup> of soil, the biological surfactant JBR210 was higher with an increasing scale (an approximately 10% increase compared to microcosms), with an average TPH removal of 30%, showing the efficiency of the solid phase bioreactor used. In a study by Li et al. [32], the removal of hydrocarbons in the presence of rhamnolipid biosurfactant was compared with the Tween 80 surfactant, where the highest removal values observed were achieved when the biosurfactant was used. In a solid-phase bioremediation study, the application of the rhamnolipid biosurfactant at

a concentration of 0.1 mg g<sup>-1</sup> of soil was studied over a period of 35 days, reaching mean values of 72.4% removal, while an average removal of 15.6% was achieved for the control, demonstrating the efficiency of biosurfactant application [33]. However, the actual efficiency depends on the type of soil, oil, and technology applied. According to Vandana and Singh [34], the use of biosurfactants is advantageous over the application of surfactants of synthetic origin, since they are environmentally friendly, easily biodegradable, and non-toxic.

Table 3. TPH results for the bioremediation tests in bench scale solid phase bioreactor during 42 days.

Treatment Condition	Time (day)	TPH concentration (x10 <sup>4</sup> ) (mg.kg <sup>-1</sup> soil)	TPH removal (%)
Moisture 70% da WHC	42	3.18 ± 0.10*	20.50
Tween 80-0,1mg.g <sup>-1</sup> 70% WHC	42	2.99 ± 0.10*	25.25
JBR 210-0,1mg/g 70% WHC	42	2.80 ± 0.40*	30.00

Corroborating the results obtained by Taketani et al. [31], the use of a solid phase bioreactor was promising, especially with the appropriate humidity adjustment to favor the microbial soil and to improve the remediation of contaminated soil. As stated above, all types of contaminated soils should be studied in advance in order to analyze the best technique / technology to be applied. Consideration should also be given to by-products formed after treatment in order to assess toxic effects on the environment. Since the TPH removal values obtained were interesting and demonstrate potential of Tween 80 synthetic surfactant and rhamnolipid JBR210 biosurfactant in bioremediation of contaminated soils, in addition to adjusting the humidity content, evaluation of changes in soil microbial community structure is necessary to infer the efficient application of this technology.

### 3.2 Molecular Analysis

The structure of microbial communities is shaped by the interaction between environmental and biological factors [35,36]. One of the most analyzed effects is community interaction with pollutants, their remediation,

and how different environmental factors may affect the course of this process [31,37]. The application of adjuncts to the hydrocarbon degradation process can alter how certain populations perceive the presence of a particular substance favoring or not the desired metabolism [37]. The sequencing analysis of the gene encoding the 16S rRNA from samples indicated that there was little difference in the richness present in these samples (Fig. 1). The ANOVA indicated that although there was some variation in the Chao1 richness estimator, the observed variation was not significant. However, the diversity measured by the Shannon index ( $H'$ ) showed significant variation. The Tween 80 treatment showed a significant decline in these indices and showed no sign of recovery, unlike the JBR210 biosurfactant treatment. Thus, the application of surfactants of different natures can have different effects. As observed by the analysis of Shannon's diversity index, both the bio-substance (JBR210) and the synthetic-substance (Tween 80) led to a decrease in diversity, although the biosurfactant JBR210 showed a tendency towards increased diversity at the end of the experiment. This result indicates the possibility that this biosurfactant has a less intense effect, or is better for the environment as indicated in previous work [38].

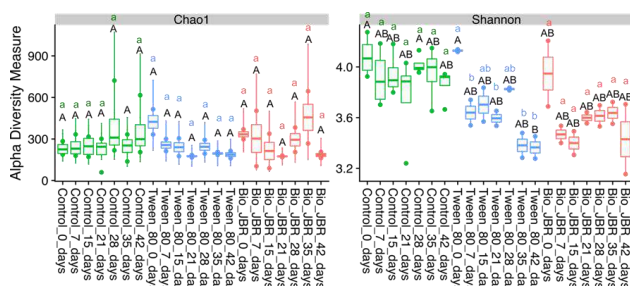


Fig.1. Values of the taxonomic unit richness index (Chao1) and Shannon index ( $H'$ ) obtained from the sequencing data. Capital letters on the samples indicate significant differences by Tukey HSD post hoc test between all samples. The lower case color letters of the treatments on the samples indicate significant differences by Tukey's test within each treatment. Control- humidity corrected to 70 % of WHC; Tween80- humidity corrected to 70% of WHC and addition of Tween 80 synthetic surfactant at a concentration 0.1 mg.g<sup>-1</sup>soil; JBR210- humidity corrected to 70% of WHC and added to the JBR210 biosurfactant at a concentration of 0.1mg.g<sup>-1</sup> soil.

The taxonomic affiliation of the sequences showed that these soils are mainly formed of the classes Actinobacteria, Gammaproteobacteria, Alphaproteobacteria and Betaproteobacteria (Fig. 2). However, all treatments varied over time. The control

showed a decline in relative abundance of Betaproteobacteria and Anaerolineae between the beginning and the end of the experiment while there was an increase in Actinobacteria. The treatments that received surfactants showed an increase of Alphaproteobacteria and Sphingobacteria during the same period, while there was a decrease in the abundance of Actinobacteria. However, when looking at the taxonomic affiliation of the OTUs found in the samples, great stability is observed in the control treatment community. This indicates that a considerable part of the community has been affected by the addition of different surfactants. Increased Proteobacteria in surfactant-containing samples has been observed previously and correlated with increased pollutant removal [39,40]. This increase was due to increased hydrocarbon contact with hydrocarbonoclastic populations [39]. However, a PCoA analysis indicated that Sphingobacteria had a stronger association with surfactant containing samples than the Proteobacteria OTUs.

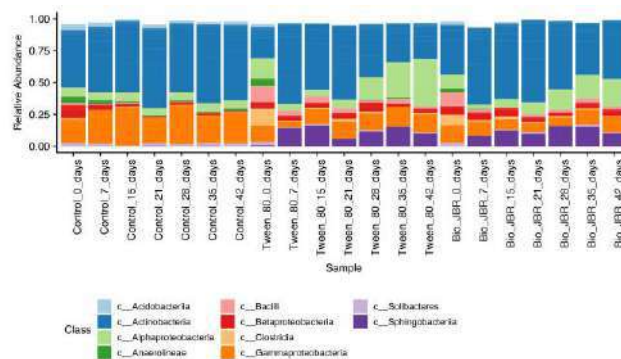


Fig.2. Taxonomic classification of sequences from the V3-V4 region of the 16S rRNA coding gene. Classification is represented at Class level. The data represent the averages between repetitions. Control- humidity corrected to 70 % of WHC; Tween80- humidity corrected to 70% of WHC and addition of Tween 80 synthetic surfactant at a concentration 0.1 mg.g<sup>-1</sup>soil; JBR210- humidity corrected to 70% of WHC and added to the JBR210 biosurfactant at a concentration of 0.1mg.g<sup>-1</sup> soil.

Principal coordinate analysis (Fig. 3) indicated that the control samples formed a group that included the initial samples (0 days) that were treated with surfactants, however, by seven days the samples that received surfactant presented a large alteration of the community observed (Fig. 3-A). Thus, the samples (Fig. 3-A) were correlated with the OTUs belonging to the five most abundant orders in the samples (Fig. 3-B), and the result indicated that these two sample groups correlated with OTUs of different orders. The control has a strong

correlation with Xanthomonadales while surfactant samples correlate with Sphingobacteriales. While correlating with both, most Actinomycetales OTUs are related to the control treatment. Bacteria of this group, although often capable of degrading hydrocarbons [41], are not commonly found in remediation of this type of pollutant.

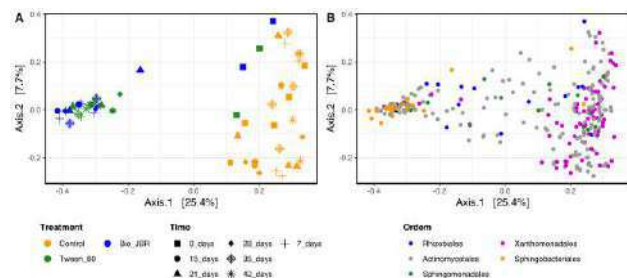


Fig.3. Principal coordinate analysis (PCoA) obtained from sequencing data. A - PCoA representing relationships between samples; B - PCoA representing the relationships between operational taxonomic units (OTU) found in the samples. The treatments are separated by colors according to the subtitle as the times are separated by shapes according to the same subtitle.

OTU's are colored according to their taxonomic classification by order of legend. Values in parentheses indicate the percentage of variance represented by the axis. Control- humidity corrected to 70 % of WHC; Tween80- humidity corrected to 70% of WHC and addition of Tween 80 synthetic surfactant at a concentration  $0.1 \text{ mg.g}^{-1}$  soil; JBR210- humidity corrected to 70% of WHC and added to the JBR210 biosurfactant at a concentration of  $0.1 \text{ mg.g}^{-1}$  soil.

The data of the two-way PERMANOVA indicates that there were significant differences between treatments ( $p = 0.001$ ) and time ( $p = 0.003$ ); however, there was no effect of interaction between the two. There was no effect of time on the control treatment, but there was an effect on both treatments containing surfactants ( $p = 0.001$ ). Surfactant treatments were significantly different from the control ( $p = 0.001$ ) but not among themselves.

#### IV. CONCLUSION

In the present study, the bioremediation of a tropical, silty, multi-contaminated soil with oily sludge and metals from a large scale application of a batch solid-phase bioreactor technology was promising, achieving removal results of approximately 20% in 42 days, only adjusted with a humidity content of 70% WHC. When combined with the incorporation of surfactants of synthetic origin (Tween 80) and of biological origin (biosurfactant,

JBR210) at the concentration of  $0.1 \text{ mg.g}^{-1}$  of soil, the removal value increased to approximately 25 and 30%, respectively, which are better results than those obtained in microcosms.

All soil treatments in bioreactors showed variation in the microbial community over time. Due to the taxonomic affiliation of the OTUs found in the samples, there was a strong stability in only the control treatment community (with humidity adjustment to 70% WHC), with an increase of Actinobacteria population. This proves that much of the community was affected by the addition of different surfactants, which promoted an increase of Alphaproteobacteria and Sphingobacteria, and a decrease in Actinobacteria abundance, with Sphingobacteriales showing a stronger association with surfactant-containing samples as opposed to Proteobacteria OTUs.

Therefore, the application of surfactants of different natures has different effects, where both promote the reduction of diversity, although the biosurfactant JBR210, after 42 days, showed a tendency of increasing diversity, indicating a less intense effect, which is better for the environment.

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# Place of Discursive Memory and Scenography in the Lausanne Covenant

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**Abstract**— *The purpose of this chapter is to analyze the Lausanne Covenant, a text produced at the end of the World Evangelization Conference 1974, in Lausanne, Switzerland, by checking how memory crossed the document, reconfiguring the effects of meaning materialized in that text. The question is, therefore, to answer the following question: How has memory reshaped different meaning effects (discourses) in the document Lausanne Pact, produced at the end of the International Congress of World Evangelization 1974? Based on the description of the selected and cataloged data, we found that during the International Congress of World Evangelization 1974, a group of South American evangelical leaders, represented by congressmen René Padilla and Samuel Escobar, gained notoriety and prominence, which culminated with the elaboration of a document that sought to affirm issues related to social justice in the practice of protestant Christian evangelism. Based on this data, we hypothesized that such insertion was mainly due to the eruption of questions situated in the intersection of religious discourse and Marxism, which are linked to the functioning of discursive memory.*

**Keywords**— *Lausanne 74, Marxism, Protestantism, Religious Discourse, Place of discursive Memory.*

## I. INTRODUCTION

The purpose of this article is to analyze the Lausanne Covenant, a text produced at the end of the World Evangelization Conference (1974), in Lausanne, Switzerland, by checking how memory crossed the document, (re)configuring the effects of meaning materialized in that text. The question is, therefore, to answer the following question: How has memory (re)shaped different meaning effects (discourses) in the document Lausanne Pact, produced at the end of the International Congress of World Evangelization (1974)?

Based on the description of the selected and cataloged data, we found that during the International Congress of World Evangelization (1974), a group of South American evangelical leaders, represented by Congressmen René Padilla and Samuel Escobar, gained notoriety and prominence, which culminated. with the elaboration of a document that sought to affirm issues related to social justice in the practice of Protestant Christian evangelism. Based on this data, we hypothesized that such insertion was mainly due to the eruption of questions situated in the intersection of religious discourse and Marxism, which are linked to the functioning of discursive memory.

## II. MATERIAL AND METHODS

To answer the question of this article, based on the verification of the presented data, we analyzed the World Evangelization Congress and the final text produced in it, called the Lausanne Covenant, considering the document as a place of discursive memory, according to Fonseca-Silva's proposal (2007a). To explain the functioning of this concept in the data, we first present some theoretical considerations about the notion of *discursive memory place*, as well as the concepts that support it, and also others that will be mobilized in the analysis and then, we proceeded to analyze the data in order to answer the problem question that guides the article.

Maurice Halbwachs, in his work *Social Pictures of Memory* (1925), seeking theoretical inspiration in Emile Durkheim departs from the Bergsonian theoretical-philosophical scheme (as well as from the Freudian notion of the unconscious) and elaborates the theory of *social frameworks of memory*, which would serve as a basis for the development of the concept of *collective memory*, presented in later works. Thus, Halbwachs states that whatever memories of the past may exist, they can exist only through the social frameworks of memory, since individuals need the memory of other individuals to remember, affirm, or deny their memories. Thus, all

individual memory is constituted based on a collective memory and all memories are constituted within a group.

On *Collective Memory* (1968), Halbwachs sustains that “the memory of society extends as far as it reaches the memory of the groups of which it is composed” (HALBWACHS, 1968, p. 51). If a particular group disappears, the only way to preserve memory is through narratives that, in turn, at specific times, will be consulted and reaffirmed. Consequently, memory receives a great contribution from language studies and social studies.

In the 1970s, when resuming Halbwachs and the correlation between memory and social structure, Pierre Nora proposes the concept of *memory places*. According to Nora, due to the rapid process of modernization that has destroyed memory societies, the need arises for the establishment of places capable of crystallizing the past. It is in this sense that Nora resumes the relationship between history and memory, proposing a distance between the two, by comparing them, as we summarize in the table below:

Table 1. Nora’s comparison between memory and history

MEMORY	HISTORY
Integrated	Unintegrated
Unaware of herself	It is conscious because there is research, there are footprints, distance, mediation (research)
Always present, a link lived in the eternal present	A representation of the past
Live, always carried by living groups	Dead, not carried by the living, is the always problematic and incomplete reconstruction of what no longer exists
Organizer	Problematic and incomplete construction of what no longer exists
Affective and magical, not accommodating to details, feeds on vague memories, smaller or larger, private or symbolic	Intellectual and laicizing, demands analysis and critical discourse
Install the memory in the sacred	It dislodges the memory of the sacred and makes it prosaic
It emerges from a group that it unites, and is by nature multiple, slowed down, collective, plural and individualized. There are as many memories as groups.	It belongs to everyone and nobody, which gives it a vocation for the "universal"
It is rooted in concrete, space, gesture, image, object	It clings to temporal continuities, evolutions, and relationships between things.
It is an absolute	Only know the relative

For Nora (1984), if memory is claimed by history, it ceases to exist. *The places of memory* are, therefore, remains, rituals of a society without rituals. These places of memory have a triple nature: material, functional and symbolic. They are born and live from the feeling that there is no longer a spontaneous memory and the need to create archives, keep birthdays, organize celebrations, funeral compliments, record minutes, among others (NORA, 1984, p. 13).

Fonseca-Silva (2007a) states that considers the contribution of Michel Foucault and his concept of *memory areas* fundamental to the constitution of the concept of *discursive memory*, created, in Discourse Analysis, by Courtine (1981), which, to operate the concept of *discursive memory*, operates detachments from Foucaultian postulates. Thus, according to Fonseca-Silva

(2007a), the concept of *discursive memory* arises from Foucault's rereading, in particular, from his discussions about the “domain of memory”. Courtine operates the displacement of the Foucaultian concept of *memory domain* to mobilize, the concept of *discursive memory*, which relates to the level of *interdiscourse*. The notion of *interdiscourse*, in the path taken by Fonseca-Silva (2007), indicates that the subject, by enunciating, produces meanings, since we speak of a certain discursive position and, thus, the action of discursive memory causes certain formulations to evoke meanings.

Mobilizing the concepts of *memory place*, by Nora (1984); *domain of memory*, by Foucault (1969); and *discursive memory*, by Courtine (1981), Fonseca-Silva (2007a) postulates the concept of *place of discursive memory* and thus analyzes the symbolic as a place of memory reproduction and preservation.

Based on the above, we understand that the Lausanne Pact (1974) functions as a *place of discursive memory* in an instance where certain statements appear, disappear and reappear, according to the interests of the groups. This is how, in the Lausanne Covenant, religious discourse intertwines with Marxism producing different effects of meaning. As a theoretical contribution of this article, beyond the notion of place of discourse memory also we use the notion of *Scenography*.

According to Maingueneau (2011), a text is not a set of inert signs, but the trail left by a speech in which speech is enacted. In this sense, anyone reading a particular text is immediately involved in three scenes: the encompassing scene, the generic scene and the scenography. The first scene proposed by Maingueneau is the *encompassing scene*, which corresponds to the type of discourse - religious, political, juridical - that is, this scene is the one in which the coenunciator must be placed to interpret it, identifying in the name of that the text challenges the reader and according to what purpose the text was organized. The second scene is the *generic one*, which concerns the genres of discourse linked to the field in which the text was produced, that is, those related to the spheres in which the texts circulate. In the political sphere there are, for example, pamphlets, saints, etc., which define their own roles: In an election campaign pamphlet, there is a "candidate" addressing "voters." Scenography, in turn, is the way the text is inscribed, the text is shown, that is, the scene constructed in/by the text, through scenes that are part of the readers' memory, that they know, for example, family conversation, participation in a religious service, etc.

The encompassing scene and the generic scene “together define what might be called the scenic

framework of the text [...] define the stable space within which the utterance acquires meaning - the space of discourse type and genre" (MAINGUENEAU, 2011, p.86-87), thus generating a kind of paradoxical entanglement, because it is not directly with the scenic picture that confronts the reader, but with a scenography that, in turn, leads the scenic picture to move to one background, then, the coenunciador initially has contact only with the set design.

Moreover, the scenography has a dual function, because while it is the source of discourse, it is also what it engenders, and in this way, it "determines a statement that, in turn, must legitimize it" (MAINGUENEAU, 2011, p. 87).

For Maingueneau (2011), there are speeches that are conducive to the diversity of scenography, as is the case of political discourse, because a given candidate can talk to his voters from different scenes. In addition, a set design can rely on validated scenes, scenes that are already part of collective memory. Thus, "the repertoire of available validated scenes varies depending on the group targeted by the discourse: religious groups have their own memory and supposedly shared scenes" (MAINGUENEAU, 2011, p. 88).

Based on the above, we understand that during the International Congress of World Evangelization (1974), in the writing and dissemination of the document Lausanne Covenant, which would be a statement of purpose (generic scene), linked to religious discourse (encompassing scene), sought adherence of those who signed the document and the other future readers of the said document by building a set design well known, shared and great weight to the Protestant Christian denominations: a Confession or Covenant .

Using the above theoretical assumptions and analytical devices, we now pass on the description of the 1974 International Congress of World Evangelization, and then present the analysis of the data.

### III. RESULTS AND DISCUSSION

The International World Evangelization Congress was held in Lausanne, Switzerland, between 16 and 25 July 1974, on the premises of the Palais de Beaulieu. The meeting was convened by a commission chaired by Reverend Billy Graham, a well-known North American Baptist pastor, and was attended by over 2300 evangelical leaders from various denominations from around 150 countries.



Fig. 1: Lausanne Assembly

With the theme, "Let the earth hear your voice", evangelical leaders attended plenary sessions and Bible studies, as well as discussions and debates about the theology, strategy, and methods that should be employed in the practice of evangelism. The meeting produced a document called the *Lausanne Covenant*, a statement that would define the needs, responsibilities, and goals of/in spreading the gospel to Protestant churches.

In Lausanne (1974), important evangelical leaders were present, among which stood out among the South American, the Ecuadorian René Padilla and Peruvian Samuel Escobar: "The key figure in convening the congress was American evangelist Billy Graham. He was expertly assisted by John RW Stott, an English gospel minister and thinker who had been working for over twenty-five years to strengthen the evangelistic witness of the Anglican Church; Jack Dain, an energetic Anglican bishop of Australia; and Leighton Ford, a Canadian member of the Billy Graham Evangelistic Association (AEBG). Before and during the conference, there were important interventions from Latin America, especially by Samuel Escobar, a Peruvian who was serving as the director of InterVarsity in Canada, and C. René Padilla, an Ecuadorian Baptist" (NOLL, 2012, p. 297).

Padilla criticized the American forms of evangelism that, according to him, emphasized only numerical growth, and called on the church to act politically in the face of social injustice; the lecture proferid the by Escobar was in the same line of argument Padilla. Escobar and Padilla were supported by various leaders during Lausanne (1974), so they organized a dissident group of about 500 delegates who supported this same thesis and sought to persuade the committee to draft a Lausanne statement, which it should incorporate. clearer propositions about social justice (SWARTZ, 2012).

About the text of the Lausanne Covenant itself, John Stott, a prominent evangelical minister present at the event and a member of the document's writing committee, states: "The first brief statement was made two or three



months before the Congress and sent to by mail to a number of directors. Already this document can be said that it was truly produced in Congress (although Congress had not yet assembled), because it reflected the contributions of keynote speakers whose works had been previously publicized. The document was revised in light of the comments of the advisers, and this review was later revised in Lausanne by the drafting committee. So what was presented to all participants in the middle of the Congress was the third version. They were invited to submit their contributions, either as individuals or groups, and they responded with great diligence. Many hundreds of submissions have been received (in the official languages), translated into English, classified and studied. Some proposed amendments canceled each other, but the drafting committee incorporated everything it could, while at the same time ensuring that the final document was a recognizable review of the project presented to participants. It can then be said that the Lausanne Covenant expresses a consensus between the mind and humor of the Lausanne Congress. I would like to express my deep gratitude to Dr. Hudson Armerding and Mr. Samuel Escobar, who were the other members of the Drafting Committee, and Dr. Leighton Ford and Dr. Jim Douglas who helped us. They worked hard and consciously, we were all aware of a harmony of mind and spirit that we believe was given to us by God Himself" (STOTT, 1975).

In view of the above, we verify the role of South American evangelical leaders linked to Liberation Theology and Marxist discourse in the elaboration of the document *Lausanne Covenant*. One of them, Mr. Samuel Escobar, was able to be part of the Review Committee of the document.

The document itself (Figure 2) was distributed the size of a sheet of white A3 paper, in a font resembling Times New Roman, size 12. In the upper left, in the heading, the time, day, month and year of the event, namely 19:00 hours, Wednesday, 24 July 1974; below the date, still under the heading, the title of the document "The Lausanne Covenant", with a fish-shaped logo on the right side saying "Let the Earth hear His Voice". In the times of Jesus Christ and in Israel, fish was something very common and very culturally present; Some of the apostles, before being called by Jesus, were fishermen, and even after following Christ, they were given the mission of being "fishers of men" (Matthew 4:19). In this way, as with fishing techniques, where details and skills were learned only with the time spent in the activity and with experience, the apostles, over time, became fishermen of souls for the Kingdom of God; The fish

symbol is also found in the miracles of Jesus, when there was the multiplication of bread and fish that fed multitudes (Mark 8:1-9), and also in the wonderful fishing narrative (Luke 5: 1-11), among others. The figure of the fish have a variety of effects of meaning and importance throughout historical Christians, being one of the strong and ancient symbols of Christianity, beginning to be used more or less at the end of the 1st century AD, and most likely, before the cross, it was used by Christians as a means of identification among themselves in the times of persecution of the Roman Empire, meaning a secret sign of faith: when a Christian met another person who thought he professed the same faith, he drew the the bow in reverse, thus forming the half of the fish, and if the judgment was right, the other completed with the other part of the bow, thus forming a figure of faith and hope in Christ (MYERS, 1975, p. 512). Fish as a symbol gains even more strength due to the acrostic of the Greek word for fish, which is "ΙΧΘΥΣ", which transliterates to "ICHTHYS" and its letters form the acronym "ΙΕΣΟΥΣ + ΧΡΙΣΤΟΣ + ΘΕΟ + ΗΥΙΟΣ + ΣΟΤΕΡ" Which translated would be "Jesus Christ, Son of God, Savior". This is due to a play of words that were written one word below the other, forming the acrostic ichthus.

The fish as a symbol is therefore very common in Christian practices, especially in evangelistic practices and, when associated with the phrase "Let the earth hear His voice" makes reference to the voice of Christ and practice of evangelism. The game of words alluded memory in the logo refers the coenunciador the need to preach the Christ, the Son of God, who is Savior and seeks to meet the primary needs of the people caring for them when they are hungry, showing that this practice is to import with each other one of the identifying elements of today's true Christians, as it was supposedly also a constant practice among those who drew fish in the sand during periods of persecution of Christianity in the Roman Empire. Once the header elements have been separated from the rest of the text by a black horizontal line, the Lausanne Covenant has three columns in which there are 17 topics, namely: In the first column - "Introduction", "1. God's Purpose", "2. The Authority and Power of the Bible", "3. The Sufficiency and Universality of Christ", "4. The Nature of Evangelism", "5. Christian social responsibility"; In the second column - "6. The Church and Evangelism", "7. Cooperation in evangelism", "8. The Church's Partnership in Evangelism", "9. The urgency of the evangelistic task", "10. Evangelism and culture"; and the third column - "11. Education and leadership", "12. Spiritual Conflict", "13.



Freedom and persecution”, “14. The power of the Holy Spirit”, “15. The Return of Christ” and the “Conclusion”. Below the description of each item, except for the introduction and conclusion, follow the biblical references that served as the basis for the statements presented in each topic. We will not cover all topics here, because the document is long and, in certain parts, contains many repetitions from the discursive point of view. That is, even if the text brings different arguments, many of these arguments converge to the same discourse, so there is no need for a detailed analysis of each topic.

At the bottom left, there is another just like the International Conference on World Evangelization, which has name “Lausanne”, at the top, and the “74” number, at the bottom, which refers to the place and year of the event, followed by two blank lines to fill in the most specific date and to sign the pact signatory.



Fig. 2: Pact Lausanne Pact distributed at the end of the event and signed by Billy Graham

Congress members should be signatories to the Lausanne Covenant, a religious document presented in the form of a covenant/contractual confession of faith. In the game between memory and actuality, we find that this type of documentary production is a common practice among Christians, who, after conciliar meetings, produce creeds and confessions to be followed by the church, as a correct and reliable expression of the biblical teaching on the topics addressed.



Fig. 3: Lausanne Pact Subscription / Signature (Graham on the right)

Since 1974, the Lausanne Covenant has posed a kind of challenge to Protestant Christians, urging them to work together to make Jesus Christ known throughout the world. However, in addition to the evangelistic issue, many worldwide evangelical organizations as well as many churches have come to use the Lausanne Covenant as a document expressing their faith, as a current creed or confession of faith.

Regarding the various texts, not being the text of the Lausanne Pact a set of inert signs, but the trail left by a speech in which speech is enacted (cf. MAINGUENEAU, 2011), we can identify in it the three scenes, presented by Maingueneau (2011) - encompassing, generic and scenography, which we will explain below.

The first scene, or encompassing the scene, says re s chest to the type of speech, which, in the case of the document under analysis, it is the religious discourse, since this document is intended to lead the Protestant church the practice of evangelism. The second scene, which is the generic scene, and with regard to genres of particular discourses, presents the coenunciador the Lausanne Covenant as one a declaration of principles and objectives. The scenography of the text, which in turn is the way the text is inscribed, has the form of a Covenant Creed, or Confession of Faith, that is, a communication authorized by the church and duly communicated to the faithful that expresses the biblical truth, elaborated not by particular elucidation, but by a group of specialists in that

particular area of biblical knowledge, producing an effect of truth. For this very reason, this document “must” be signed and taught by church authorities. By signing the document, by the present, the memory game in the event produces an effect and conclusion of a contractual commitment, and therefore should not be broken by secondary motivations. In this sense, when the co-announcer, and now signatory, accepts the contractual/covenantal place that is consecrated to him in the scenography, he assumes the provisions of the text, which are now seen as both true and as commitments assumed by the signatories.

We have analyzed the topics of the Lausanne Covenant dividing them by themes, aiming to show that, in these areas, there is regularity related to certain discursive effects. In the analysis, we present the issues, the number of the statement, the Lausanne Covenant of the topic to the which that particular utterance belongs and, only then, proceed the analysis themselves.

As we announced earlier, we have analyzed some of the topics of the Lausanne Covenant by dividing them into themes, aiming to show that there are regularities in these themes that point to certain discursive effects. In this analysis, we present the topics and the number of the statement, and only then proceed to the actual analysis. We have bolded the parts of utterances that caught our attention.

#### *Theme: Church Mission and Evangelization*

- (1) We are deeply touched by what God has been doing today, moved to repentance for our failures, and challenged by the unfinished task of evangelization.
- (2) We confess in shame that we often deny our calling and fail in our mission because we have conformed to the world or isolated ourselves too much.
- (3) Here we also repent of our neglect and of having sometimes considered evangelism and social activity mutually exclusive.
- (4) It becomes a stumbling block to evangelism when it betrays the gospel or lacks a living faith in God, a genuine love for people, or scrupulous honesty in all things including promotion and finance.
- (5) We confess that at times we have endeavored to bring about the numerical growth of the church at the expense of the spiritual, divorcing evangelization from the edification of believers.
- (6) We fully support the principles governing the formation of a truly national church, and earnestly desire that the whole church have national leaders who manifest a Christian style of leadership not in terms of dominance but of service.

(7) In every nation and in every culture, there should be an effective training program for pastors and lay people in doctrine, discipleship, evangelization, edification, and service. This training should not depend on a stereotypical methodology but should build on creative local initiatives according to biblical standards.

(8) We need both vigilance and discernment to safeguard the biblical gospel. We recognize that we ourselves are not immune to the acceptance of worldliness in our actions and actions, that is, the danger of capitulating to secularism.

Statements (1) to (8) indicate that in this new historicity about the evangelistic/missionary task of the church, Protestants should be ashamed, repent, and also confess their failure to share the gospel among the nations. This failure, in turn, would be related to an unfinished and incomplete evangelization, and pointed to an equally flawed church in its leadership, characterized by being dominating and leading the church to worldliness. and secularism, expressed mainly in the absence of the church's engagement with social justice issues.

The statement (1) is part of the Lausanne Covenant Introduction in which the co-announcer is informed of a large participation of representatives of Protestant churches in the International Congress of World Evangelization, representing more than 150 nations. Such “information”, by a memory effect, shows the importance, representativeness and unity of the Protestant church in the event.

The initial approach of the Lausanne Covenant on important theological themes such as salvation and communion is in keeping with the orthodox view of these themes. However, in mentioning the issue of evangelization, another important pillar of Christ's teachings, the words that stand out in Lausanne's text refer to meaning effects that function as a paraphrase of terms such as “failure”, “lack”, “incompleteness”, and produce the effect of a supposed failure: “We are deeply touched by what God has been doing in our day, moved to repentance for our failures, and challenged by the unfinished task of evangelization”. The words “repentance”, “failure” and “challenged” highlight the discourse about a supposedly “unfinished” task, suggesting serious difficulties in the practice of evangelistic missions in Protestant Christianity.

Thus, the so-called Great Commission, that is, the command given by Jesus Christ to his church to preach the gospel to all nations, making disciples, teaching and baptizing them, is presented as something “unfinished” and such unfinished. It is discursivized as being linked to

the failure of this collective subject (our failures). Concerning the mission given by Christ to his church, here is a biblical quotation:

And Jesus came and spake unto them, saying, all power is given unto me in heaven and in earth. Go therefore, make disciples of all nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghost; teaching them to keep all the things that I have commanded you. And behold, I am with you always until the end of the century (Matthew 28: 18-20).

Based on this Mission, the text of the Lausanne Covenant allows the emergence of meaning effects that materialize a supposed failure. In this case, it is up to us to ask: what does this “failure” consist of? What were they “sorry” for? Why was the task “unfinished”? The notion of evangelization, in a historical perspective, goes back to the patriarch of the Christian faith, Abram. To him, according to the Bible, God appeared, informing him of the mission to leave his land and family and to go to a place that divinity itself would show him (Genesis 12.1ff). Following this, Abram receives a promise that all the families of the earth would be blessed in him: “I will bless those who bless you and curse those who curse you; in thee shall all families of the earth be blessed”(Genesis 12: 3). The term “family” in both Hebrew *בְּרִייתָא*, as in the Septuagint *φυλή*, the Greek version of the Old Testament text, builds the sense that in Abram all the ethnic groups of the earth would be blessed, that is, the diverse groups of people of every tribe, language, race, and nation. In this sense, according to the progressiveness of biblical revelation, the missions really are unfinished until the gospel message is announced to all these groups of people, but for this biblical perspective, this unfinished does not correspond to failure. After all, the failure of evangelism, according to the teaching of Scripture and the orthodox exegetical interpretation of it, would be the failure of God Himself, since God elected specific people for salvation in eternity, as Paul teaches the Ephesian believers: He chose us in Him before the foundation of the world to be holy and blameless before Him and in love predestined us unto him, to the adoption of children through Jesus Christ, according to the good pleasure of his will” (Ephesians 1:4-5). What we regard as the orthodox view of biblical teachings is found in the historical documents of the Christian faith, known as creeds and confessions. The creeds originated in the early centuries of the Christian church, especially during the doctrinal controversies of the fourth and fifth centuries. The first historically known creed was the so-called Apostolic Creed, probably formulated in the second century. In the year 325, another creed was formulated at

the Council of Nicaea, Asia Minor, brought together to address doctrinal controversies about the person of Christ (Christological) and its relationship to the trinity. At that council, Church leadership condemned Arius, an elder of the city of Alexandria, and his teachings as heretics. Then there was the Creed of Constantinople (381) and the Creed of Chalcedon (451), which deal specifically with the two natures of Jesus Christ. In addition to these early creeds, several others later appeared, expressing what may be considered the orthodox faith of the church, which was, through its conciliar meetings, at various historical times, contrary to the teachings considered heretical. Only much later, at the time of the Protestant Reformation, that is, from the 19th century. It was in the sixteenth century that Confessions of Faith arose, which dealt with Christian doctrine in a more extensive and elaborate way than creeds. The first document of its kind was the Augsburg Confession (1530) of Lutheran tradition. Then came those of Calvinist origin, such as the Second Helvetic Confession (1566), the Scottish Confession (1560), and the Westminster Confession of Faith (1646), which is considered one of the most important confessions of Protestant doctrine. From now on we will refer to this last document, which will be the basis for presenting, where necessary, orthodox examples of reformed doctrine. To refer to this confession, we use the abbreviation CFW, followed by the chapter number and the topic from which the excerpt was taken. Regarding the issue of “mission failure”, the Westminster Confession of Faith states: “By God's decree and for the manifestation of His glory, some men and some angels are predestined for eternal life and others foreordained for eternal death. Other biblical references: 1Timothy 5:21; Mark 5:38; Jude 6; Matthew 25:31; Proverbs 16:4; Romans 9.22-23” (CFW III.3, emphasis added).

From this perspective, God's plans would be unfailingly fulfilled, which indicates that, by the interpretation taken by the Orthodox Protestants, to which the signatories of the Lausanne Covenant would in principle be bound, there is no failure in evangelization. For those who advocate such an interpretation, there are no failures or failures, for no person in this group (the chosen and/or predestined) will be permanently lost or separated from God. This is what we see materialized in the teachings of the apostle John, who, quoting Christ himself, clarifies: “Whoever the Father gives me, he will come to me; and he that cometh to me, I will not cast out at all” (John 6:37). On predestination, states the text of the Westminster Confession of Faith: “These men and angels, thus predestined and foreordained, are particularly and unchangeably designated; Their number is so certain

and definite that it can neither be increased nor decreased. Just as God appointed the elect to glory, so by the eternal and very free purpose of His will, He foreordained all means leading to that end; those who, therefore, are elected, being fallen in Adam, are redeemed by Christ, are effectively called to faith in Christ by His Spirit, who works in due time, are justified, adopted, sanctified, and guarded by His power by through saving faith. Apart from the elect there is none that is redeemed by Christ, effectively called, justified, adopted, sanctified, and saved" (CFW III.4-5).

Thus, according to the Orthodox Protestant interpretation, the task of evangelization is unfinished only in the sense of reaching the message to God's elect (predestined) at all times, for all families of the gospel to be spread or proclaimed. Earth. However, the failure mentioned by the enunciator of the Lausanne Covenant indicates the functioning of an issue outside the central task of evangelization, something that will be presented, as we will see, throughout the text.

It is in this way that the faults and misconceptions of the church reported in the statements from (1) to (8), through the use of the words "repentance", "failure", "confess ashamed", "failures", etc., have as their The effect of meaning indicates the notion of failure of the Church's mission and the consequent need for change in its evangelistic practice, which leads to another theme that appears regularly in the Covenant, namely the need for change . It should also be borne in mind that, by pointing out so many flaws in the life and practice of the church, the statements analyzed also implicitly criticize the way of life of the missionaries of the United States, the main world representative of Protestantism at that time, presenting them. as dominating, negligent, not affective of the poor and social issues, but affective of secularism and worldliness.

*Theme: Need for Change*

(9) He enlightens the minds of God's people in every culture to perceive their truth in an ever-new way with their own eyes, and thus reveals to the whole church an ever greater portion of God's manifold wisdom.

(10) The salvation we claim to possess must be transforming us into all of our personal and social responsibilities. Faith without works is dead.

(11) We affirm that Christ sends his redeemed people into the world just as the Father sent them, and that this requires an equally deep and sacrificial penetration. We need to leave our ecclesiastical ghettos and penetrate non-Christian society. In the church's mission of sacrificial service evangelism is paramount. Worldwide evangelism

requires the whole church to bring the whole gospel to the whole world.

(12) We rejoice in the dawn of a new missionary age.

(13) The development of strategies for world evangelization requires new and creative methodology. With God's blessing, the result will be the emergence of churches deeply rooted in Christ and closely related to local culture.

(14) With God's help, we will also seek to oppose all unrighteousness and remain faithful to the gospel at any cost.

(15) World evangelization will only come true when the Spirit renews the church in truth, wisdom, faith, holiness, love, and power.

Lausanne's signatory theology, also in principle, shows an orthodox view of the Holy Scriptures by bringing to light the doctrines of divine inspiration of the Word, the authority of the composition of Scripture, and the inerrancy and sufficiency of biblical revelation. All of this is materialized in topic 2 of the Lausanne Covenant, "Authority and Power of the Bible", as shown in the following excerpt: "We affirm the divine inspiration, truth, and authority of the Old and New Testament Scriptures in their wholeness, as the only written Word of God, without error in all that it affirms, and the only infallible rule of faith and practice." This discourse is also materialized in Paul's letter to Timothy: "All Scripture is inspired by God and useful for teaching, rebuking, correcting, and education in righteousness" (2 Timothy 3:16). Regarding Westminster theologians, let us look, even as regards the authority and legitimacy of the Bible, as follows: "Under the name of Holy Scripture, or written Word of God, now all the Old and New Testament books are as follows, all given by God's inspiration to be the rule of faith and practice: THE OLD TESTAMENT - Genesis, Exodus, Leviticus, Numbers, Deuteronomy, Joshua, Judges, Ruth, 1 Samuel, 2 Samuel, 1 Kings, 1 Chronicles, 2 Chronicles, Ezra, Nehemiah, Esther, Job, Psalms, Proverbs, Ecclesiastes, Song, Isaiah, Jeremiah, Lamentations, Ezekiel, Daniel, Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah and Malachi. The New Testament - Matthew, Mark, Luke, John, Acts, Romans, 1 Corinthians, 2 Corinthians, Galatians, Ephesians, Philippians, Colossians, I Thessalonians, II Thessalonians, I Timothy, II Timothy, Titus, Philemon, Hebrews, James, 1 Peter, 2 Peter, 1 John, 2 John, 3 John, Jude, and Revelation. Books generally called Apocrypha, not of divine inspiration, are not part of the canon of Scripture; They are therefore not authoritative in the Church of God, and in no way can they be approved or



employed except as human writings. The authority of Holy Scripture, which is why it must be believed and obeyed, does not depend on the testimony of any man or church, but only on God (the same truth) who is its author; therefore must be received, because it is the word of God. By the witness of the Church we may be moved and incited to a high and reverent appreciation of Holy Scripture; the supreme excellence of its content, and the effectiveness of its doctrine, the majesty of its style, the harmony of all its parts, the scope of its whole (which is to give God all the glory), the full revelation that makes the one Man's means of saving himself, his many other incomparable excellencies, and complete perfection, are arguments by which it is abundantly evidenced to be the word of God; however, our full persuasion and certainty of his unfailing truth and divine authority comes from the inner workings of the Holy Spirit, who by word and word testifies in our hearts" CFW I.1-5).

Thus, in the text of the Westminster Confession of Faith, we also identified this discourse on the inerrancy and sufficiency of biblical revelation. However, when He states that the Holy Spirit "enlightens the minds of God's people in every culture, so that they may perceive their truth in an ever-new way with their own eyes, and thus reveal to the whole church an ever-increasing portion. Of the manifold wisdom of God, the enunciator of the Lausanne Covenant, through the interspersed in an ever-new way, with his own eyes, once again refers to issues that are not linked to orthodox Protestant discourse and which they do not say in any aspect of the foundational Christian, as teontologia or inerrancy. Such questions indicate that the enunciator emerging from the text under analysis advocates a supposed "renewal" in relation to the interpretation of the Holy Scriptures. This renewal would be made possible by the action of the Holy Spirit, which "enlightens the minds of God's people". In this sense, the interpretation of the Bible would not always be the same, which refutes, in a way, the thesis of biblical immutability, since it argues that, even if the Word of God does not change, interpretations occur "in an always new way" and linked to the way of "seeing" each culture (with one's own eyes).

Therefore, having identified the alleged errors and omissions of Protestants in their missionary practices, the statements from (9) to (15) address this need for change. These changes are related to a new and creative vision and evangelization that, from that moment, it would make it real because it corroborated the need to fight at all costs, for reasons linked to social justice. In other words, the Christian need to worry about anything else what was considered evangelization by Protestants until that

moment, that is, he would have to worry also with questions linked to a particular understanding of social justice. These questions which, according to our hypothesis, are related to a Marxist memory. Thus, according to what the Covenant enunciator argues, in the practice of evangelization, the church must be available to dialogue with culture to understand the social needs of the evangelized. The effect of meaning that emerges from these statements is that of that particular commitment to social justice would therefore be an essential part of the evangelizing mission of the church, since, according to this new view, without this particular engagement, the mission does not it is complete, not integral, hence the statement "faith without works is dead." In this sense, proposed changes to the practice of the church summed up, in the text of the Covenant, the issue of social justice. In this regard, let's look at the following parts of the Covenant.

#### *Theme: Social Justice*

(16) To evangelize is to spread the good news that Jesus Christ died for our sins and rose again according to the Scriptures, and that as the reigning Lord he now offers the forgiveness of sins and the gift deliverer of the Spirit to all who repent and believe. Our Christian presence in the world is indispensable to evangelization, and so is that kind of dialogue whose purpose is to listen sensitively in order to understand. But evangelization itself is the proclamation of the biblical and historical Christ as Savior and Lord, in order to persuade people to come to him personally and thus be reconciled to God.

(17) The results of evangelism include obedience to Christ, incorporation into his church and responsible service in the world.

(18) Although reconciliation with man is not reconciliation with God, nor is social action evangelism, nor is political liberation salvation, we affirm that evangelism and socio-political involvement are both part of our Christian duty. For both are necessary expressions of our doctrines about God and man, our love for our neighbor, and our obedience to Jesus Christ.

(19) The message of salvation also implies a message of judgment on all forms of alienation, oppression and discrimination, and we should not be afraid to denounce evil and injustice wherever they exist.

(20) However, we who share the same biblical faith must be intimately united in communion with one another, in deeds, and in testimony.

(21) We are all shocked by the poverty of millions, and troubled by the injustices that cause it. Those of us who live in the midst of opulence accept it as their obligation



to develop a simple lifestyle in order to contribute more generously to alleviate the needy and to evangelize them.

The statement (16) is found in the fourth topic of the Lausanne Covenant, entitled "The Nature of Evangelization", in which we find an explanation of what evangelistic practice should be like, which is presented as responsible for "spreading the good news. that Jesus Christ (who) died for our sins and rose again according to the Scriptures, and that, as Lord and King, he now offers forgiveness of sins and the liberating gift of the Spirit to all who repent and believe." In this excerpt, in addition to the relationship with Protestant orthodoxy, we find that the statement "that kind of dialogue whose purpose is to listen sensitively in order to understand" refers to something other than evangelization as understood by Orthodox Protestantism. This is because, according to the biblical basis taken up by this orthodoxy, the central point of evangelization is to make disciples, as shown in the following quote: "Jesus came and spake unto them, saying, All power is given unto me in heaven and in earth. Go therefore, make disciples of all nations, baptizing them in the name of the Father, the Son, and the Holy Ghost; teaching them to keep all the things that I have commanded you. And behold, I am with you always until the end of the century" (Matthew 28: 18-20).

Returning to the excerpt (16), we note in the passage "Our Christian presence in the world is indispensable to evangelization, and so is that kind of dialogue whose purpose is to listen sensitively in order to understand" that the Christian's presence in the The world is important for evangelization, but it is equally important for establishing a certain kind of dialogue, which is characterized as having the purpose of "listening sensitively in order to understand." In other words, as we have seen earlier, according to the speech materialized in that stretch, the Christian have to worry about anything else of that evangelization. That something else is social justice. However, shortly thereafter, the enunciator asserts: "But evangelization itself is the proclamation of the biblical and historical Christ as Savior and Lord, in order to persuade people to come to Him personally and thus be reconciled to God." This statement marks an opposition in the text, which materializes through the argumentative operator "but", which works in a counterjunctive relationship with the previous argument, showing that evangelization is, in fact, the proclamation of the biblical and historical Christ as Savior. and Lord and not in "dialogue whose purpose is to listen sensitively, to understand." We will see other tensions like these in the next set of utterances listed below, which we cataloged under the theme tension. There is, therefore, an

opposition between two points of view, which discursively mark two positions of subject that attempt to dialogue, but which do not fit together: that of Orthodox Protestantism and that of Protestantism that dialogues with Marxism. The relationship between these two positions is again taken up in the statement (17), when the speaker states: "The results of evangelization include obedience to Christ, membership in his church, and responsible service in the world." Here, the first two aspects mentioned, namely, "the obedience of Christ" and "incorporation into his church" are related, as shown above, the interpretation of the biblical text Matthew (28, 18-20), interpreting these presented by orthodox Protestant theology; the last aspect, "responsible service in the world", presents a closer interpretation of what Pêcheux (1983) calls "hopelessly equivocal", since "responsible service in the world" can be read as related to both the evangelistic task, which must it is done with zeal and dedication, as a certain conception of social justice, which is linked more to what the above is displayed as "that kind of dialogue whose purpose is to listen sensitively in order to understand." Thus, the discourse that defends a social action within Protestantism seeks to insert itself, surreptitiously, into the discourse of Orthodox Protestantism.

The set (16) to (21) show how it would then give the insertion of the ideology of Marxism assumptions in evangelistic practice Protestant church, since, according to the speech embodied in/by the statements above, the sharer should now also include another type of responsible service in the world. Such an approach evangelism is presented as contrary to the alienation, the oppression, the discrimination, materializing thus one discourse that approaches the practice Marxist. The statement (20) shows more critical to American evangelists and the way of life they represent, the which, according to the speech embodied in the text, would be linked to capitalist production mode. However, the insertion of these themes in the text of the Lausanne Covenant was not without tension. We identify, even in that text, two enunciators, which we call the historical Protestant and Protestant Marxist, as we show in the analysis of the next topic.

#### *Theme: Tension*

(22) Although reconciliation with man is not reconciliation with God, neither social action evangelization, nor political liberation salvation, we affirm that evangelization and socio-political involvement are both part of our Christian duty. For both are necessary expressions of our doctrines about God and man, our love for our neighbor, and our obedience to Jesus Christ.

(23) The church is a community of God's people rather than an institution, and cannot be identified with any particular culture, social system, or political system, nor human ideologies.

(24) The development of strategies for world evangelization requires new and creative methodology. With God's blessing, the result will be the emergence of churches deeply rooted in Christ and closely related to local culture. Culture must always be judged and proved by the Scriptures. Because man is God's creature, part of his culture is rich in beauty and goodness; Because he experienced the fall, his whole culture is tainted with sin, and part of it is demonic.

(25) - we reject as being just a dream of human vanity the idea that man can ever build a utopia on earth. Our Christian confidence is that God will perfect His kingdom, and we look forward to that day, and the new heaven and the new earth in which righteousness will dwell and God will reign forever. In the meantime, we rededicate ourselves to the service of Christ and men in joyful submission to their authority over the whole of our lives.

In Topic 5 Lausanne Covenant, in which it finds utterance (24), "The Christian Social Responsibility", we read the opening statement that "God is the Creator and the Judge of all men." It is important to stress that in the previous questions the character of the judgment of God was not postulated at any time, even when, in the first topics, the theontological statements were expounded, since there would be more expectation of this kind of statement, since it is usually within the theological studies that presents the question of God as judge. The notion of judgment appears here, so inevitably to the development of this topic, because in it the enunciator introduces more explicitly, issues related to social justice and thus refers the coenunciador the discourse according to which God will judge the s practices of all. It is based on this supposed judgment that the enunciator defends the thesis that "we must share his interest in justice and conciliation in all human society, and in the liberation of men from all kinds of oppression." In this sense, as we have seen, Christians must engage in social justice practices in order to avoid the judgment of the divine legislator. Following the presentation of the central thesis on the topic "Christian Social Responsibility," the speaker sets out the issue of repentance for alleged failures in the evangelistic task. At this point, in the argumentative play of the text, all the "failures" and "regrets" mentioned in the opening topics lead to the statement "Here we also repent of our neglect and of having sometimes considered mutually exclusive evangelism and social activity". Moreover, the

phrase "here too", referring to these "repentances" and "failures" referred to above, is intended to lead the co-announcer to the thesis that there has historically been a "neglect" on the part of the Protestant church, which It allowed to consider if "evangelization and mutually exclusive social activity." This statement thus materializes a sense effect that now, and only now, does the church come of age by understanding its shortcomings, and therefore assuming the duty to correct them. Also according to the Covenant's enunciator, the way to make this correction would be to insert social activity into evangelistic practice. However, we see the continuation of the excerpt, the expression of a tension between the position of orthodox Protestant subject and Marxist Protestant subject position as the enunciator says: "Although reconciliation with man not be reconciliation with God, nor the social action evangelism, nor the political liberation salvation, we affirm that evangelism and socio-political involvement are both part of our Christian duty. For both are necessary expressions of our doctrines concerning God and man, our love for our neighbor, and our obedience to Jesus Christ." In this statement, issues appear which, in the previous topics of the covenant, are referred to as church failures, or at least as a significant part of those failures. Also according to the enunciator of the text, such flaws give rise to the need to insert guidelines and themes related to the issue of "social responsibility". Such themes materialize in the text through expressions such as: "reconciliation with man", "social action" and "political liberation". However, it is marked in this statement that there is a strong tension between Orthodox Christians and those who fit into the Marxist discourse, because the enunciator himself, linked to an Orthodox Protestant position, says that reconciliation with man is not reconciliation with God, what action social is not evangelization, and political liberation is not salvation. Thus, the issue of "social responsibility" is placed in the context of the evangelization of the church, but at the same time the tension between Orthodox and Marxists is marked, all due to the insertion of themes related to Marxism into themes that are part of the Church. Protestant Christian camp.

In utterance (24), the tension between Orthodox and Marxist is materialized in the claim that the church is rather the community of God's people and that it can not be identified with any particular culture, social system, or political system. human ideologies. To the extent in which the Marxist Protestant enunciator tries to approach the church culture, as we saw earlier, the Orthodox

Protestant states, as stated (24), that all it is tainted by sin, and part of it is demonic.

In the statement (24), see materialized another aspect of this tension between orthodox and Marxists. Such an aspect is materialized through the statement: "We reject as just a dream of human vanity the idea that man may someday build a utopia on earth", which, by an effect of memory on the present, refers to Marxism, which is implicitly presented as a paraphrase for this "utopia on earth".

In summary, the set (22) to (25) materializing the tension between an orthodox Protestant enunciator and a Protestant enunciator Marxist, either implicitly present in Lausanne Compact text.

#### IV. CONCLUSION

The text of the Lausanne Covenant of the document, document produced at the end of the International Congress on World Evangelization, 1974, in Lausanne, Switzerland, is a trail left by a speech in which speech is performed (MAINGUENEAU, 2001). In this sense, those who read the text of the Lausanne Covenant are immediately involved in its three scenes: the first, called the encompassing scene, corresponds to the type of discourse, namely, religious discourse, which challenges the co-announcer within religious field; the second scene, which is the general, relates to speech genres linked to the field in which the text was produced, at that point the Lausanne Covenant is shown as a statement doctrine will laugh and objectives; and finally, the scenography, which is the way the text shows itself, namely, that of a Covenant, covenant, creed or confession of religious faith.

The set design adopted by the enunciator of the Lausanne Covenant fulfills its role in bringing the co-announcer into contact with a scene known, validated, by Protestant Christians: the covenant scene. This is because, as shown earlier in this chapter, one of the central themes of the Bible, the book sacred of Christians, concerns the pact or to the alliance signed between God and man. Also according to the biblical text, this covenant/contract is initiated and affirmed by the deity and the covenant community is the church, which began with the vocation of Abraham. Likewise, also through the Lausanne Covenant, the signatories, the great authorities, both in the area of theology and in the area of evangelism, function as representatives of God, who, speaking for Him, propose a new Covenant that must be signed., as are the Christian creeds and confessions, by the church, as an expression of God's truth.

Thus, as with the assumption of Protestant theology, since Abraham's time, God has always maintained a covenant community on earth, the text of the Lausanne Covenant suggests a kind of new covenant sign that marks the true church and the true doing. missionary, namely, the concern with certain questions related to social justice, as also present in the Marxist presuppositions.

From this perspective, one of the meaning effects identified in the analyzes performed here is that, as in the biblical covenant, which was established in eternity among the Trinity Persons and presented to man in Eden, the Lausanne Covenant was formulated by representatives of this same God. And just as in the Bible man had to obey the covenant conditions, just as they were presented to him, for only then would God fulfill his covenant commitment to bestow blessings on man and his posterity, the Protestant churches, by subscribing to the Lausanne Covenant, how the text is presented to them, there would be blessed. This is because, even taking the Bible as a place for discursive memory, in the narratives of the biblical text, when man transgressed the divine commandment, thus violating the covenant terms, he lost the right to divine promises. Similarly, for an action of this memory on the actuality of the Lausanne Covenant, the effect of meaning materialized is that so too will succeed with the disobedient to the postulates of the said Covenant.

The scenography of the Lausanne Covenant still leads to the effect of a sense of unity, a unique discourse, and the integration of ideas. However, the analysis, what is presented in terms of set design, including important leaders of different Protestant denominations pictures signing the document, does not occur in argumentative level. The analysis shows a strong tension between two utterers, which we call "Orthodox Protestant" and "Marxist Protestant." Thanks to this enunciative framework, Marxist assumptions are introduced in the text of the Covenant, but there is also a reaction from Protestant orthodoxy to these assumptions. Such action is shown through different memory effects. Ultimately, the Lausanne Covenant text is an attempt to approach the orthodox Protestant Christianity of Marxist assumptions. However, this attempt characterized by argumentative tensions, which differs to some extent, the message of unity to the set design of the Covenant presents. In short, the Lausanne Covenant states that evangelization cannot happen in a way alienated from reality, because the church's mission should be integral, that is, the church must be committed to spiritual salvation but also to issues related to the Marxist notion of social justice.

Finally, we conclude that, at the International Congress on World Evangelization in Lausanne, South American Protestant leaders, proposed changes in the preparation of the Lausanne Covenant document, inserting especially issues linked to marxist the notion of social justice. The Lausanne Covenant thus functions as an important transition point for the emergence of Integral Mission Theology (IMT), which we will can discuss in a next work. The title given to this new theological current evokes the statement that was postulated in the Lausanne Covenant, excerpt No. 7, item 6 of the Covenant, entitled “The Church and Evangelization,” which says “world evangelization requires that the whole church bring the whole gospel to the whole world. From this statement comes the little phrase “the whole gospel, to all man, to all men.”

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# Socioecological Status of Human Ecology

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**Abstract**— *This article discusses anthropocentric, ecocentric, sustentric and biocentric theories, correlating a designated approach to capitalism and sustainable development. In order to ask: what is the ecological status of human ecology? Regarding the changes caused by man's action in nature and the very change that these actions infer his perceptions. Evolving biologically and socially entails changes, and it is pertinent to highlight that environmental problems, illusory issues of environmental preservation accommodate society, following the anthropocentric and capitalist bias. However, biocentrism presents an idea of respect between human ecology and interactions with the environment, addressing environmental education as one of the primary alternatives for changing attitudes, cultures and the perception that natural resources are finite, and they must be preserved for present and future generations.*

**Keywords**— *Biocentrism. Ecocentrism. To conserve. Perceptions.*

## I. INTRODUCTION

Human ecology is an innovative science that studies human-environment interactions, and the results of these relationships both in man and in the environment in which he is inserted. For this reason human ecology transcends other knowledge (BEGOSSE, 1993), provoking a search for subjective understanding, resulting from the inevitable changes that the human species causes in the environment and that the environment causes in the species itself.

Following a temporal and adaptive perspective, arising from the interactions between the bioecological factors explained by Begossi (1993). For human ecology, this text proposes a specific approach in ecological, social, political and anthropological bias. Seeking to define each of these aspects in the transdisciplinary context, addressing the consequences that such factors determine in the way of life of human societies.

In ecological status we highlight the Anthropocentric and Biocentric theories, before the Ecocentric and Sustentric conceptions, which in turn surpasses some cultural and environmental practices common in influential societies of anthropocentrism. In a capitalist society, where the status of greater domination is the result of the prevalence of anthropocentric theory, which aims for superiority, power over the dominance of other species and natural resources.

These conceptions may vary according to the individual's socioeconomic, intellectual, and cultural profile, as is political influence. Obeying the

aforementioned social criteria, anthropocentrism is the most dominant and oldest theory that has prevailed for about 2,000,000 years (STOPA; VIOTO, 2015). On the other hand, biocentrism and ecocentric and sustentric currents have similar ideals, which propose innovative conservationist measures for the environment.

Knowing each of these theories is essential to identify the profile of societies, and the approach of human ecology, which as a knowledge adopts a critical and analytical position on environmental sustainability. Evidenced only from the 1990s with the holding of conferences, which adopted the term “sustainability” as one of the factors that can transform social institutions, behavioral patterns and dominant values (RATTNER, 1999).

Factor that explains that the human being is part of the environment, understanding that the natural resources offered by planet earth are finite, endowed with economic value and essential for the maintenance of life, establishing, therefore, the concern with the conservation of natural resources. For Reigota (2017), there is an urgent need to seek means of conservation of natural resources, starting with the change in people's mentality.

Following these questions this text aims to identify in which socioecological status the human ecology is inserted, with the basic question, what is the ecological status of the human ecology?



## SUSTAINABLE DEVELOPMENT IN ANTHROPOCENTRIC, ECOCENTRIC AND SUSTAINABLE CONCEPTS

The concept of sustainable development confuses the noun sustainability with the adjective sustainable or presents sustainability with a characteristic of what is sustainable (CARVALHO, 2013). Scientific writings and research fit the definition that sustainable development is “one that meets the needs of the present without compromising the ability of future generations to meet their needs” (BRUNDTLAND, 1987).

The concept of sustainable development linked to current and future human well-being is also emphasized in Article 225 of the Federal Constitution of Brazil, 1988, by stating that everyone has the right to an ecologically balanced environment, as essential to a healthy quality of life, imposing It is the duty of the public power and the community to defend and preserve it for present and future generations (BRAZIL, 1988).

In both legal documents, the concepts give visibility to the information that must ensure the healthy environment for the human being of the present time and those to come. Thus, they highlight the human being as the recipient of such a right, corroborating the anthropocentric view of the relationship between man and the environment. For ecocentrism theorists, it is a very anthropocentric approach to the environment, as it analyzes the environmental issue in terms of human interests (JACOBS, 1993; BRAZIL, 2015)

It is worth mentioning a mistake expressed in the concept of sustainable development adopted by the above article, imposing on the collectivity the duty to “preserve” the environment for present and future generations. In the direction of sustainable development what is possible is “conservation” and not “preservation”. To conserve is to use natural resources not to cause their depletion for present and future generations and to preserve is not to use, to make it whole (ANTUNES, 2011).

Thus, the concept that best fits the conception of sustainable development is that of “conservation”, since nature is touched by humans to remove materials necessary for their survival. It is a myth to believe that nature is preserved, ie free from human interference (DIEGUES, 1994). Moreover, it is clear that the legislator still confuses the terms “preserve” and “conserve”, bringing both as synonyms (COSTA, 2007).

Boff (2017) defends the idea that sustainability is a term often used to disguise capitalist interests, even calling it “ecological falsehood” and “greenwash” as a way to deceive people about the real intentions of using the term in question by many sectors of society. The same author

points out that it is necessary to change human values and attitudes for true sustainability to occur.

Still, some argue that sustainable development is a new version of capitalism in crisis, so as not to lose space among consumers, disrupted by economic and environmental balance, to ensure that the most favored classes do not lack resources for present and future generations (COUTO et al., 2014). Thus, sustainable development would be a creation of the capitalist system to soften its performance and create the idea that it cares about the environment.

It is noteworthy that even the Bible bears a passage that upholds the idea of human supremacy over the resources of nature, as stated in the book of Genesis: “And God blessed them, and God said unto them, Be fruitful and multiply, and fill the earth, and subdue it; and rule over the fishes of the sea, and over the birds of the heavens, and over every beast that moves upon the earth.” (Genesis chapter 1, v. 28). This reinforces the anthropocentric conception, since it preaches the dominance of nature's resources by the human species (MILARÉ, 2005).

Contrary to anthropocentrism, an ecocentric view of natural resources is suggested, although it does not exacerbate the value of man over nature (BOFF, 2012, apud BRASIL et al., 2015). Thus the centrality and importance rests on all living beings and not only on the human species. Each biotic and abiotic being has its relevance on the planet, without needing to be subordinate to each other, forming the biosphere.

It is known that there is still no harmony between socioeconomic development and the balanced environment. It is necessary to allocate in the level of importance all living species and not only the human one, in overcoming anthropocentrism by ecocentrism, in which everyone can live in harmony provided that the necessary is consumed and not the exorbitant (CARVALHO, 2013).

Overcoming, for now, the relationship of the anthropocentric and ecocentric paradigms with respect to sustainable development, deserves attention the sustainable paradigm. According to Brasil (2015), it fits the concept of sustainable development used today, because it does not put the human being out of the picture, as the most radical ecocentric line of environmentalists does, but the sustainable paradigm harmonizes nature and human life.

The importance of sustainable development and the defense of this model by many theorists is not denied as a way of mitigating the impacts caused by humans on nature. It is necessary that the theory of sustainable development has an epistemological basis that holds a logical guiding thread, which may be the sustainable paradigm of Gladwin et al. (1995).

Sustainable development in the sustainable conception is the most appropriate paradigm to promote growth and economic and social development, allied to a healthy environment. According to Nery (2009), economic activity needs to be integrated with environmental planning and aimed at promoting the welfare of citizens. It is necessary to align economic growth with social development and efficient ecological management (CORRÊA; HOELTGEBAUM, 2010).

To overcome anthropocentrism linked to environmental issues, the great challenge lies in the consciousness of the human species. "Care must be taken with the massification of subjectivity. Is it possible to build a new man? Yes, a new ethic, new values." (BRAZIL, 2015). This environmental awareness, although difficult, develops in environmental education to change values and attitudes toward the balance between the socioeconomic and environmental spheres. According to Morin (2008), quoted by Brazil (2015), the path is prudence, to bring a decent life, until reaching the level of consciousness.

Therefore, one cannot fall into the naivete or even the demagogic discourse of non-human intervention in nature, since both the conservation of natural resources and economic development are necessary for the progress of humanity and to alleviate social inequalities. What is sought is harmony between economic, social and environmental aspects. It is necessary to align economic growth with social development and efficient ecological management (CORRÊA; HOELTGEBAUM, 2010).

### **THE ECOLOGICAL ISSUE BETWEEN ANTHROPOCENTRISM AND BIOCENTRISM**

Anthropocentrism and biocentrism are two streams of philosophical thoughts aimed at understanding the ecological ethical context of society. Such questions are concerned with the ecological problems that occur naturally and the anthropic action of man, or even with the association of these factors. Therefore, Stoppa and Viotto (2015) state that the anthropocentric view considers man to be a superior being to other life forms, which causes selfishness regarding the dominance and exploitation of natural resources without worrying about the environment.

The anthropocentric current is old and perhaps for this reason concern with environmental issues has come to the fore, emphasizing it the industrial revolution, the technological revolution and capitalism, followed by the overexploitation of natural resources for human well-being. . Anthropocentrism is present as a majority legal orientation, meaning that man is still privileged with rights over other species (STOPPA; VIOTTO, 2015).

The pursuit of comfort standardized by capitalism is one cause of the cause of overconsumption. In addition, consequences such as the exploitation of natural resources, energy and the increase in the world's population have caused consumerism even more, leading to an environmental crisis, which only in the 1960s began to be spoken of as changes. of habits seeking to make humanity aware of the global environmental problem (OLIVEIRA, 2017).

However, the ecological aspects that differentiate anthropocentrism from biocentrism is that the former brings man as the center of the universe, not being part of nature, forming a selfish, immediate and inconsequential society that does not care about the future of humanity itself or the future. planet (STOPPA; VIOTTO, 2015). The economic factor being the main axis of anthropocentric society, and the second is a concept that came from biology man as part of nature.

In the biocentric theory life in its most varied forms is a universal reference center, treating man as an intelligent part of nature (FERREIRA; BONFIM, 2010). In this theory, there is respect for the environment, animals, concern and actions with the conservation of environmental resources. It is positioned as a different perspective on anthropocentrism, which has long prevailed influencing the culture, education and perception of many generations.

In the ecological field, biocentrism is challenging, presenting enigmatic proposals to remain in a capitalist society, since the ideals of the biocentric nature are hopeful and quite relevant in the face of the environmental crisis. On the other hand, few people are determined to give up their comfort for the sake of all life on the planet.

On these premises, is it possible to be totally biocentric? In a consumerist society does the biocentric current prevail? Here are the questions!

Thus, De Oliveira (2013) proposes that we be more critical with regard to ecological ethics, it is necessary to know the aspects of the philosophical political currents, which allow the reader / researcher reflection and decision making regarding their biological, ethical positioning. and social in the face of incalculable ecological problems for this generation and the future and the entire biota.

In the light of these epistemological currents Steil and Carvalho (2014) define the concept “ecological subject” as the set of beliefs, values and behaviors emphasizing a personality from the environment in which the individual is inserted, together with the development of the imaginative horizon. . Thus, human ecology is about studies of the interactions of the individual with the environment, inserting itself as the proposal to know the social and environmental issues, seeking to overcome such difficulties that prevent the sustainable living of the ecological subject.

For De Moura Carvalho (2017) the formation of ecological subjects is essential and needs to be reciprocal, becoming possible from the perception of the environmental crisis, which requires environmentally sound actions. These statements contradict the anthropocentric idea, in which De Moura Carvalho (2017) proposes a reciprocal relationship between man and the environment, living the concept of conservation that is in line with the proposals of human ecology.

Other theories are radical, aiming to cease technological development in order to take care of the planet. It is an illusion to believe in environmental preservation, because humanity is not willing to regress its evolution to the point of life of our ancestors, that would not be possible! In these questions it is clear that human beings need to develop their “environmental ethics”, marked by social developments in the twentieth, addressing environmental education as part of the ecological movement (FISCHE et al., 2017; DE MOURA CARVALHO, 2017).

It is a challenge for human ecology to overcome environmental ideologies embedded in the anthropological, economic, political, social, religious and cultural context of a society. This fact determines that to be an ecological subject one must realize the seriousness of the events, at local and global levels. Thus, De Moura Carvalho (2017) proposes pedagogical ideas in environmental education that raise awareness through the finitude of natural resources.

When Engels (2018) says that man modifies the environment and the environment modifies it, it means that the anthropic transformations occurred in nature caused by the human being, also changed the way in which the individual perceives the environment, having his conscience formed by his coexistence. in the landscape in which it relates. For SIRVINSKAS (2018) time is not a linear sphere and the environmental changes that occur on the planet have rapid, severe and non-recurring consequences.

In the book “Modern Myth of Untouched Nature”, Diegues (1996) shows that the natural world is a conception that diverges between human societies and that the natural term refers to something untouched, that there was no human interference related to the concept of preservation. Unraveling this emphasis, and in view of reality, the alternative to slowing down environmental impacts is from biocentrism.

Man is the animal that causes most changes in nature, influences the acceleration of the finitude of natural resources (MENDONÇA, 2015; ROLLA, 2016). However, the experience of biocentrism can be one of the essential mitigating alternatives, so that present and future generations can enjoy sustainable living conditions and environmental health.

Is it possible to establish sustainable development measures in line with biocentrism? The term sustainable development is broad, and for something to develop it needs to be changed, Diegues (1996) give some alternatives, aiming at conservation and especially avoiding overconsumption and waste, perhaps the biggest problem is to explore and not have concern repair or conserve.

#### **A CRITICAL LOOK THROUGH ANTHROPOCENTRIC THEORY**

From the famous phrase of Protagoras, one of the sophists of ancient Greece, that “man is a measure of all things,” begins a transition from a cosmos thought based on interests in natural processes to an anthropocentric idea. , (FAT; SILVA). Philosophers were the basis for highlighting the human being at the top of the pyramid to the detriment of the other species with particular characteristic their rationality, standing out for their ability to think.

Still following a philosophical thought addressed by Hegel, the faculty of thinking is what separates men from brutes. We accept it as true, which the human being has more noble than the animal is thanks to thought, action, reflections on society (CHALFUN, 2014), and this difference should be the starting point for the innovation of human beings. ecologically sustainable habits, reducing

the accelerated and exacerbated consumption of the planet's environmental resources.

Anthropological conceptions, by themselves, take a selfish approach, in which man develops feelings of dominance and superiority, remaining as characteristics of civilizations, the power of domination that has gained a historical-social body in technology, and a technological civilization is undisputed. say that the instrument as a primordial form of relationship with nature (BOOF, 1995). Characterizing as a misguided justification of domination needed to expand and exploit nature and achieve the maximum of self-development.

Given these claims, industrial revolutions and the mastery of technologies were the most exploitative forms of direct human actions on the environment, without concern for the results, such as environmental degradation, which reached alarming levels of pollution, extinction of various species, climate change, eventually raising an environmental concern, including the lives of all beings, including humans (MILARE, 2009). It is not about the advance of techniques for generating the environmental crisis, but about a misconception of what man does with it.

Anthropocentrism becomes the thought or organization that makes the human being the center of the universe (MILARE; COIMBRA, 2014), also considering human values as the source of all value that manipulates, destroys nature, to satisfy desires. materials (PEPPER, 1996). Thus, the human being is contemplated in detriment of the feeling of superiority in relation to the other beings.

Anthropocentrism configures that attitude whereby one only sees meaning in things as they are ordained to the human being and fulfill their desires (BOFF, 1995). For example, in the process of world modernization, nature has become only a tool to satisfy a consumerist society and to feed the capitalist means of production, reproducing actions and thoughts of dominance that are established as problematic addressed in studies of human ecology.

Thinking about anthropocentric culture has made the human species obtain special characteristics, and therefore can determine what will be made of the lives of other existing species, using nature irresponsibly, not caring about the effects of such use, often causing irreversible problems (STOPPA; VIOTTO, 2015). Still, the environmental law that solidifies human attitudes becomes selfish because it is an idea of particular favoritism.

It is noteworthy that this form of thinking has been building an inconsequential society that cares little or nothing for the future of humanity itself and so little for the future of new generations (STOPPA; VIOTTO, 2015). Anthropocentrism is called the perspective of thought that takes as its paradigm the peculiarities of the human

species, showing that the only known environment is that of its existence.

Anthropocentric practices remain rooted in some sectors of contemporary society, which prevents many advances in environmental care, especially the conservation of endangered species (ABREU; BUSSINGUER, 2013). Reproducing an individualistic ideology that aims to make a profit and to continue the exploitation of natural resources, which create and recreate terms to aim for the maintenance of power through unsustainable ideas.

When Capital praises, supports and rewards environmental protection measures, it is certainly because such initiatives do not affect the very interest of their reproduction (BOMFIM, 2014). They are always weak decisions that do not bring effective solutions, being unable to remedy any environmental damage, in this sense, the socioeconomic interest is the most relevant objective for harming natural resources, perhaps being the biggest reason why environmental education is ineffective, as it covers the economic aspects and metals.

The status of mistress of truth, human reason acquires a warlike power in relation to nature which for many centuries has been used in a humanly irrational way to generate a vicious circle of wealth accumulation (BONFIM, 2014). This circle still remains internalized not only in accumulation, but in essence a system that spares no effort to reach its maximum.

In the anthropocentric view the economy is seen as a linear, closed and isolated system of nature, with positive growth, and the expansionist strategy would be sufficient to generate resources for environmental protection, fostering the adoption of clean technologies, alleviating poverty and improving poverty. quality of life of the underprivileged, (SILVA; REIS; AMÂNCIO, 2010). However, what really happens is the opposite of the situation mentioned, in fact the social inequalities are blatant and the environment highly unbalanced.

What about anthropocentrism? Everything in the history of millions of years has reason to be solely because of the human being man and woman, nothing has alterities and meaning without him. All beings are at your disposal, to fulfill your wishes and projects, are your property and domain (BOOF, 1995). It is a major challenge for the century or the total destruction of resources, as the means to do so have already been built or create viable alternatives.

## II. FINAL CONSIDERATIONS

Human ecology seeks to answer social questions in the human-environment relationship, proposes innovative



and sustainable interactions, seeking to overcome anthropocentrism, in a conception of sustainable development, following an evolutionary idea that no life form should be harmed, that all biotic beings and Abiotics are important for the balance of the sociosphere.

Ecocentrism is a conception that defends nature itself and not for the sake of the human species. Conserving living and non-living natural resources is essential as they are important to the terrestrial ecosystem and not just for human needs. In this way, ecocentrism does not fit the literal meaning of the concept of sustainable development.

Anthropocentric conceptions arise not only from philosophers, but from texts cited in the bible with the idea that man was created in the image and likeness of God, with dominion over other species. Thus, it is apparently easier and more immediately effective to use biblical conceptions and personal, economic, and developmental welfare as a justification for radicalizing these aspects for the common welfare of the entire ecosystem.

These are foundations that contributed to the understanding of human superiority. That said, harmonious relations with the environment were increasingly distanced. In prehistoric and medieval periods the techniques did not give man advantages over nature, life was summed up only to obtain his own sustenance and could still be considered stagnation of humanity by conserving natural resources.

The worldview, in which the human being is the center and the end of all things, in view of their rationality and superiority over all nature, are concepts that must be overcome. Considering man as part of nature, the destructive practices of the environment must be overcome, because it is an ecological crisis, caused by a so-called political, philosophical and ethical posture, in order to achieve a satisfactory balance.

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# Determination of physical properties of *Eucalyptus cloeziana* sp. wood in different dimensions

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**Abstract**—The *Eucalyptus* belongs to the family *Mirtaceae* and has about 600 species with several varieties and hybrids, besides having different types of cells that adapt to perform specific functions. The objective of this study was to evaluate the physical properties of *Eucalyptus Cloeziana* wood, specifically, apparent density, basic density, moisture content, total volumetric retractability and anisotropy factor. The wood of this species was cut into three different sizes of species according to the current Brazilian standard, the old Brazilian standard and the French standard. The values found were similar to those found in studies of other researchers, which shows a data concordance for the *Eucalyptus Cloeziana* species.

**Keywords**—Density, Forest Biomass, Retratability.

## I. INTRODUCTION

Planted forests represent an essential role in the industrial supply of wood, which shows effectiveness in replacing timber from natural forests. The favor of this scenario occurs due to the rapid growth of plantations, forest yield and technologies applied in the forestry sector [ 1 ] The Brazilian forestry is based on the cultivation and management of some species, mainly of the genus *Eucalyptus* that represents more than 70% of the planted forest areas, in the year 2015 corresponded to approximately 5,630,000 hectares [2].

The species *Eucalyptus Cloeziana* is widely applied in the civil, furniture, energy, pulp and paper sector, this way is increasingly consolidated in the industry in Brazil [ 3 ]. In addition, this tree has a rapid growth, easy management and develops in a wide variety of habitats. *Eucalyptus* wood has a heterogeneous structure due to variations in anatomical elements, which implies the determination of existing variation patterns for better application [4].

*Eucalyptus* belongs to the family *Mirtaceae* and has around 600 species with several varieties and hybrids, besides having different types of cells that adapt to perform specific functions. The variations existing in the chemical, physical and anatomical compositions of wood among the species are remarkable, such differences may also be present within the same species, especially as a function of age, genetic and environmental factors [ 5 ].

Among the physical properties of wood, the specific mass, one of the main parameters of application, determines the final quality and the performance of raw material in industrial and technological processes, since it is directly related to most of the other properties, as well as the cellular composition of wood [ 6 ].

The basic density of wood and the relationship between Mass and volume are directly associated with moisture content, instability of dimensions and durability [ 7 ]. The present study aimed to determine the physical properties of *Eucalyptus Cloeziana* wood from Diamantina-Minas Gerais, specifically regarding apparent density, basic density, moisture content, retractability Volume and the anisotropy factor.

## II. MATERIALS AND METHOD

The procedures for the determination of physical properties followed the standard ABNT NBR 7190/1997 (adapted) [ 12]. The wood of the species *Eucalyptus Cloeziana*, object of study, from the region of Diamantina-Minas Gerais was cut in three different sizes of species (Fig. 1). The dimensions were in accordance with the current Brazilian standard ABNT NBR 7190/1997 (5cm x 3cm x 2cm), the Brazilian standard NBR 7190:1982 (3cm x 2cm x 2cm), and the French Norm (5cm x 2cm x 1cm) [ 13 ].



Fig 1 : Samples with different sizes

To calculate the factors associated with the physical properties of Eucalyptus Cloeziana Wood, the initial mass and the measurements of the sides of the cross section, length and width of 50 species were determined for the three different sizes. After measurements, saturation of the species was performed (Fig. 2). The wood samples were completely submerged in water around 90 days, and during this period, the water was changed weekly and the mass was verified to accompany the progression of saturation. This procedure was performed for the determination of saturated mass and volume.



Fig 2 : Saturation Analysis

Then all these bodies were subjected to a maximum temperature of  $103 \pm 2 \text{ }^\circ\text{C}$  in a greenhouse for the calculation of the dry mass and volume. During drying, the masses were checked every 6 h until there was a variation between two consecutive measurements less than or equal to 0.5% of the last mass measured for all sizes of species, this fact occurred in the third weighing.

The calculation of densities and moisture contents were performed according to the following equations involving mass and volume ( $M_i$  = initial mass (g);  $M_o$  = dry mass (g);  $M_s$  = saturated mass (g);  $V_i$  = initial Volume ( $\text{cm}^3$ );  $V_s$  = saturated Volume ( $\text{cm}^3$ )).

$$\text{Aparent Density (g/cm}^3\text{): } D_{ap} = \frac{M_i}{V_i}$$

$$\text{Basic Density (g/cm}^3\text{): } D_b = \frac{M_o}{V_s}$$

$$\text{Moisture Content (\%): } U = \frac{M_i - M_o}{M_o} \times 100$$

$$\text{Maximum moisture content (\%): } U_{max} = \frac{M_s - M_o}{M_o} \times 100$$

The calculation of total volumetric retratibility and the anisotropy factor of wood were defined from the following expressions, noting that some were determined in an analogous way. ( $R_v$  = Total Volumetric Retratability (%);  $V_s$  = Saturated Volume of moisture ( $\text{cm}^3$ );  $V_o$  = Absolutely dry Volume ( $\text{cm}^3$ );  $L_t$  (Sat) = Saturated Tangential length (cm);  $L_t$  (dry) = Tangential Length

absolutely dry (cm);  $R_t$  = Longitudinal Tangential retraction (%);  $R_r$  = Longitudinal Radial retraction (%).

**Total Volumetric Retraction (%)**:  $R_v = \frac{V_s - V_o}{V_s} \times 100$

**Longitudinal Tangential Retraction (%)**:  $R_t = [L_t(sat) - L_t(dry)] \times 100$

**Longitudinal Radial Retraction (%)**:  $R_r = [L_r(sat) - L_r(dry)] \times 100$

**Anisotropy Factor** :  $A = \frac{R_t}{R_r}$

**III. RESULTS AND DISCUSSION**

The mean values of the apparent density found for the three different body sizes of the test: current Brazilian norm, the old Brazilian norm and the French norm were, respectively, 0.780; 0.755 and 0.668 G/cm<sup>3</sup> and the values of the basic density, in this order, 0.603; 0.600 and 0.541, both at 14% humidity. The mean values of the basic and apparent density of Eucalyptus Cloeziana Woods indicate that they are inserted in the class C30 of NBR 7190/1997 for structural application purposes and the figures found in the literature were similar to those obtained in this study. The species with dimensions according to the current and the old norm presented very close results and those who followed the French norm had a higher variation, however, do not interfere in the classification of wood. The following table points out the average values found (Table 1).

Table 1: Mean values for determination of the apparent densities and basic densities of Eucalyptus Cloeziana wood.

Samples	Apparent Density	Basic Density
(cm)	(g/cm <sup>3</sup> )	(g/cm <sup>3</sup> )
5cm x 3cm x 2cm <sup>1</sup>	0,780	0,603
3cm x 2cm x 2cm <sup>2</sup>	0,755	0,60
5cm x 2cm x 1cm <sup>3</sup>	0,668	0,541

<sup>1</sup>ABNT NBR 7190/1997; <sup>2</sup>NBR 7190:1982; <sup>3</sup>French norm

The woody materials have a large amount of water that, most of the time, it is necessary to remove before the use of raw material [ 8 ]. The high moisture content of the wood is characterized as one of the factors that causes drying defects, which can cause warings and fendilhings and, therefore, it is important to obtain little variability around the desired average moisture content [ 9 ]. The moisture content is defined as the relationship between the

amount of water and the mass contained in the wood, with this, the ideal percentage depends on the application of the raw material. The tables below show the values found were very similar for the three different types of species (Table 2).

Table 2: Mean values for determination of the moisture content and maximum moisture contents of Eucalyptus Cloeziana wood

Samples	Moisture Content	Maximum Moisture Content
(cm)	(%)	(%)
5cm x 3cm x 2cm <sup>1</sup>	14,547	89,672
3cm x 2cm x 2cm <sup>2</sup>	14,966	100,950
5cm x 2cm x 1cm <sup>3</sup>	14,036	113,866

<sup>1</sup>ABNT NBR 7190/1997; <sup>2</sup>NBR 7190:1982; <sup>3</sup>French norm  
The total volumetric retraction found for the three different sizes of the test body: Current Brazilian norm, the old Brazilian norm and the French norm were, respectively, 19.80; 17.75 and 14.98%, that is, with the reduction of the Mass, the volume was also affected [ 14 ]. It is noted that there was a significant difference between the different sizes of species with a variation of approximately 2% between the samples of the Brazilian norms and 2.77 and 4.82% when compared with the French norm. The value verified in the species of ABNT NBR 7190/1997 is in conformity with the values presented by [ 3 ] which obtained a number of 19.68%.

According to [10] the ideal anisotropy factor approximates to 1, this indicates that there was no variation or there was minimal variation in the wood dimensions or a symmetrical alteration was observed. The greater the difference between the variations of the dimensions the greater the anisotropy factor, which results in an unwanted behavior in the drying and moisture absorption processes. The anisotropy factor values found for the species of the current Brazilian norm, the old Brazilian norm and the French norm were, respectively, 1.352, 1.259 and 1.513, being within the range that qualifies this wood as excellent For use, because it does not allow for warings and Twitions [11] The following table shows the mean values found (table 3).



Table 3: Mean values for determination of Total volumetric retractilities and anisotropy factors of *Eucalyptus Cloeziana* Wood

Samples (cm)	Total Volumetric Retrability (%)	Anisotropy Factor
5cm x 3cm x 2cm <sup>1</sup>	19,80	1,352
3cm x 2cm x 2cm <sup>2</sup>	17,75	1,259
5cm x 2cm x 1cm <sup>3</sup>	14,98	1,513

<sup>1</sup>ABNT NBR 7190/1997; <sup>2</sup>NBR 7190:1982; <sup>3</sup>French norm

#### IV. CONCLUSION

The determination of the physical properties of wood allows the proper use of this raw material, in addition to preserving future problems in structural projects, making furniture, among others. The values found were similar to the studies of other researchers, which shows a data concordance for the *Eucalyptus Cloeziana* species. Finally, through this study, it was perceived the importance of this raw material in the present day, since it has a wide purpose and the physical properties of these materials confirms the possibility of use in various sectors.

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# Oral Health and Quality of Life: Perceptions of Adolescents Enrolled in a Health Promoting School

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**Abstract**— *Background*-Oral health is an integral part of general health and constitutes an indicator of quality of life in adolescence. The present study aimed to know the profile and the perception of adolescents of a health promoting school about oral health-related quality of life. *Methods*- Quantitative study of students of a health promoting school in Fortaleza using a questionnaire addressing sociodemographic data, general health and oral health status. The OHIP-14 (Oral Health Impact Profile) questionnaire was also used. *Results*- Participants were 210 adolescents aged between 11 to 19 years, with a mean age of 15.82, SD ± 1.269. The mean OHIP-14 score was statistically associated with: current general health ( $p=0.023$ ); health in the previous year ( $p=0.003$ ), hearing problem ( $p=0.004$ ); use of medication ( $p=0.002$ ) and difficulty in chewing and swallowing food ( $p=0.009$ ). *Conclusion*- The adolescents believe their general health is very good or fair; however, self-perception assessed by the mean OHIP-14 score showed that oral health can influence quality of life. In this context, the Health Promoting School constitutes an important space for the development of political practices and pedagogical strategies through which health priorities and social actions can be truly incorporated into education.

**Keywords**— *Oral Health; Self Concept; Adolescent; School Health.*

## I. INTRODUCTION

Adolescence is a period of life characterized by rapid and intense physical, social and cognitive changes that lead to new ways of thinking and relating and to new roles and responsibilities. Given that, large institutions have pointed to the need for programs and projects to promote the health, well-being and development of adolescents[1].

The World Health Organization (WHO) launched in 1995 the Global School Health Initiative to mobilize and strengthen health promotion and education activities at local, national, regional and global levels. The initiative was guided by the Ottawa Charter (1986) followed by discussions at the Fourth International Conference on Health Promotion (1997) and the recommendations established by the WHO Expert Committee on Health Education (1995). The initiative is intended to improve the health of students, school staff, families and other

community members through Health Promoting Schools [2].

According to WHO [2], school health promotion programs are more effective when guided by major themes and supported by the teacher, who plays an important role in the sustainability of education in school health actions. The teacher acts as a facilitator who will encourage changes in daily life at school to promote adolescents' health.

Adolescence is considered a period of risk for oral problems like caries, gingivitis and periodontal disease [3,4], particularly because oral hygiene is a complex practice [5]. Given that, health promotion in the school context should be entirely focused on three interrelated components: health education; development of life skills; and creation and maintenance of healthy physical and psychosocial environments that provide health services, healthy food and active life [6]. Therefore, health

promotion at schools should recognize oral health as an integral part of general health because a healthy mouth allows the person to speak, eat and socialize without discomfort or embarrassment [7].

A trend study was carried out to evaluate the progression of oral health of Brazilian adolescents over a period of 24 years based on the three national epidemiological surveys conducted in 1986, 2003 and 2010. The study identified a decrease in the prevalence of dental caries at all ages. However, when comparing that reduction to the values recommended by the World Health Organization and the International Dental Federation for the year 2000 [8], only the 12-year-old group reached the target for DMFT in 2003 (average number of decayed, missing and filled teeth divided by the number of people examined). None of the age groups reached the target set for the year 2010, particularly that set for the component “missing teeth”. Furthermore, according to the equation used in the study, the target set for DMFT in the 12-year-old group would only be reached in 2029 [9].

In this context, health and social policies must be adapted to and effectively conceived and integrated into the policies, processes and practices of education systems. In short, health must find its cultural anchor point within the education system [10].

Thus, the comprehensive nature of dental care requires integration with other professionals and understanding of life in all its aspects (e.g., physical, social and psychological). However, the assessment of such conditions requires indicators/indices, such as the OHIP (Oral Health Impact Profile), developed by Slade and Spencer (1994), and its short form—the OHIP-14 [11].

Researchers have pointed out that self-reported symptoms, perceived oral health status and need for treatment are relevant measurable dimensions of oral health and quality of life [12]. Therefore, good oral health is imperative to maintaining good general health, well-being and quality of life. In addition, it has a significant positive impact on self-esteem, dignity, social integration, and nutrition in general.

Thus, the aim of the present study was to know the profile and the perception of adolescents enrolled in a Health Promoting School regarding oral health-related quality of life.

## II. METHODS

This is a quantitative descriptive cross-sectional study conducted with adolescents enrolled in a Health Promoting School (HPS) located in the city of Fortaleza, Ceará, Northeastern Brazil.

Although Brazil's Statute of the Child and Adolescent (*Estatuto da Criança e do Adolescente – ECA*)

– law No. 8069/90 – considers adolescents to be 12 to 18 years old [13], the present study took into consideration the World Health Organization reference, which establishes that adolescence corresponds to the period between 10 and 19 years of age [14].

The health promoting school in which the research took place carries out educational activities aimed at promoting the health of the whole school community, which includes students, teachers, school staff and family members. The strategies developed at the school are supported by a University.

As a result of this partnership (school and university), three high school students who were junior scientific initiation fellows at the same school were prepared to be disseminators of health notions, particularly those related to oral health. The students underwent training in workshops on the issue.

As disseminators, the students were able to carry out health education actions in order to pass on the knowledge acquired in the training to their peers.

A census of students aged 10-19 years old was conducted in the health promoting school using a questionnaire addressing: a) sociodemographic information (age, gender, skin color, marital status, education, profession and income); b) general health (how do you feel, systemic disease, vision, hearing and speech problems, use of medication, smoking, and drinking); and c) oral health (dry mouth, difficulty chewing and swallowing, problems with the taste of food, burning mouth sensation, pain for no apparent reason, edema). Additionally, the OHIP-14 questionnaire was applied.

The OHIP-14 (Oral Health Impact Profile, short form) questionnaire contains 14 items whose answers are organized with scores ranging from 0 to 4, where: 0. Never; 1. Hardly ever; 2. Occasionally; 3. Fairly often; and 4. Very often. The OHIP-14 aims to assess the impact of oral problems on quality of life based on people's perception of dysfunctions, discomforts and disabilities due to problems in the mouth.

Absolute and relative frequencies were used to describe categorical variables; mean and standard deviation were used for numerical variables. The Shapiro-Wilk test was used to check the normality of data and the Mann-Whitney and Kruskal-Wallis tests were used for comparisons involving two groups or more than two groups, respectively.

The Shapiro-Wilk test was used to check the normality of the OHIP score prior to comparisons. The hypothesis of normality of data was rejected ( $p < 0.001$ ). Thus, nonparametric tests were used for comparisons. All the tests were performed with a significance level of 5%.

Without any conflicts of interest, the research project was approved by the Research Ethics Committee of the University of Fortaleza under Approval No. 745.659/2014. Written consent was obtained from the parents or legal guardians of students.

### III. RESULTS

Participants were 210 adolescents aged 11-19 years, with a mean age of  $15.82 \pm 1.269$ . Most participants were aged 15-19 years (181; 86.2), single (181; 86.2), women (140, 66.7%), *pardos* – Portuguese for Mixed-race Brazilians – (90; 42.9), unemployed (200; 95.2), had a household income of two or more minimum wages (111; 52.9) and eleven years of study (88; 41.9). A total of 19 students (9%) reported drinking.

Table 1 shows the oral health characteristics of the participants in relation to the analysis of the mean OHIP-14 score and the sociodemographic condition of the interviewees. There were no statistically significant differences.

Table 2 shows statistically significant associations between the mean OHIP-14 score and general health conditions: current general health ( $p=0.023$ ), health in the previous year ( $p=0.003$ ); hearing problems ( $p=0.004$ ); and use of medication ( $p=0.002$ ).

Table 3 presents the statistical analysis of the mean OHIP-14 score in relation to oral health. Statistically significant association was found for difficulty chewing and swallowing food ( $p=0.009$ ).

### IV. DISCUSSION

The Health Promoting School is defined as an educational institution with policies, procedures, activities and a structure that allow the protection and promotion of the health of all members of the community. Thus, an in-depth analysis of the objectives, functions and current operations of the school system is necessary to determine political practices and pedagogical strategies through which health priorities and social actions can be truly incorporated into education. This analysis should take into consideration the various cultural, economic and geographical aspects so that the various education systems and contexts can be understood [10].

It was in this context that we sought to know the perception of adolescents enrolled in a Health Promoting School regarding oral health-related quality of life. The students presented predominant characteristics which are shown in table 1. Most participants are 15-19 years old, single, women, unemployed and enrolled in vocational high school programs.

A total of 19 students (9%) reported drinking. This result shows that the Health Promoting School has

been effective in preventing this deleterious habit when compared to other studies conducted with adolescents in the school community.

Brazilian research found that 78% of the students analyzed had already consumed alcohol. Of these, 7% reported having consumed alcohol for the first time when they were between 5 and 10 years old, 45% when they were between 11 and 14 years, and 48% when they were between 15 and 18 years old. As for drinking frequency, 7% consumed alcohol at least once a week, 32% did it 2-3 times a week, 44% did it every weekend, 13% did it every day, and 4% did it occasionally [15].

International studies corroborate this reality. Data from Madagascar, Africa, show a high proportion of students who drink alcohol (69.1%), with men more likely to report this habit [16].

The hearing problems reported by 15 adolescents (7.1%) in the present study indicate that education professionals and society in general need to break the paradigm that deaf children cannot learn and cannot achieve the same goals as the other students. This requires changes in pedagogical practices, in school curricula, and in the educator's plans to work with such children because speech and hearing limitations cannot become a barrier to learning [17].

In addition, students' hearing health should be a major focus in school health promotion at all levels because the sense of hearing is one of the keys to good communication and learning. Research has shown that hearing health programs in educational institutions are aimed at the implementation of healthy habits, which involves the entire school community and environment, as well as the early detection of hearing loss so that it can be treated prior to affecting the students' performance [18].

In the context of oral health, dental diseases have a considerable impact on self-esteem, masticatory capacity, nutrition, and health in childhood and more advanced ages. Teeth have a significant role in the preparation of food for digestion, as well as in the aesthetics of the individual, in speech and in global communication [19]. Therefore, the experience of oral diseases has an impact on quality of life.

Research has shown that the health education provided by Health Promoting Schools has a positive impact on the oral health of adolescents, which can be observed by the low frequency of complaints related to this issue. In this regard, oral health education messages can be reinforced throughout the school years, which are the most influential stages of children's lives, and during which lifelong beliefs, attitudes and skills are developed [7].

In Denmark, school-based oral health programs have been developed over time and have involved the parents of young children in supervised brushing, which is encouraged from the age of six. As the age increases, educational actions become deeper, i.e., the students receive education about the following aspects: functions and structure of teeth, caries process, oral awareness about nutrition, hygiene models, trauma, sugar and types of candy, dental plaque, caries recording, mouth self-examination, health, well-being, general and oral health, flossing, lifestyles, gingivitis/periodontitis, and dental health care [20]. It should be noted that the involvement of the family, school and community in the process of planning and decision making is key to the success of these actions.

In the present research (Table 3), a statistically significant association ( $p=0.009$ ) was found between the mean OHIP score and difficulty chewing and swallowing food. Interviewees with such difficulties had a mean OHIP score of 13.9, which is higher than that of students who did not report these problems – mean OHIP score of 5.2. This shows that the higher the value obtained by the respondent, the greater the impact of oral health on quality of life [21]. In the group analyzed, this finding reflects a self-perception based on the actual limitations caused by the oral condition.

Another study carried out with adolescents found that chewing and swallowing problems were the most reported problems in the OHIP-14 questionnaire, with a mean score of 20.3% [22]. This mean value is similar to that obtained in the present study.

In order to successfully provide an integrated school health service, schools are calling for improvements in the working relationship between health care centers and the community [23]. It is believed that knowledge of the oral health status of a population and the factors that may influence it can help promoting behavioral changes that lead to positive attitudes towards necessary care. Thus, the oral cavity may reflect people's living and health conditions [3].

In the present study, the fact that the institution investigated is a Health Promoting School that is responsible for providing nutrition education by pointing out healthy foods, teaching about the chewing of foods and including in its menu foods that stimulate salivary flow may have contributed to the absence of statistically significant associations between the mean OHIP score and burning mouth sensation or pain for no apparent reason ( $p=0.057$  and  $p=0.064$ , respectively). However, those who reported feeling such problems presented higher mean OHIP scores.

Given that, it is assumed that an interdisciplinary approach can enable professionals to make decisions in an integrated way so that they can plan and carry out actions taking into consideration the epidemiological profile of the target population. Thus, medication control and a diet that stimulates salivary flow are helpful in dental care and effective in maintaining oral health [24].

The cariogenic feeding practices of adolescents favor the demineralization of teeth because of the acidic pH of foods purchased at school, such as snacks and soda [25]. Therefore, the multifaceted interactions between diet, nutrition and oral health require efforts from both the Nutrition and the Dentistry fields in order to assure the provision of comprehensive patient care in education and research practices [26].

Poor nutrition affects the teeth during their development and can worsen periodontal problems and oral infectious diseases. However, the significant effect of nutrition on the teeth is directly observed in the mouth – caries and enamel erosion. Tooth erosion is associated with acids from sugars and soft drinks [19].

It should be noted that self-perception of oral health is different across individuals, societies and generations. It is related to both physical and subjective aspects which are primarily influenced by socioeconomic and cultural factors [27]. These factors were related to preventive practices, daily oral health care, and social relations in the health promoting school analyzed.

It is known that the longer the average life of the population is, the more significant the concept of quality of life becomes. Thus, oral health plays an important role in this context [28]. The 2<sup>nd</sup> National Oral Health Conference considers that: "Oral health is an integral and inseparable part of a person's general health" [29]. Therefore, oral health care should be taught and encouraged in all stages of life, without interruption, so that the problems are minimized in adulthood.

The fact that the present research did not perform any comparisons with schools that are not health promoting institutions should be highlighted as a limitation. However, a study carried out in seven public schools has found adolescents with poor oral health conditions and a high prevalence of dental caries (51.29%) and pain (73.6%) that had a major impact on adolescents' quality of life [30].

Self-perception assessed by the OHIP-14 showed how much oral health influenced quality of life, although most adolescents believed that their overall health was very good. In recent years, there has been an increase in the promotion of oral health; however, there is an urgent need for preventive measures and oral hygiene instructions as early as possible.



## V. IMPLICATIONS FOR SCHOOL HEALTH

Education permeates the health promotion proposal and is aimed at contributing to the politicization of health debates and practices. Therefore, the parameters for the interventions should consider a broad view of the educational environment with its physical, social and psychological aspects.

Thus, it is important to ascertain adolescents' satisfaction with their oral health so that the organization of dental care can be performed in a comprehensive way based on the capabilities and needs of this population group.

The present study was carried out in a reference school; therefore, its findings are expected to serve as a basis for integrated health promotion actions and systematic evaluations of students' health aimed at improving their quality of life through preventive and educational strategies.

With the support from Health Promoting Schools, health professionals, teachers, parents and/or legal guardians can promote activities to increase knowledge about Health Education and to improve students' oral health and quality of life.

## HUMAN SUBJECTS APPROVAL STATEMENT

Without any conflicts of interest, the research project was approved by the Research Ethics Committee of the University of Fortaleza under Approval No. 745.659/2014. Written consent was obtained from the parents or legal guardians of students.

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Table.1. Analysis of the mean OHIP-14 score and sociodemographic characteristics. Fortaleza, Ceará, Brazil, 2016.

Variables	N (%)	Mean	Standard Deviation	p-value
<b>Age</b>				
11-14	29 (13.8)	5.6	7.3	0.819 <sup>1</sup>
15-19	181 (86.2)	5.4	6.7	
<b>Marital Status</b>				
Single	181 (86.2)	5.3	6.9	0.198 <sup>1</sup>
Other	29 (13.8)	6.2	6.2	
<b>Gender</b>				
Boys	70 (33.3)	5.5	7.5	0.680 <sup>1</sup>
Girls	140 (66.7)	5.4	6.4	
<b>Skin Color</b>				
White	69 (32.9)	5.8	6.6	0.066 <sup>2</sup>
Black	18 (8.6)	7.0	7.6	
Pardo	90 (42.9)	5.4	6.7	
Other	33 (15.7)	4.0	6.9	
<b>Employment</b>				
Yes	10 (4.8)	7.2	9.7	0.788 <sup>1</sup>
No	200 (95.2)	5.4	6.6	
<b>Income</b>				
Upto 2 MW	99 (47.1)	5.3	6.4	0.969 <sup>1</sup>
More than 2MW	111 (52.9)	5.6	7.1	
<b>YearsofStudy</b>				
10	78 (37.1)	4.2	5.6	0.331 <sup>2</sup>
11	88 (41.9)	6.1	7.3	
12	44 (21)	6.3	7.4	

Source: research data. <sup>1</sup> Mann-Whitney Test; <sup>2</sup> Kruskal-Wallis Test. MW = Minimum Wages

General health status	N (%)	OHIP Mean ± SD	p-value
<b>Self-rated general health</b>			
Verygood	84 (40.0)	4.3 ± 5.8	0.023 <sup>2</sup>
Fair	124 (59.0)	6.1 ± 7.1	
Poor	2 (1.0)	17.0 ± 15.6	
<b>Currenthealth status</b>			
Betterthanlastyear	67 (31.9)	4.0 ± 5.0	0.003 <sup>2</sup>
The same as last year	129 (61.4)	5.6 ± 7.0	
Worsethanlastyear	14 (6.7)	11.3 ± 9.2	
<b>Vision Problems</b>			
Yes	83 (39.5)	5.6 ± 6.7	0.789 <sup>1</sup>
No	127 (60.5)	5.4 ± 6.9	
<b>HearingProblems</b>			
Yes	15 (7.1)	9.8 ± 7.5	0.004 <sup>1</sup>
No	195 (92.9)	5.1 ± 6.6	
<b>Speech Problems</b>			
Yes	45 (21.4)	7.2 ± 7.9	0.129 <sup>1</sup>
No	165 (78.6)	5.0 ± 6.4	
<b>Current use ofmedication</b>			
Yes	39 (18.6)	7.4 ± 6.2	0.002 <sup>1</sup>
No	171 (81.4)	5.0 ± 6.8	
<b>Mouthwash</b>			
Yes	82 (39.0)	6.3 ± 7.6	0.210 <sup>1</sup>
No	128 (61.0)	4.9 ± 6.1	
<b>Drinking</b>			
Yes	19 (9.0)	7.1 ± 8.1	0.458 <sup>1</sup>
No	191 (91.0)	5.3 ± 6.6	

Source: research data. <sup>1</sup>Mann-Whitney test; <sup>2</sup>Kruskal-Wallis test.

Table 3. Analysis of the mean OHIP-14 score and oral health conditions. Fortaleza, Ceará, Brazil, 2016.

Oral Health Condition	n (%)	OHIP Mean±SD	p-value
<b>Drymouth</b>			
Yes	45 (21.4)	5.9 ±6.9	0.246
No			
<b>Difficulty chewing and swallowing food</b>			
Yes	7 (3.3)	13.9±9.7	0.009
No	203 (96.7)	5.2±6.5	
<b>Problems with the taste of food</b>			
Yes	14 (6.7)	9.6±9.6	0.102
No	196 (93.3)	5.2±6.5	
<b>Burningmouthsensation</b>			
Yes	5 (2.4)	11.6±10.0	0.057
No	205 (97.6)	5.3±6.7	
<b>Pain for no apparent reason</b>			
Yes	32 (15.2)	7.4±7.2	0.064
No	178 (84.8)	5.1±6.7	

Source: research data. <sup>1</sup>Mann-Whitney test.

# Pollution due to backwater Tourism and possibilities for use of Green Energy Technologies

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**Abstract**— Backwaters in Kerala state of India are water bodies nourished by rivers but there is little or no water current and in most cases connected to the sea. Vembanadu lake, the largest backwater in the state is also the largest wetland system in South India. The major attraction of the area is backwater tourism and is emerging as the main income source of the region since the introduction of houseboats. Vembanadu lake is included in the Ramsar sites and there is a great concern on the environmental degradation due to the backwater tourism. Hence a study was taken up to assess the ecological threats to the backwaters due to pollution. It was found that pollution from untreated sewage waste, seepage of oil from engine driven boats, discharge of non-biodegradable wastes were serious issues. Possibilities to use green energy technologies such as bioenergy and solar energy were evident in the study.

**Keywords**— Backwater tourism, Environmental pollution, Renewable energy, Bioenergy, Solar energy.

## I. INTRODUCTION

Vembanad lake is spread over the districts of Alappuzha, Kottayam and Pathanamthitta of Kerala state and is famous for backwater tourism. This wetland system lie in the humid tropical region between 09°00' -10°40'N and 76°00'-77°30'E. It is unique in terms of physiography, geology, climate, hydrology, land use and flora and fauna [1]. The lake is identified as a Ramsar wetland and supporting a bird population of more than 20,000 during winter [2]. The lake is also home to many rare and endangered species of fishes and birds.

In the past few decades Vembanadu lake has emerged as a major tourist attraction in Kerala. In former days, traditional boats used for transporting goods ('kettuvallam' in Malayalam) were mainly used for transportation of agricultural products to the markets and ports. With the change in the mode of goods transportation they were converted to house boats which are now the icon of back water tourism in Kerala. The traditional looking house boats are attractive to tourists and now tourism is a major economic activity in the area.

But, the population of houseboats has increased significantly in the recent years creating a serious concern on their impact on the wet land ecosystem. Even though there are legal restrictions and rules imposed by the government to mitigate the environmental impacts of

house boat tourism, there are many instances of negligence on the part of the operators. The waste from houseboats consisted of solid wastes including food wastes and liquid wastes like sewage [3]. Large quantities of diesel fuel are also being used for propulsion of boats resulting in pollution due to diesel and oil spilled from engines. Most house boats are air conditioned and they use diesel generators throughout the day. In an effort to mitigate global warming the concept of "low-carbon tourism" is emerging so as to provide a good tourism experience; but taking efforts to lessen carbon emission and pollution [4]. A study to identify the challenges to eco-friendly tourism has suggested changes in the "water-energy-food nexus" in vulnerable tourist locations [5].

There were efforts to study the possibilities of in-situ bioenergy production in wetlands for their sustainable management [6]. Biodiesel is biodegradable and its spill is not fatal for aquatic life as petro diesel spills. This renewable fuel can be used either in pure form or in blends with petro-diesel in unmodified engines. Countries like Philippines have been trying to introduce coconut oil biodiesel in the transport sector [7]. Even though coconut is an important crop in Kerala, little attention is seen paid on the production and use of coconut oil biodiesel. A number of Pacific island countries have plans for complete switch over to renewable energy with a major

focus on solar PV coupled with indigenous bioenergy production [8]. Utilisation of PV technology for powering the gadgets used in houseboats also is a possibility in the present context. In addition, the organic solid wastes including food wastes and sewage can be treated in anaerobic systems to produce biogas.

Hence a study was taken-up to understand the major pollution problems associated with back water tourism in Vembanad Lake and to propose suitable renewable energy techniques for reducing carbon emission and pollution.

## II. MATERIALS AND METHODS

### 2.1 Data collection

The methodology adopted for the present study was a mix of primary data collection through surveys as well as analysis of secondary data collected from various stakeholders. The survey was conducted during the months of February to April 2016. The pollution hazard in the area becomes severe in this period of the year due to the closing of the regulator (Thaneermukkam bund) which controls the outflow of lake water to Arabian sea, resulting in the stagnation of wastes in the backwaters. Information was gathered by interviews with key stakeholders, focus group discussions and interactions with a number of selected respondents. The office bearers of All Kerala House Boat Owners Association were also consulted (Table 1). Data from the Kerala State Pollution Control Board and documents from the Department of Port, Government of Kerala, were reviewed. The analysis was based on the surveys at two locations viz. Alappuzha and Kainakary. The present strategy and facilities for waste management available for the houseboats were also studied with a view to assess the usefulness.

### 2.2 Study of sewage treatment system

A survey was also done to assess the usefulness of the present waste management system. The technology used for the present system with respect to the requirement and technology options was also examined.

### 2.3 Assessment of renewable energy options

Based on the above studies and in consideration of the geo-physical and climatic factors, suitable renewable energy options were suggested.

Table 1. Details of informants

Sl. No	Category of informants	Total number	Percent of informants
1	Local inhabitants	50	38
2	House boat workers	35	27
3	Tourists	45	35
	Total	130	100

To quantify the possible biogas production potential of mixed organic wastes generated in houseboats, a random survey was undertaken in the Kuttanad area. Standard design procedures [10] were adopted for arriving at the design dimensions.

Solar energy availability was assessed by estimating the monthly average daily global radiation on a horizontal surface using the Page's equation [11].

$$H_o = \frac{24}{\pi} I_{sc} \left\{ 1 + 0.033 \cos \frac{360}{365} n \right\} \{ \omega_s \sin \phi \sin \delta + \cos \phi \cos \delta \sin \omega_s \} \quad (1)$$

'Ho' is the monthly average of the daily extra-terrestrial radiation on unit area of a horizontal surface at a specific locality of latitude  $\phi$  (9.6° N)

'I<sub>sc</sub>' is the solar constant (1367 W/m<sup>2</sup>)

'n' is the day of the year (1<sup>st</sup> January taken as 1)

' $\omega_s$ ' is the sunrise hour angle.

' $\delta$ ' is the solar declination estimated using the Cooper equation,

$$\delta = 23.45 \sin \{ 360(284 + n)/365 \} \quad (2)$$

The monthly average daily global radiation actually incident on a horizontal surface is given by [11]:

$$H_g = H_o \left[ a + b \frac{h}{H} \right] \quad (3)$$

'h' is the actual daily sun shine hours (ranged from 8.5 hours to 10 hours depending on the climatic condition) and 'H' is the maximum possible sunshine hours on a particular day in the specific locality. 'a' and 'b' are constants. For this study the constants for Thiruvananthapuram were taken into consideration i.e. a= 0.37 and b= 0.39.

## III. RESULTS AND DISCUSSION

The general information collected from different classes of local inhabitants as well as tourists gave a picture of



Fig.1. Perspectives of different classes of informants on pollution due to house boats

the environmental problems as well as their perceptions on the severity of problems.

3.1 General perception of respondents

The perspectives of the different classes of respondents when they were asked to record their opinion on the environmental hazard as ‘very much’, ‘slightly’ and ‘not significant’ were as shown in Fig.1. Out of the 130 respondents surveyed local inhabitants were the maximum (50) and majority of them were skeptical about the house boat tourism.

When 66 % of the local people and 51 % of tourists opined that the houseboat tourism ‘very much’ pollutes the environment, only 7 % of houseboat workers admitted that. More than 48% of the total respondents felt that houseboat tourism affected the environment ‘very much’. But, 32% of the respondents were of the perception that the environmental problem due to this venture was not significant. About 20 % of them opined that there was slight effect on the environment. In general, people who got direct financial benefit from the venture tried to see the issue as insignificant whereas most local inhabitants felt the pollution issue, even though they seemed to benefit from the venture indirectly. From Fig. 1 it is clear that local inhabitants as well as tourists were concerned about the environmental problems even though the house boat workers seemed to neglect them. The personal biases of the respondents are evident from this.

3.2 Assessment of sewage treatment plant

Another query addressed in the present study was the usefulness of the sewage treatment plant installed by the District Tourism Promotion Council in collaboration with the houseboat owners’ association. It was intended to prevent the discharge of sewage from house boats to the lakes and was supposed to have a treatment capacity of 180,000 litres of sewage per day. A layout of the system is shown in Fig.2. The sewage management process involved collection of raw sewage from house boats to an

Table 2. Perception of respondents on the extend of utilization of the sewage treatment plant

Respondents →	Local people		House boat crew		Officials	
	No.	%	No.	%	No.	%
Perception on usage ↓						
Well used	16	23.53	25	62.50	4	11.76
Low usage	12	17.65	15	37.50	10	29.41
Rarely	40	58.82	0	0.00	20	58.82
Total	68	100.00	40	100.00	34	100.00

equalization tank. Natural aeration by recirculation by the feed pump was expected to homogenise the effluent from the equalization tank which was fed to a reactor. The reactor working on electricity was based on the principle of electro-coagulation. The treated sewage coming out from the reactor was passed through a clarifier tank where the solids settle down. The clarified water was collected in a feed tank from which water was fed to a pressure sand filter and activated carbon filter. The outflow of the carbon filter was further treated by passing through an electro chemical oxidation unit for microbiological disinfection and the treated water was finally discharged to a soak pit.

From the survey, it could be understood that different class of people had different perceptions on the utilization of the treatment plant as shown in Table 2. More than 58 % of the local people felt that the treatment plant was not effectively used by the houseboat operators. They complained that the sewage from the houseboats were most often not transferred to the treatment plant and were dumped into the backwaters. The toilet sewage and other liquid wastes from the households on the bank of lakes also often found their way into the lakes. More than half

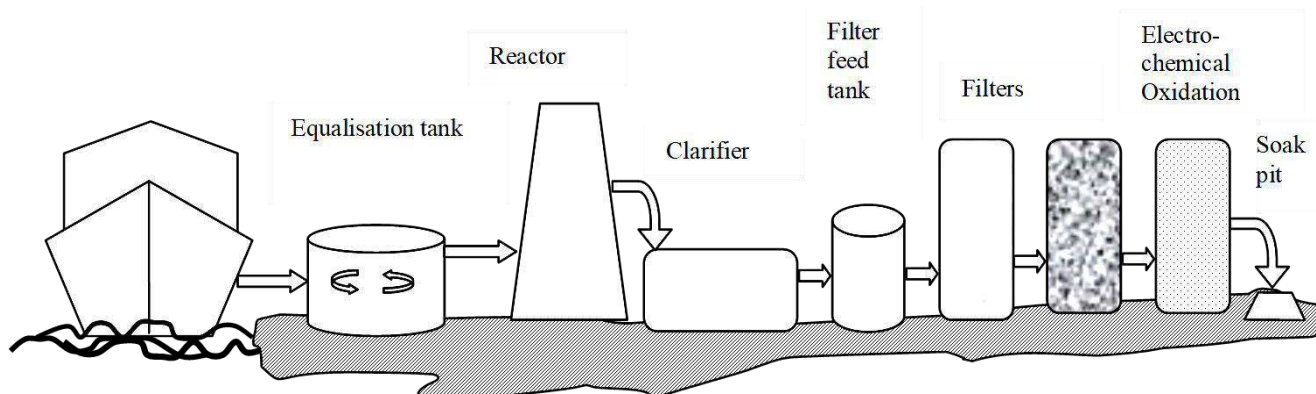


Fig.2. Layout of the sewage treatment plant



Table 3. Pattern and quantity of waste generation in house boats of Kuttanad region

Sl. No.	Particulars	Quantity
1	No. of house boats in Kuttanad region of the lake	838
2	Average number of house boats in daily service	465
3	Average number of persons per boat	10
4	Total amount of biodegradable solid wastes	1488 kg
5	Total amount of recyclable plastic waste	697 kg
6	Wastes to be incinerated	93 kg
7	Waste water	232.5 m <sup>3</sup>

of the respondents endorsed that the management of wastes and sewage is not at all done in a proper way. But majority of the houseboat crew (60%) responded against this and claimed that they do not dump sewage into the lakes. However a large percentage of the local people had the opinion that water and soil characteristics had been badly affected because of the backwater tourism. As per their opinion oil spill from engines also cause deterioration of the ecosystem. These observations call for urgent measures to address the issue of pollution so as to protect the ecosystem of the *Vembanad* backwaters.

The pattern and extend of waste generation in house boats are shown in Table 3. It was fairly evident that if a proper waste management strategy is implemented the pollution issue could have been addressed in a much better way than being done presently. It can be seen that the major portion of the wastes generated is waste water from bathrooms and kitchens of house boats which is difficult to be carried to the treatment plant and treated as the quantity is large. The better way to lessen the pollution will be the usage of less harmful detergents and chemicals. The tourists need to be educated on these aspects and they should be persuaded to follow an eco-friendly protocol for personal hygiene. If eco-friendly detergents with medicinal qualities are promoted they can replace soaps and other detergents to a great extent. If this is possible, the major portion of waste waters can be disposed in-situ without causing substantial harm to the aquatic life.

### 3.3 Possibilities for eco-friendly waste management and use of renewable energy

The non-biodegradable plastic wastes and biodegradable solid wastes should be segregated at the

source itself and transferred to collection centres located at convenient places. The biodegradable wastes can be used for biogas production. The waste generation pattern is shown in Table 3. About 1.5 metric tonnes of biodegradable waste is available for anaerobic digestion for energy production. Assuming an average biogas productivity of 60 litres per kg of organic wastes, total biogas that can be produced amounts to almost 90 m<sup>3</sup>. The Total Solids of the organic wastes fed to the biogas plant is likely to get reduced to 40 percent and hence the quantity for further treatment gets reduced. The output from the biogas plant may be treated for removal of pathogens and subsequently converted to organic manure. Only a small quantity of the waste needs to be incinerated for which the biogas can be utilized. The operation of treatment plant as well as other energy needs of the waste management system can also be met from the anaerobic system as fuel with a total heating value of 1800 MJ is available considering the heating value of biogas as 20 MJ/m<sup>3</sup>. Decentralisation of the waste management system is also possible, as small systems which can manage about 500 kg of wastes can be installed. Thus the size of the plants can be reduced as there are limitations due to high water table. As the wastes are having a high water content addition of further water for digestion may be limited so as to have about 10 % TS for the input material. Special and unconventional designs of anaerobic digesters may be required in Kuttanad area as the water table is high in most locations. Possibility of floating type digesters which can be anchored to the shores also can be considered. The proposed design aspects and dimensions of the biogas system is given in Table 4.

The estimated availability of solar energy during the months except June and July (off season) are shown in Fig. 3. The mean daily solar radiation incident on unit area of a horizontal surface during the 10 months period amounts to 24,358 kJ. Even though the cloud cover is less during the months of January and December, the solar energy availability is less due to the reduction in

Table 4. Design aspects of biogas system

Particulars	Capacity/ Quantity
Daily waste feed	500 kg
Total daily input volume	750 litres
Retention time	50 days
Capacity of digester	37.5 m <sup>3</sup>
Daily gas production	30 m <sup>3</sup>
Gas holder capacity	15 m <sup>3</sup> (50% storage)

maximum possible sunshine hours, which is dependent on the position of the Sun relative to Northern hemisphere. The maximum possible sunshine hours is decided by the latitude as well as solar declination. The declination is negative and maximum during this period. The maximum possible hours of sun shine are during the month of May the period being near to the summer solstice. Even though summer solstice occurs in June, due to the monsoon clouds there will be very less hours of bright sun shine, and the monsoon season of June and July has not been considered for the analysis. The maximum solar energy availability is in the month of March due to the reduction due to cloud cover in the month of May. It is noteworthy that sufficient solar energy is available during the tourist peak seasons.

At present, either diesel generators or electricity from the grid is used for powering the air conditioners and lights in the house boats. Solar charging stations on the shores could very well be used at least for lighting needs. Many houseboat owners are not favouring installation of roof top PV panels on boats due to the fact that the panels do not suit the aesthetic requirements of traditional looking house boats. However, floating PV installations in the lake is a possibility. New architecturally attractive design of solar panels to match the traditional house boats also is an alternative. As house boats are slow moving vessels, use of electric drives for propulsion of the boats needs to be seriously considered. There has been studies to evolve design procedure for solar PV powered boats [13]. Possibility of PV power stations to energise batteries is a possibility as new technologies are emerging in electrical energy storage. There has also been efforts to explore the potential of renewable energy use in isolated islands such as the Corales del Rosario Archipelago a national park of ecological importance in the Colombian Caribe [14].

Apart from solar PV, there is also a possibility to use solar thermal energy also. In general no solar water heaters were seen installed on the houseboats. Some area of the roof can be used for installation of a solar water heater without affecting the aesthetics of the boats. As food is being cooked inside the boat with LPG stoves, hot water availability for cooking can tremendously reduce the fuel requirements.

Another alternate green energy option is the use of coconut oil biodiesel for propulsion of boats. The current price of coconut oil is much higher than diesel fuel and hence the economic aspects of coconut oil biodiesel are not promising. But, the reduction in emission combined with the possibility of biodegradability in the instance of oil spills are factors favouring biodiesel usage for

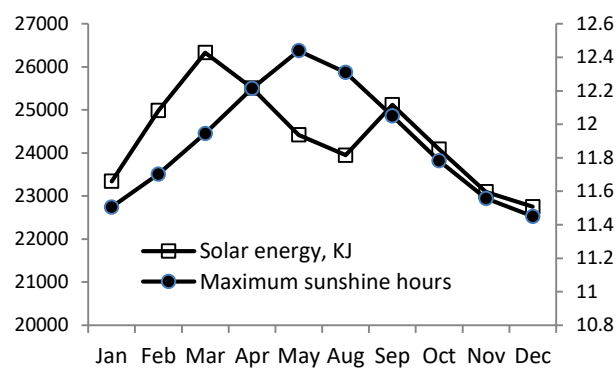


Fig.3. Monthly average daily solar radiation,  $\text{kJ/m}^2$

propelling houseboats. Prior studies have already proven [12] the advantages of coconut oil biodiesel in combating pollution due to diesel fuel.

#### IV. CONCLUSION

An overview of the pollution hazard due to tourism in the *Vembanad* backwater revealed the following salient aspects:

- i. The wetland ecosystem of the *Vembanad* lake is adversely affected by the tourism activities, especially houseboats.
- ii. The present waste management system is inadequate to keep the serenity of the area and the local people are badly affected by the pollution hazard.
- iii. Proper waste management strategies coupled with utilisation of renewable energy is recommended for reduction of carbon emission and environmental protection.
- iv. Anaerobic digestion of organic biodegradable wastes with simultaneous production of energy is a possibility. Decentralisation of waste management facilities and promotion of eco-friendly practices in tourism sector need to be promoted.
- v. Utilisation of solar photo-voltaic power generation has good scope as revealed by the analysis of solar radiation availability.
- vi. Solar thermal energy utilization by way of solar water heaters is a readily available technology and can be utilised in the houseboats.
- vii. Use of coconut oil biodiesel to replace diesel fuel used in house boats is also one among the possibilities of green energy technology even though the economic feasibility is not promising.
- viii. Integrated and decentralised waste management approach along with renewable energy usage is required to impart eco-friendly tourism in *Vembanad* lake.

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# Survey of Environmental Quality in Three Springs of an Integral Protection Conservation Unit in Manaus-Amazonas

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**Abstract**— Springs are characterized as groundwater environmental hydro systems, in which they occur temporarily or perennially, and are present in natural and anthropic areas. The present study analyzed the environmental quality in three springs located in an integral protection conservation unit in the city of Manaus, Amazonas. To characterize the study area, there was georeferencing of images from the Google Earth software in the ArcGIS and Qgis programs, the survey of the environmental quality of the springs was performed through the methodological procedure of macroscopic analysis of 12 physicochemical and biological parameters and, the classification of spring conditions by the sum of the degree of criticality of each item evaluated, resulting in a score. It was verified that two springs were classified as “bad” and “bad”, respectively, and only one spring was rated “optimal” for its environmental condition, due to its degree of distance from the urbanization limit. The results revealed a warning sign regarding the neglect of the environmental agencies regarding the protection of existing natural resources, consequently, indicate the need to carry out an inspection regarding compliance with the established laws for the preservation of water bodies and riparian forests.

**Keywords**— Hydro systems; Environmental Quality; Environmental impacts; natural resources; water bodies.

## I. INTRODUCTION

Natural territorial spaces intended for the protection of sites in certain zones are necessary for the maintenance of the environment, these spaces are defined as Conservation Units [29]. PAs are unique areas, given a range of ecological diversity and should therefore be protected by law [20]. In Brazil, the first movements for the establishment of conservation units started from the southeast region of the country, in which the concern with the protection of the predominant natural wealth of the locality arose.

These areas aim at maintaining ecosystems, regulating climate, supplying watercourses, guaranteeing social well-being and protecting places of great beauty, presenting the need to maintain natural resources and biodiversity from the establishment of protected spaces, in which limits of use and occupation are established according to legal instruments [4]. Only in the year 2000 there was the establishment of a legislation that protected the natural spaces.

Through Law No. 9,985 of July 18, 2000, protected areas were defined as “peculiar and highly relevant areas, legally established by the Public Authorities (municipal, state and federal), with conservation objectives and defined limits, under special regime. appropriate safeguards for protection” [6]. Based on this decree, the units were grouped into UC's of Integral Protection and Sustainable Use, where they have categories for the classification of protected areas [7].

The environmental protection functions that are applied in the concepts of conservation units also fall into the maintenance of springs and the formation of water bodies necessary for the life of the natural environment [14]. Law 12,651 of May 25, 2012, in its art. 3, clause XVII conceptualizes the springs as “groundwater outcrops that give rise to watercourses”, having no definite location for their emergence [5]. The outcrops are protected entirely by riparian forest in their surroundings and are typical of lowland areas, characterized by having sandy terrain and surrounded by vegetation consisting of palm species [25].



The delimitation of protected areas in urban areas is a positive point for the social and environmental environment, regarding the stabilization of rainfall regimes in cities and the supply of water bodies and groundwater. Despite the existence of legislation for the management and preservation of forest fragments, these spaces continue to shrink, one of the main factors being urban growth [8]. From this problem, the protected areas were classified according to their physical, chemical and biological characteristics in order to enable their control at the federal, state and municipal levels.

Municipal PAs also represent a relevant tool to influence the use and occupation of territories in municipalities by constituting an important element for the socioeconomic dynamics of the local landscape [12]. However, the complexity of the implementation of conservation units, their management and maintenance are becoming increasingly difficult, given the low investment in them and the lack of control of urban growth in the surroundings [22]. The problems for its establishment contribute to the reduction of these spaces in urban areas.

Given the need to preserve Conservation Units, especially those located in urbanized areas, methodologies for environmental analysis were developed [19]. These methods are intended to investigate the main indicators of degradation in the natural environment by macroscopic means. The macroscopic analysis consists in the determination of criteria of evaluation of the environmental impacts in a quantitative form.

In this conception, it should be noted that changes in the environment directly affect the social and economic environment, see the intertwining between these pillars. It should be noted that there is a dearth of in-depth studies that portray the environmental conditions surrounding the PNMN and its springs.

Given the above, this study aimed to perform a macroscopic analysis in three springs that originate the Igarapé do Mindu, during the ebb and flow of the river, which are located in the Municipal Park of Spring water of Mindu.

## II. MATERIALS AND METHODS

### 2.1. Study Classification

This study was conducted through qualitative and quantitative research, considering that the study was divided into two parts. The first part consisted of a bibliographic analysis in which the main articles that addressed the efficiency of applying macroscopic analysis in a conservation unit were classified. In the second part of the research a field visit was made to survey the macroscopic data about the site.

### 2.2. Study area

The study was carried out at the Spring water of Mindú Municipal Park - PMNM, where it is classified as an integral protection conservation unit. The UC is located in the Cidade de Deus neighborhood, Manaus, between the geographic coordinates 3°00'33.93" (south latitude) and 59°56'01.72" (longitude West of Greenwich), as shown in Figure 1.

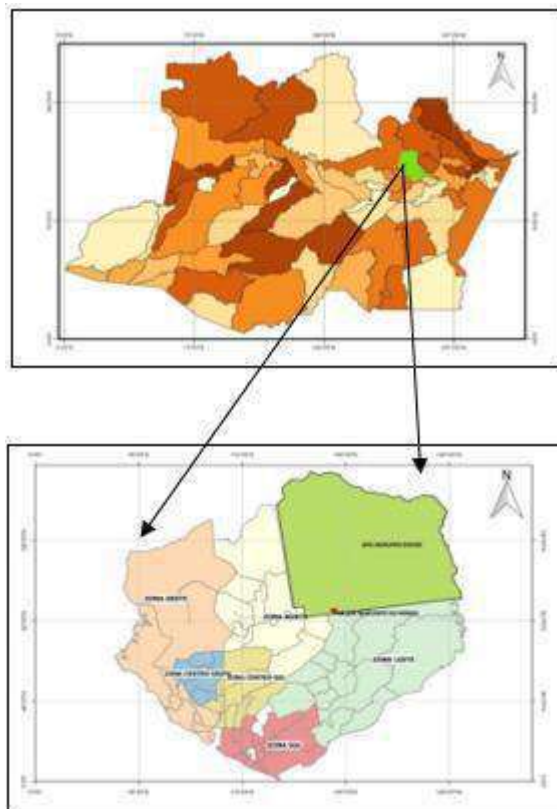


Fig. 1: Location map of the Municipal Park, Mindú Springs, Amazonas and Manaus.

Created from Decree No. 8.351 of March 17, 2006, the Mindu Springs water Municipal Park is home to the three (3) main springs that originate the Igarapé do Mindú. The neighborhood where it is located is one of the most populous in northern Manaus, with about 70,000 inhabitants. [26]

The PMNM is inserted in a region of humid equatorial climate, with annual average temperature of 31°, with maximum temperatures of 36° C and minimum of 29°C [2]. Relative humidity ranges from 77 to 80%, considered a normal percentage for the area where the study is being performed. And precipitation in the Amazon basin currently ranges from 1,000 to nearly 3,000 millimeters annually [17].

Regarding the predominant vegetation inside the park, it is characterized as Tropical Rainforest, typical of the Amazon region, with predominance of secondary forests, shoal forest and area with low vegetation. It was observed





By collecting the physical parameters of the present spring during the ebb season, it was found that it has a transparent water color, with no solid residues around the water body and no odor. A study along the same lines found that with regard to the water color parameter, it is found that 75% of their analyzed streams are light or transparent in color and 25% of their collected points are dark in color [10]. Water color is an analytical parameter that indicates the presence of dissolved substances in water [28].

No floating materials on their surface, oils and foams in their respective surface, nor the proximity of domestic sewage causing any disturbance or degradation were identified. Other studies that performed the same analysis presented satisfactory results regarding the evaluation of the present indicators, since of their 15 observed sources, four sources presented low contamination [15]. However, it should be considered that it is necessary to prove it by chemical analysis of water quality [1].

It was observed that the vegetation is native, in which some palm species were observed, such as buritis (*Mauritia flexuosa* L. f.), Acai (*Euterpe oleracea*) and several other species that are adapted to surfaces that have sandy terrain (also characterized like shoal zones).

In the preservation parameter, a research in the same field of analysis found that 72.73% of the vegetation-predominant springs are still preserved; however, 36.36% (3 springs) have a distance greater than 100 m from homes and establishment. , only one spring has a minimum distance of 50 m in compliance with current legislation [30].



Fig. 3: Arboreal species around Spring 01

Regarding the protection of the site, it is located in an area of closed vegetation, preventing direct access by people, requiring the support of environmental agents who are in the park and who make such a path to visit the source. In another study on the environmental quality of springs, it was found that they are devoid of fence to protect the surroundings, but legally protected [16].

Although there is some level of difficulty in accessing springs that are overgrown by vegetation, yet access to water bodies by humans is unavoidable [32].

In the parameter of human presence, some domestic wells were seen, possibly opened by the surrounding population. Near the source, the presence of people was visualized using the resource. The analysis of this indicator shows that in 53% of the studied sources there were signs of human presence through the deposition of residues to the ground and 23% of the sources had people close to the water body.



Fig. 4: Presence of artesian wells near the Spring 01

During the course, excessive rain-borne solid waste was observed in the park interior and an advanced gully in the ground in the slope zone, as shown in Figure 5. Briefly, gullies are large holes of erosion from human action or Natural. In this spring, the amount of solid waste was lower compared to Springs 2 and 3. In some studies on this parameter, there was a certain fluctuation in the amount of predominant waste near the sources [24].



Fig. 5: Presence of solid waste near east 01

Regarding the collection during the flood period, which reaches its maximum peak in July, the indicators analyzed in the present spring did not change significantly. One observation that differs from the first collection of the study in the ebb season was the finding of the soggiest terrain near the source, since at this time there is also extreme rainfall and an increase in the amount of water in the water table [22]. .



### 3.2. Spring 02 - (3°00'31.7 "S / 59°56'06.1" W)

Spring 02 had some opposite characteristics to Spring 01 and 03, as it was directly influenced by the discharge of domestic effluents from a sewage treatment plant that is located in the vicinity of the park. Considering that the degradation in water bodies is due to effluent discharge, such waste comes from residences and commercial establishments and from the growth of the surrounding community without adequate infrastructure [35].



Fig. 6: Sewage treatment station

As visited on site, observed the dark color of the water due to the large amount of organic matter deposited in it. A study carried out by four surveyed springs showed dark coloration and three springs fit as light, considering that they are in private properties and in public areas. However, it was observed that in the research carried out at Nascente Douradinho, in São Paulo, the water coloring characteristics visualized were similar to that of Nascente 02 and both presented the domestic sewage discharge activity in its bed.

The surface of the water body showed the presence of floating materials and domestic solid waste (television and pet bottles) inside the spring, as shown in Table 3. This parameter analyzed in other cases, resulted in only 18% of the verified sources were without floating materials [31]. On the other hand, other studied areas could observe the non-predominance of residues in the area of interest, however, floating materials were visualized in the water, such as PET's bottles. possibly coming from homes near the study site [23].

There was a moderate degree of foam and absence of oil on the surface of the spring. There was an advanced degree of odor from the WWTP, however, the odor from the outcrop was characterized as weak. It can be observed that the distance from the source to the sink was at least 50m.

With regard to vegetation, the characteristics are similar to those of Springs 01 and 02, since all are in lowland. The predominance of vegetation around the

springs is an important parameter due to its preservation capacity, as the vegetation cover promotes soil protection and stabilization [33]. Other factors affect the quality of the spring, even if there is a predominance of riparian forest in its surroundings [21].

The analysis of this spring during the flood period only found the human presence through clothes left in the vicinity of the study area, as shown in Figure 7. A weak odor and low foam on the surface of the outcrop were also found.



Fig. 7: Clothes around the Spring 02

### 3.3. Spring 03 - (0300'35.7 "S / 59°56'06.9" W)

Spring 03 was the first to be found along the way. In the first survey, the abovementioned survey had a large amount of solid waste in and around it, was odorless and contained an irrelevant presence of foams and oils.

Despite the presence of solid residues, the spring water coloration was defined as clear and considered in good condition. The water color parameter is the result of substances in solution that can be caused by elements such as iron or manganese, the decomposition of organic matter from water (mainly vegetables), algae or the introduction of industrial and domestic sewage [18].

As for the surrounding vegetation, it does not differ from the other sources studied. In contrast, Nascente 03 is more vulnerable due to its proximity to the urbanized area. One of the main consequences arising from the interference of anthropization on the springs is the flow, which may occur to the reduction of water flow and consequently its disappearance [9].

It has been found that accessibility to this spring is of mild degree, with no protection in its surroundings. The proximity to homes and establishments is a factor that influences their environmental degradation.

In a last survey carried out during the ebb period, Nascente 03 was silted due to the carry-over of sand and

solid waste into the park, mainly affecting the water system. The disordered growth of communities around protected areas causes social and environmental problems, mainly contributing to the degradation of water bodies and green areas [3].

Some parameters analyzed in the flood period differ from the first analysis, such as the amount of floating material on Source 3, the presence of surface domestic sewage and an advanced gullet from the surface runoff, as just above the surface. PMNM there are access roads.

#### 3.4. Analysis of spring preservation indicators

Considering that there were no exorbitant differences in the comparisons made between the flood and ebb periods of the river, we obtained as a result the classification of springs 02 and 03 in low preservation condition, as shown in Table 4. These areas are located near public places and homes, they do not have protection. Both were critical for the presence of solid waste, floating materials, sewage and human use. Thus, applying the preservation index through the sum of the points, Spring 02 scored 20 and Spring 03 scored 23, being classified respectively in Class D and E, as bad and bad [11].

Table 4: Indicator Results

SPRINGS WATER	SW1	SW2	SW3
Water Coloring	3	1	2
Solid Waste	2	1	1
Floating Materials	3	2	1
Oils	3	3	3
Site Protection	3	1	1
Insert Area	3	3	3
Sewer	3	1	3
Odor	3	1	3
Foam	3	2	2
Vegetation	3	2	2
Human Use	1	2	1
Animal Use	2	1	2
Equipment Urban	-	-	-
Visits	-	-	-
Punctuation	32	20	24
Preservation Level	Great	Terrible	Bad

However, Spring 01 is in adequate preservation condition, since the analyzes of its macroscopic characteristics were satisfactory, obtaining the classification A, as excellent. It should be emphasized that these data are considered alarming, given that the three springs are located in an integral protection conservation unit. Considering that one of the main functions of protected areas is to fully protect the natural areas of interest to future generations [34].

In the urban equipment parameter considered in the present study, the results were weighted by the distance from each source to the nearby urban areas, given that the conservation unit is in an anthropic pressure area. As for the visits, it was verified through the layout of the visitation book that, at the entrance of the park, about 300 people access the park freely for the practice of sport and leisure. In the data collection of three of its studied sources were under anthropic pressure due to its proximity to the anthropized areas [27].

Being a Conservation Unit of Integral Protection, it was verified the absence of signs, banners or informative that signal the existence of the present springs and the animals that occur in the park. The springs influence changes in the surrounding vegetation, together with urban facilities and facilitated access, their degradation becomes faster, affecting their entire environment [24]. Given that only one spring is preserved and performing its environmental activities normally, it is necessary to develop recovery techniques in the other two outcrops.

The park has an administration department that controls the entry and exit of visitors and employees who clean the unit. However, the solid residue parameter and, concomitantly, its impacts on the springs was the most critical data of this study, considering that in times of precipitation these residues are carried into the water body and green areas. These findings influence the environmental quality of the park and its springs.

#### IV. FINAL CONSIDERATIONS

The study of the seasonality of the three springs located inside the conservation unit was necessary, as they give rise to one of the main streams that cross the city of Manaus: The Mindu Stream. Thus, research on these outcrops becomes important not only for their representativeness in the capital, but above all for the importance of preserving water bodies and their challenges faced in the urban growth surrounding them. It is also emphasized that the studied sources are vulnerable.

From the above, it was concluded that the springs 02 and 03 are in a critical state of preservation, requiring direct intervention by the public agency. Despite the level of preservation of spring 01, this one is still vulnerable due to the amount of solid waste found in its path. Thus, it is of utmost importance to tighten existing environmental laws, meeting the unique needs of these areas, especially the increased security around the park. In this sense, it is suggested to deepen new researches that portray the environmental conditions of that unit and send this information to the competent agency.

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# Studies on the chemical properties of rainwater around the Distrito Industrial I, in the city of Manaus, Amazonas

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**Abstract**— *The objective of this study is to verify if the Industrial Pole of Manaus has a significant participation in the polluting load of the region, through the identification of heavy metals present in the rainwater. Collectors were distributed at three strategic locations and three rainwater measurements were made and sent to a specialized laboratory for analysis procedures. The method for analysis was Standard Methods for the Examination of Water and Wastewater, USA 2017. The results did not reveal significant concentrations of heavy metals, by the method adopted, but they revealed changes for chlorine, pH and electrical conductivity. Although there are no results for heavy metals other than iron, the other results show significant signs of industrial pollution.*

**Keywords**— *Toxic metals, Industrial pollution, Environment, Human health.*

## INTRODUCTION

Human activities, in particular industrial and transport activities, cause numerous pollutants to be released into the atmosphere that are harmful to the environment and humans, causing many problems that are often not observed or analyzed correctly.

Distrito Industrial, in Manaus, houses several industries from different segments, processing different raw materials, as well as some incinerators [34]. Knowing the products and by-products that are being dumped into the atmosphere is very important to characterize the tendency of the polluting load of some companies established in this micro region.

One of several studies conducted in this bias characterizes the chemical properties of rainwater, which have been developed in various areas of Manaus - AM, highlighting the study by Fernandes (2013) conducted by the Federal University of Amazonas - Ufam, which has shown promise, since it determines the quality and quantity of the polluting load of the Manaus Industrial Pole, AM.

The interference of man in the composition of the planet's atmosphere demonstrates the lack of knowledge of its consequences or the disregard of those known. The history of human life on earth is very recent and begins to significantly interfere in the atmosphere with the Industrial Revolutions and, if we consider the history begun when life began on Earth, such interference means nothing on this time scale. What remains for us is to predict the future

to ensure the survival of the human species and to better understand the resources present in our Planet [8], [18].

Climate change as part of these anthropic actions are strongly affected by changes in the terrestrial radiation balance components, the understanding of these environmental phenomena involves the knowledge of chemistry, physics and mathematics, which make up the scientific-technological basis. Therefore, the notion of climate cycles should include other conditions, such as: solar phases, glacial ages, comet and asteroid fall, oceanic-atmospheric conditions and cycles related to tectonism, volcanism, cosmic rays and supercontinent formation [10], [20], [25].

What drives such anthropic interference is the pursuit of economic development and the improvement of society's living standards leading to the increasing consumption of natural resources. Chemicals play important roles in industries, transportation, among others, contributing significantly to the improvement of living standards. Its use causes the release of gases, toxic metals, volatile and soluble organic compounds, suspended solids, dyes, nitrogenous compounds, phosphorus in air, water and soil [18], [20], [28].

Another scientific research highlights the concentrations of CO<sub>2</sub> in the atmosphere as the main climate regulator [10], according to Gerhardt; Reisdorfer; Cardoso (2017), in his analysis of pollutants in precipitation by industrial influences, highlights the concentrations of nitrogen and phosphorus, which are responsible for several problems, including the

eutrophication of rivers and lakes, as well as human health problems. .

It is evident that the global climate is the result of the complex interaction between the energy radiated by the Sun and physical variables such as liquid masses, relief, vegetation, among other factors, explaining the multiplicity of climatic typologies. Thus, any change in this system results in a natural and dynamic adjustment, characterized as climate change, which are events that have always been part of the earth's evolution process [10], [25].

Every economic activity generates some kind of environmental impact, be it in the physical, biological or socioeconomic environment. The socioeconomic development brought an environmental pressure that from the point of view of the use of resources accelerated the process of change, taking as an example the use of natural resources such as minerals (sand, gravel, etc.), industrial elements (Pb, Zn, Cu, Au), fossil fuels (natural gas, oil, coal), biomass (waste, wood), generating pollutant emissions and other environmental problems [16].

Manaus Free Zone - ZFM, created in 1957, with numerous industries established prior to the enactment of Law No. 6,938, which instituted the National Environmental Policy - PNMA, in 1981 [3], [34]. Conama Resolution No. 357, which provides for guidelines on water bodies, of the year 2005, as well as Conama No. 491, which provides for air quality, of 2018 [6], [7], has its pollutant potential evidenced through of the industrial processes it uses.

These establishments, for the most part, are not included in the register of potentially polluting activities and users of natural resources of the Brazilian Institute of Environment and Renewable Natural Resources - IBAMA, and are not part of the list of the annual report of potentially polluting and users activities. environmental resources - RAPP [15], where all activities with potential pollutants are required to report annually their pollution potential and the processes adopted for mitigation.

The impacts of air pollution are: direct weather effects on radiation transfer, sunlight, visibility and development of fog and clouds, greenhouse gas production releasing CO<sub>2</sub>, CH<sub>4</sub>, NO<sub>x</sub>, chlorofluorocarbons and hydrogenated halocarbons, photochemical effects, ozone formation in the troposphere, acidification involving SO<sub>2</sub>, NO<sub>x</sub> and NH<sub>3</sub>, and societal disorders (dust, odor, smog) that affect health and quality of life [2].

In the same vein as Von Sperling (2009), he stated that water and air quality are interrelated and the impurities contained in water come from many sources, defining that for the environmental area the concept of water quality is

much more complex when observed only its molecular formula H<sub>2</sub>O, having great solvent and particle transport capacity, incorporating several impurities, which define its quality.

Heavy metals have high levels of reactivity and bioaccumulation, triggering in the organism of living beings non-metabolizable chemical reactions, occurring their cumulativeness [27].

Notably, human activities in particular, industrial and transport, emit a load of pollutants and particles that harm the environment, such as acid rain that alters the hydrogenic potential (pH) of water bodies and harms the entire biota. Studies by Fernandes (2013), Neto (2015) and Kubota (2017) show that in addition to promoting human health problems, it can also compromise the artistic historical heritage. Identifying the chemical elements of these pollutants, such as inorganic metals, aims to know the air quality of a given region, thus seeking to reduce or even indicate treatment processes, aiming to minimize the impacts generated by them.

The objective of this study is to know the chemical properties of rainwater collected in an area around Distrito Industrial I, Manaus, Amazonas, identifying inorganic compounds such as cadmium, lead, chromium, iron, zinc and mercury; identify chlorine content, pH and electrical conductivity, comparing the results with the provisions of CONAMA Resolution No. 357/2005, which provides for the classification of water bodies and environmental guidelines for their framing, and the national standards of the air quality, established by CONAMA Resolution 491/2018, verifying if Manaus Industrial Pole has a significant participation in the polluting load of the region.

## MATERIALS AND METHOD

### 2.1 Area of Study

The study area is located in the city of Manaus, Amazonas, located in the east and south, housing most of the industries. Samples were collected at three locations, where Image 1 indicates the sampling points.

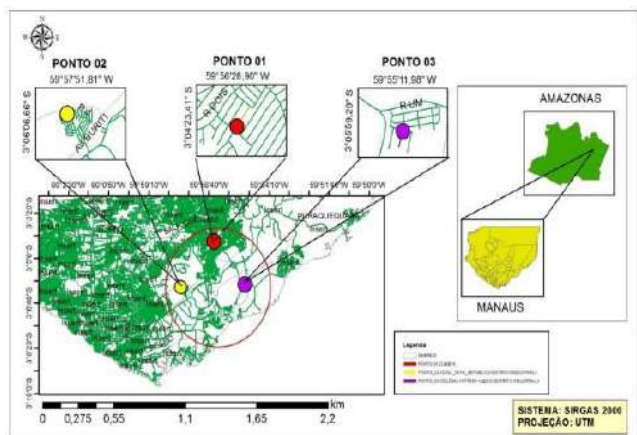


Image 1: Study area for rainwater survey. Source: Own authorship (2019)

2.2 Data Collection

Rainwater was collected through the locations named as: P-1, P-2 and P-3, beginning in June 2019 and ending in September 2019. For the collections, the following procedures were followed:

One liter of water was collected from previously sanitized GPP amber glass. The samples were analyzed in the laboratory of Micro-Lab Complexo de Diagnósticos Ltda, by the following procedures:

The laboratory used international models in accordance with the recommendations of the Standard Methods for the Examination of Water and Wastewater (23rd ed.); method 2510 B for conductivity analysis; Method 3030 E for the analysis of cadmium, iron, zinc, chrome and lead; method 3112 B for mercury analysis.

The electrical conductivity was analyzed using the digital conductivity meter. The samples were transferred to a nitric acid vial at pH <2.0, using the flame atomization and cold vapor atomization spectrophotometry equipment.

RESULTS AND DISCUSSION

Table 1 shows the results of the analysis of the samples collected from June to September 2019, including dry and rainy periods.

The method for the study did not reveal significant trace level concentrations for the metals Cd, Cr, Fe, Hg, Pb, Zn. The results obtained were different from those found by studies conducted by Fernandes (2013) and Santos E. (2019) at UFAM.

The results were influenced by weather conditions, due to the influence of the pollutant duration time in the place, as a function of the wind speed and direction, precipitation rate, temperature among other factors [33].

Some samples showed chloride indices, demonstrating that there are indications of industrial influences [14], associated with the incineration of plastic materials [30], characteristics of some factories installed in the Manaus

Industrial Pole [34]. Concentrations are demonstrated in the analysis of variance in Image 2.

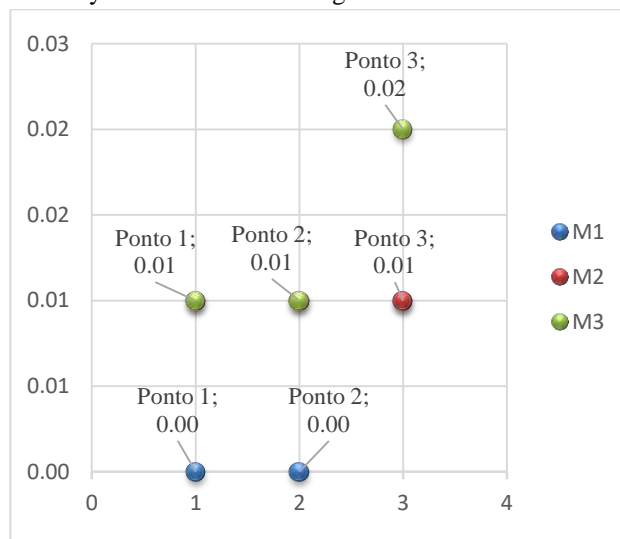


Image 2: Chlorine Variations.

Source: Own authorship (2019)

Analysis of variance shows that:

$F_{treatment} = 2,42857; p > 0,05$

$F_{block} = 1,42857; p > 0,05$

They do not present statistically significant differences [21].

The expected pH value for rainwater is 5.6, considered slightly acidic. The results of the samples show a pH with low acidification, neutral to alkaline, different from other results found as in the study by Botelho (2019), Fernandes (2013). For better understanding of the phenomenon more samples should be collected for studies of pH variations, the results of the analyzes are shown in Image 3.

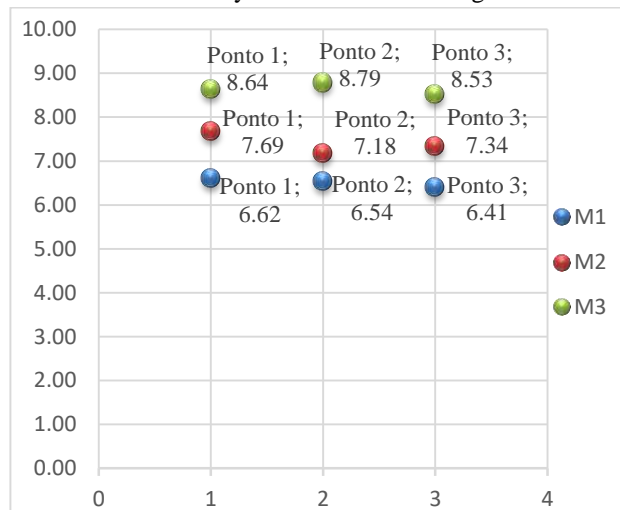


Image 3: pH variations. Source: Own authorship (2019)

Analysis of variance shows that:

$F_{treatment} = 0,22835; p > 0,05$

$F_{block} = 0,002571; p > 0,05$

They do not present statistically significant differences [21].

Through the analysis of Image 4, it is noticed a high variation of the electrical conductivity for point two, this fact is indicative of a high content of ionic species such as sodium, potassium, calcium, magnesium among others, as well as suspended particulate materials carried in the atmosphere during precipitation [32].

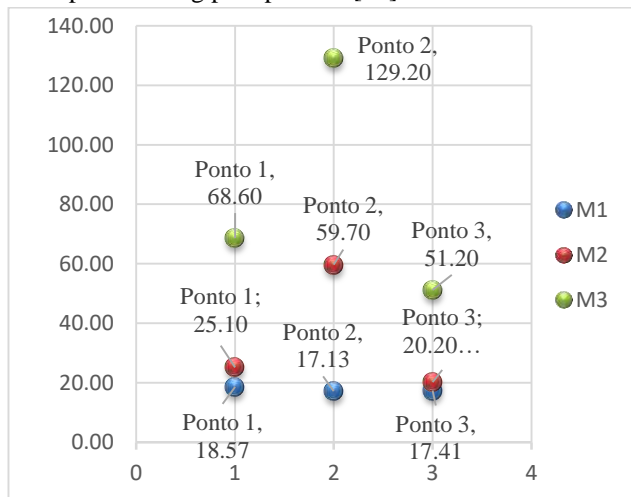


Image 4: Variations of electrical conductivity. Source: Own authorship (2019)

Analysis of variance shows that:

$$F_{\text{treatment}} = 1,3209; p > 0,05$$

$$F_{\text{block}} = 0,99; p > 0,05$$

They do not present statistically significant differences [21].

The presence of iron in sample three of point three can be explained by anthropogenic actions in industrial processes (paints, obtaining iron, fertilizers among others) suspended particulate material [1], [19]. After a dry period, the materials accumulated in suspension.

## CONCLUSION

The method used to identify the concentrations of traces of heavy metals Cd, Cr, Fe, Hg, Pb and Zn did not reveal significant statistical results, which does not make the study unfeasible since more accurate analyzes can be employed to obtain positive results. Comparisons with current legislation are unfeasible. However, the results obtained with chlorine, pH and electrical conductivity show a polluting profile of Manaus Industrial Pole, evidenced by the positive result found in the chemical element iron, suggesting that several industries should be submitted to IBAMA potential polluters register.

The study demonstrated the behavior of pollutant transport via wet deposition and emphasizes the importance of monitoring heavy metals emitted by industrial processes, in view of the negative burden it exerts on the environment and man.

It is clear the necessity of greater investments in the scientific production of its relationship with the environment and human health in the city of Manaus, Amazonas.

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# Phosphorus Rates Applied by Soil on Yield of Japanese Hybrid Pumpkin

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**Abstract**—Growing Japanese hybrid squash has been a cost-effective alternative to growers; however, several factors directly influence plant growth and development, nutrition being one of the main ones. Data regarding the nutrition of these vegetables are scarce. The objective of this study was to verify the effect of phosphorus doses applied via soil, on fruit yield of Japanese hybrid squash. Two experiments were conducted in 2017, May 1 through July and September 2 through November, in the experimental area of the Olericulture Sector of the Federal University of Tocantins. For the development of both experiments, it was used the Divina<sup>®</sup> cultivar owned by the company “Horticeres seeds”. The experimental design was randomized blocks with five treatments and four replications, as follows: 0; 75; 150; 225 and 300 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub>. The characteristics evaluated were: productivity (ton ha<sup>-1</sup>), average fruit mass (kg), number of flowers per parcel (unit), transverse diameter (cm) and phosphorus content in Japanese squash (g kg<sup>-1</sup>). The mean values related to the study variables were submitted to analysis of variance, and subsequently, regression analysis. The 300 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> provided higher yield and average fruit mass. In both growing seasons. Cultivation of the Japanese hybrid squash between September and November showed higher productivity.

**Keywords**—*Cucurbita* spp., *Cucurbita moschata* Duch, *Cucurbita maxima* Duch, phosphate fertilizer, productivity.

## I. INTRODUCTION

In Brazil, pumpkin cultivation has great social and economic importance, being consumed by all social classes, as it is a source of sugars, fiber, and carbohydrates, in Brazil, pumpkin cultivation has great social and economic importance, being consumed by all social classes, as it is a source of sugars, fiber and carbohydrates, besides being rich in carotenoids such as  $\alpha$ -carotene,  $\beta$ -carotene, and lutein (Veronezi and Jorge, 2011). The Japanese squash is an interspecific hybrid resulting from the crossbreeding of selected strains of squash (*Cucurbita maxima* Duch) with strains of the species (*Cucurbita moschata* Duch), the first being used as a female parent (Bisognin, 2002).

It has several advantages over open-pollinated cultivars, such as precocity, resistance to borer, yield stability, uniformity in size

and color of the fruit, resistance to handling, transport and post-harvest conservation (Vilela et al., 2007). Thus, for the fruiting of the plant, it is necessary to synchronize other pumpkins or strawberries that will serve as pollen suppliers for entomophilic cross-pollination or even the use of Parthenocarpy induction techniques through the application of growth regulators (Cheng and Gavilanes, 1980; Pereira, 1999).

Data on the national production of these vegetables are scarce. But according to IBGE (2006), pumpkin consumption has been increasing over the years, from 1.6 kg per person-year to 4.2 kg per person year<sup>-1</sup>. Hybrid squash cultivation is booming, dominating the market in some Brazilian regions. Brazil produces 426 thousand tons of hybrid squash, in an area of approximately 44, 9 thousand hectares, where the average productivity varies from 8-15 t ha<sup>-1</sup> (Filgueira, 2008). Several

factors influence plant growth and development, being fertilization one of the main ones, Vidigal et al., (2007) found that phosphorus was the third element most exported by the Japanese pumpkin fruit, just behind potassium and nitrogen. In fertilization, phosphorus is particularly involved in many functions within the plant, such as energy transfer, ATP required for photosynthesis, translocation, among others. In inorganic form, inorganic phosphorus (Pi) is a substrate or end product in many important enzyme reactions, including photosynthesis and carbohydrate metabolism (Fernandes, 2006). According to Mendes et al. (2016), it is the element that most influences fruit size and its deficiency begins with lower development of plants. Phosphorus is generally a limiting nutrient for agricultural production in tropical and subtropical soils due to its low soil content, which implies the constant practice of phosphate fertilization. Given the above, the objective was to verify the

effect of phosphorus doses applied via soil on the yield of fruits of the Japanese hybrid pumpkin.

## II. MATERIALS AND METHODS

Two experiments were installed in 2017, the first from May to July and the second from September to November, in the experimental area of the Olericulture Sector of the Federal University of Tocantins (UFT), in the municipality of Gurupi, located in the south. From the state of Tocantins at latitude 11°44'42 "south and longitude 49°03'05" west at 287 meters elevation. The climate of the region is characterized as being AW-Tropical climate domain of humid summer and drought period in winter, according to the Köppen classification (1928). Temperatures and rainfall rates in the southern region of the state of Tocantins, from May to November, are shown in Figure 1.

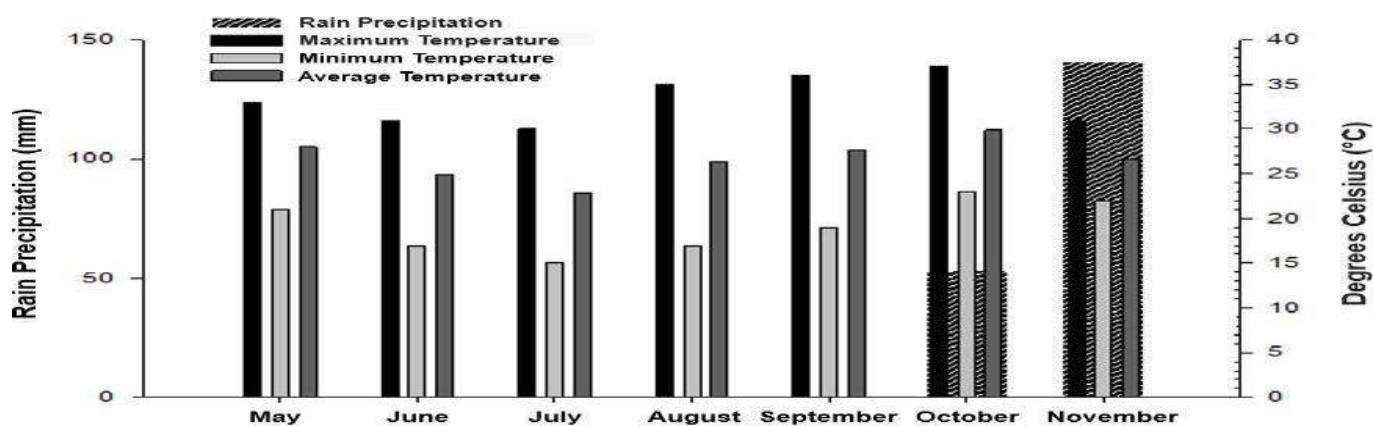


Fig. 1: Maximum (° C), minimum (° C), average (° C) and rainfall (mm) temperatures during the experiment period. Gurupi-TO.2018. Source: INMET, 2017.

The soil of the region in which the experiments were conducted is classified as Dystrophic Red Yellow Latosol, whose chemical characterization is presented below (Table 1).

The chemical attributes table presents the soil analysis of two distinct areas, being area 1 used for experimenting from May to

July and area 2 for experimental conduction between September and November. The chemical attributes table presents the soil analysis of two distinct areas, being area 1 used for experimenting from May to July and area 2 for experimental conduction between September and November.

Table 1. Chemical and physical attributes of the soils of the experimental area where the experiments were conducted.

Area	pH	P meh	K	Ca	Mg	Al	H+Al	M.O.	Clay	Silt	Sand
	CaCl <sub>2</sub>	--mg.dm <sup>-3</sup> --	-----cmolc.dm <sup>-3</sup> -----	-----cmolc.dm <sup>-3</sup> -----			--dag.kg <sup>-1</sup> --	-----%-----			
1	4.9	5	0.07	0.9	0.3	0.0	3.40	1.0	26	5	69
2	5.3	4.6	0.24	3.8	1.4	0.0	2.5	2.3	35	5	60

O.M - organic matter; O.C - organic carbon. The soil in the cultivated areas is classified as sandy loam.

For the development of both experiments, it was used the cultivar Divina® owned by the company “Horticeres Sementes”.

In both experiments, the experimental design was randomized blocks with five treatments that were doses of P<sub>2</sub>O<sub>5</sub> applied as MAP (Mono Ammonium Phosphate — 11% nitrogen and 51% P<sub>2</sub>O<sub>5</sub>) with four replications. In both experiments, the experimental design was randomized blocks with five treatments that were doses of P<sub>2</sub>O<sub>5</sub> applied as MAP (Mono Ammonium Phosphate — 11% nitrogen and 51% P<sub>2</sub>O<sub>5</sub>) with four replications. The doses were established as recommended for the crop and soil analysis results. In each plot, after the draw was established, 0 were applied; 75; 150; 225 and 300 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub>.

The acidity was corrected by applying 2 and 3 tons per hectare of lime filler (PRNT- 99.99%) with MgCO<sub>3</sub> content above 25%, for areas 1 and 2, respectively, increasing the saturation by the base at 60%. For plant fertilization 150 kg ha<sup>-1</sup> FTE, 100 kg ha<sup>-1</sup> potassium chloride (60% K<sub>2</sub>O) and as P<sub>2</sub>O<sub>5</sub> doses. Coverage fertilization was performed at 15 and 45 days after planting, using 80 kg ha<sup>-1</sup> of urea (45% nitrogen) and 50 kg ha<sup>-1</sup> of potassium chloride (60% K<sub>2</sub>O) per application.

The planting was carried out in pits (0.40 m × 0.40 m × 0.40 m), spaced 2.0 m × 2.0 m. Each pit was sown with two seeds and subsequently, germination was thinned, ensuring one plant per pit. The experimental plot, as well as the useful plot, consisted of 6 consecutive plants within the same row. At 30 days after planting, the daily monitoring of all plots of the experimental field began in the afternoon shift, aiming to identify flower buds capable of inducing asexual fruiting (parthenocarpy) the following morning. After opening the flower bud the next morning, between 6 and 7 am, with the aid of a mini hand sprayer, about 2 ml of 2, 4-D solution (2, 4-dichlorophenoxyacetic acid) was applied. At 200 ppm, inside the newly opened flowers of each plot. For the manufacture of the solution, 1 ml of the commercial product DMA 806 BR® Dow Elanco (pure source of 2, 4-dichlorophenoxyacetic acid), diluted in 5 liters of distilled water, was used and this solution was renewed every 7 days and stored in room temperature.

Weed control was carried out from chemical control and weeding. The water supply of the crop was performed with drip irrigation, where at 6 am and 6 pm, hoses with drippers spaced

25 cm and a pot of 2.5 liters per hour was triggered for 1 hour.

The harvest was performed 85 days after sowing from the observation that 90% of the fruits presented dry stalk and peel resistant to nail penetration.

The characteristics evaluated were:

— Average fruit productivity (ton ha<sup>-1</sup>): obtained by summing the average mass of fruits harvested from the useful area of each plot and the result was converted to ton ha<sup>-1</sup>;

— Average fruit mass (kg fruit<sup>-1</sup>): obtained by the total weight in a kilo of fruits harvested in each useful plot, divided by the number of fruits of each useful plot; —

Average fruit mass (kg fruit<sup>-1</sup>): obtained by the total weight in a kilo of fruits harvested in each useful plot, divided by the number of fruits of each useful plot;

— Number of flowers per plot (unit): obtained from counting the number of flowers of the 6 plants that make up the useful plot of each treatment; — Fruit cross diameter (cm): expressed in centimeter and obtained by measuring the fruit cross diameter;

— Phosphorus content (g kg<sup>-1</sup>): determined from equitable samples collected from all plants of the parcel at the vegetative stage, and on the fruits of each parcel.

The mean values for the measured variables were submitted to variance analysis and then regression analysis using SISVAR version 5.0 software (Ferreira, 2008).

### III. RESULTS AND DISCUSSION

In the analysis of joint variance, there was no significant effect of the interaction between the doses and growing seasons at the 5% probability level compared to the “F” test for all characteristics evaluated (Table 2), but in the unfolding of dose-effect levels within each season, there was a response to these characteristics with the variation of the applied dose. Only for the average fruit yield characteristic, a significant effect was observed at 5% probability by the “F” test concerning the applied P<sub>2</sub>O<sub>5</sub> doses (Table 2).

Table 2. Summary of analysis of joint variance (two evaluation times) on average fruit yield (PROD), average fruit mass (AFM), number of flowers per plot (NFP) and cross-sectional diameter (CSD) of Japanese squash produced as a function of P<sub>2</sub>O<sub>5</sub> doses. Gurupi –TO. 2017.

F. V.	D. F.	Q. S.			
		PROD (ton ha <sup>-1</sup> )	AFM (Kg)	NFP (und.)	C.S. (cm)
Blocks / Season	6	11,855 <sup>ns</sup>	0,0706 <sup>ns</sup>	39,700 <sup>ns</sup>	0,244 <sup>ns</sup>
Doses	4	29,128*	0,1392 <sup>ns</sup>	16,025 <sup>ns</sup>	1,339 <sup>ns</sup>
Season	1	37,597*	0,1587 <sup>ns</sup>	1060,9*	10,09*
Doses vs Season	4	3,4806 <sup>ns</sup>	0,0082 <sup>ns</sup>	16,525 <sup>ns</sup>	0,2543 <sup>ns</sup>
Average waste	24	7,6387	0,0441	17,408	0,7068
<b>Overall Average</b>		<b>13,05</b>	<b>1,69</b>	<b>18,850</b>	<b>11,55</b>
<b>CV (%)</b>		<b>21,17</b>	<b>12,41</b>	<b>22,13</b>	<b>7,28</b>

\* Significant at the 5% probability level; <sup>ns</sup> Not significant.

The second growing season presented superior results concerning the first growing season for all the evaluated characteristics. This fact must be related to the climatic conditions observed in the second growing season, mainly concerning precipitation that was higher than that observed for the first growing season Marouelli et al. (2017), evaluating the response of the Tetsukabuto hybrid

squash to water depths (irrigation + effective precipitation) and nitrogen doses, found that the average soil water stress at irrigation associated with water depths precipitation, maximized fruit yield, corroborating the results observed in this work.

The average yield, regardless of the growing season, increased linearly as P<sub>2</sub>O<sub>5</sub> doses were increased (Figure 2).

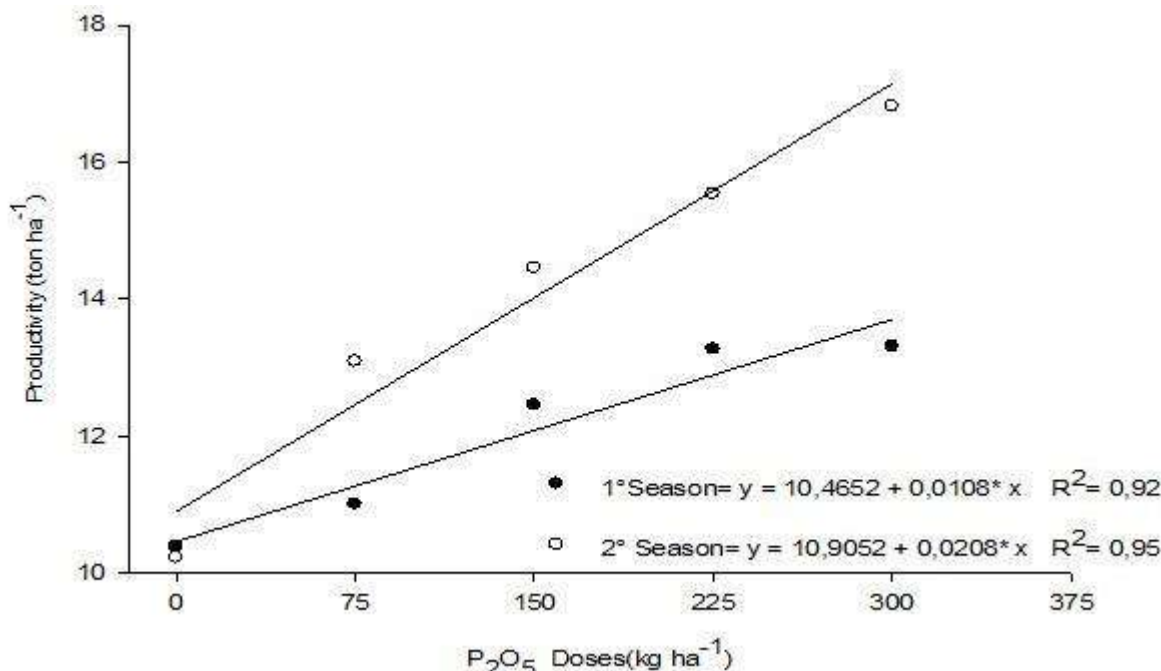


Fig. 2: Average productivity (ton ha<sup>-1</sup>) of Japanese pumpkin fruits produced as a function of P<sub>2</sub>O<sub>5</sub> doses. Gurupi –TO. 2017.

The 300 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> was higher in both growing seasons, which means that the maximum point was not reached under the studied experimental conditions.

For the first season, there was an increase of 2.9 tons, equivalent to an increase of 28% when compared to the control, while for the second growing season there was an increase of 64%



compared to the control, equivalent to a 6.5 tons, showing that the crop is very responsive to phosphate fertilization (Figure 2). The average yield obtained with the 300 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> in the second growing season is higher than the average yield observed for the state of Minas Gerais of 15 ton ha<sup>-1</sup> (Sediyama et al., 2009), however. Lower than the average productivity observed by Ferreira et al. (2017), for the state of Tocantins. Studying the phosphate fertilization in the irrigated watermelon crop in Cassilândia, Freitas Júnior et al. (2008), observed that the application of increasing doses of phosphorus in the planting did not provide the significant difference for the average fruit yield. Cortez et al. (2011) studying the effect of phosphate fertilization on melon production observed that there was a significant result for average yield, with 320 and 311 kg ha<sup>-1</sup> doses of P<sub>2</sub>O<sub>5</sub>, respectively.

The same was observed by Souza et al. (2017), who study the agronomic performance of zucchini as a function of phosphate fertilization, found that increasing phosphorus doses increased the accumulation and concentration of phosphorus in the plant and, consequently, the productivity of zucchini fruits. Similar results were found in this work.

Studies have shown that the effect of phosphate fertilization on crops is especially pronounced in low fertility soils, in which case phosphorus stimulates root development, it is fundamental to the production of early reproductive parts and generally increases crop production (Rajj, 1991).

For the average fruit mass characteristic, a behavior similar to that observed for average yield was observed, since the increase of the phosphorus dose in the soil increased the average fruit mass (Figure 3).

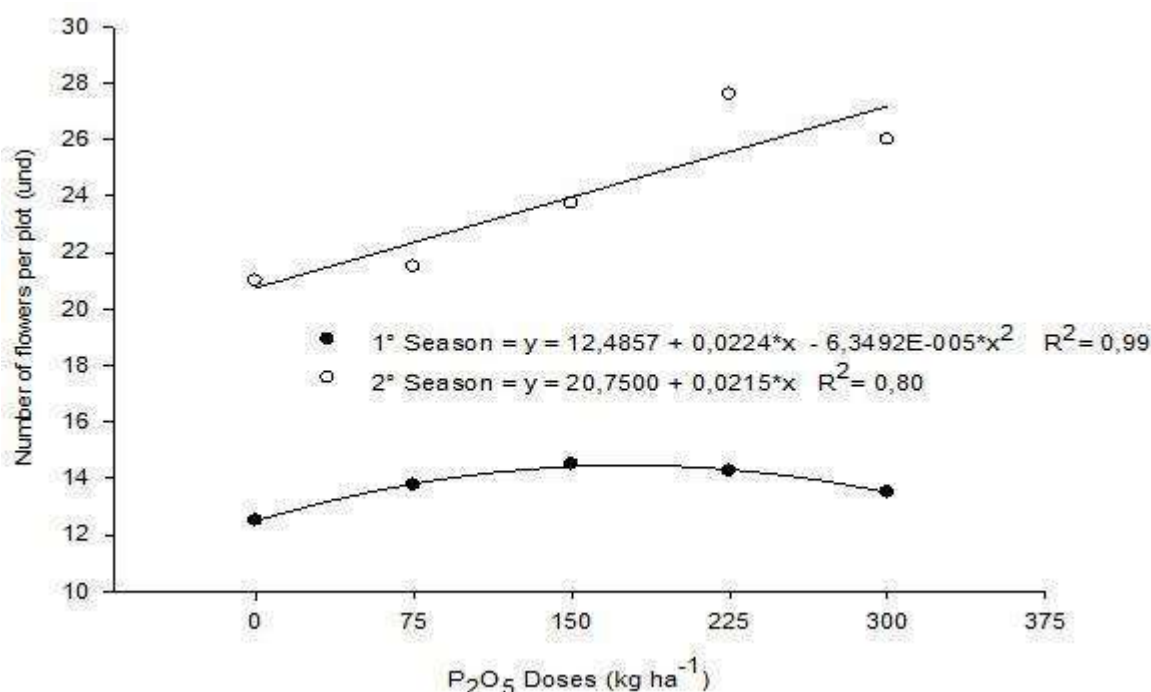


Fig. 3: Average fruit mass (kg) of Japanese squash produced as a function of P<sub>2</sub>O<sub>5</sub> doses and growing seasons. Gurupi –TO. 2017.

The 300 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> was higher than the others, presenting an increase of 18%, or 0.27 kg when compared to the control of the first season while for the second growing season, the increase was 24% concerning the control, which represents an increase of 0.38 kg (Figure 3), indicating that the maximum point was not reached in the studied interval.

The linear behavior of P<sub>2</sub>O<sub>5</sub> doses concerning the average fruit mass, corroborate the results found by Porto (2015), in a study on watermelon yield under phosphorus and potassium doses in the Cerrado of Roraima, however, Chaves (2014), in a study on watermelon yield under phosphorus and potassium doses in the Cerrado of Roraima, however, Chaves (2014), studying the residual effect of phosphate fertilization on production and accumulation of pumpkin nutrients did not observe significant results for this variable.

The P<sub>2</sub>O<sub>5</sub> doses directly influenced the number of flowers per plot of Japanese squash (Figure 4).

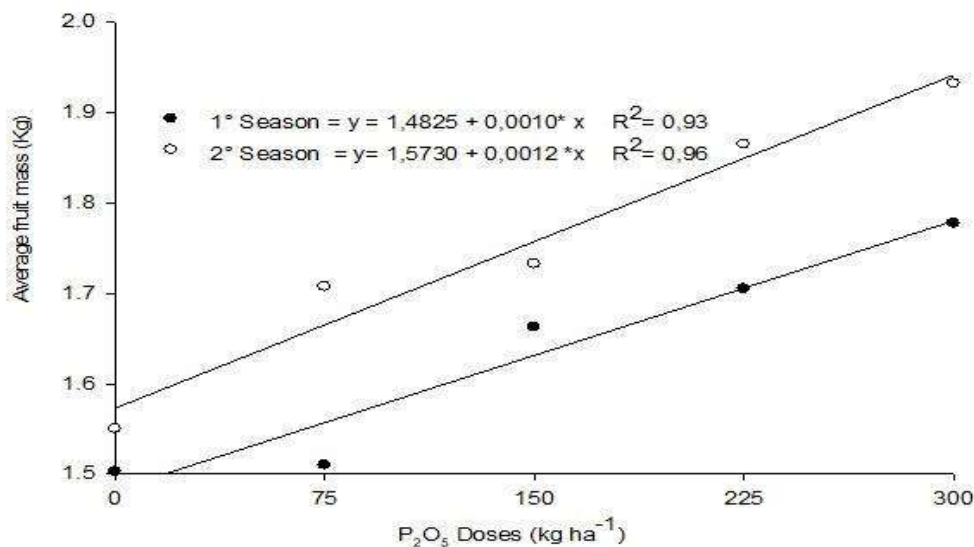


Fig. 4: The number of flowers per plot (unit) of Japanese squash produced as a function of P<sub>2</sub>O<sub>5</sub> doses. Gurupi-TO. 2017.

It is observed that in the first growing season the variable number of flowers per plot adjusted to a quadratic regression model wherefrom the derivation of the regression equation, the maximum point was found at the dose of 176 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub>, presenting an increase of 16% when compared to the control, for the second growing season there was a linear adjustment of the regression equation, where the 300 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> dose was higher than the other doses evaluated, presenting an increase of 31% concerning the control, clearly demonstrating that the observed doses were sufficient to supply the energy demand of the culture, because, according to Sardans et al. (2005), the formation and maintenance of flowers and fruits are processes of high energy expenditure and require the synthesis of substances (proteins and

hormones) that demand nutrients such as phosphorus, which is required to form the main energy molecule of plants.

The results observed in the study corroborate the results found by Pereira et al., (2011), in a study on the flowering and fruiting of Manso pine genotypes under phosphorus doses in the cerrado of southern Tocantins.

For the variable cross-sectional diameter of Japanese squash fruits produced as a function of P<sub>2</sub>O<sub>5</sub> doses, a distinct behavior was observed between growing seasons, where the averages observed for the first growing season were adjusted to a linear equation model, while the averages observed for the second growing season were adjusted to a quadratic equation model (Figure 5).

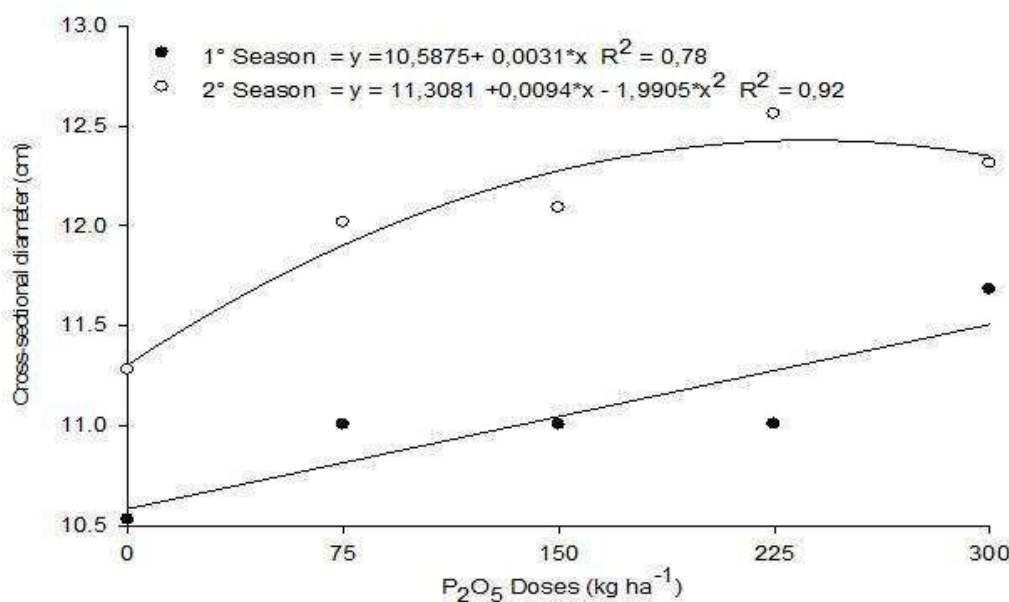


Fig. 5: Cross-sectional diameter (cm) of Japanese pumpkin fruits produced as a function of P<sub>2</sub>O<sub>5</sub> doses. Gurupi -TO. 2017.

The 300 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> was higher in the first growing season, indicating that the maximum point was not reached in the study dose range, however, the 300 kg ha<sup>-1</sup> dose, presented an increase of 11% in fruit cross-sectional diameter (11.68 cm) concerning the control, representing an increase of 1.15 cm.

For the second growing season, the upper P<sub>2</sub>O<sub>5</sub> dose was 236 kg ha<sup>-1</sup>, with a cross-sectional diameter of 12.42 cm, representing an increase of 1.78 cm in the cross-sectional diameter and an increase of 16% concerning the control (Figure 5). The observed values of cross-sectional diameter are below the 17 cm values found by Pereira et al., (2012), working with Tetsukabuto pumpkin fruiting under application of 2,4-D doses in the dry

season in Pombal-PB.

The same behavior is observed by Gonçalves (2014), in a study of the quality of 'Tetsukabuto' Hybrid Pumpkin fruits submitted to different applications of synthetic auxin and nitrogen fertilization. The observed averages corroborate the results found by Abreu et al. (2011), who verified positive effects of P<sub>2</sub>O<sub>5</sub> doses on the diameter of melon fruits, obtaining the maximum value of 13.15 cm at the dose of 354.4 kg ha<sup>-1</sup>. For the variable phosphorus content (g kg<sup>-1</sup>) present in leaves and fruits of Japanese squash produced as a function of P<sub>2</sub>O<sub>5</sub> doses, regardless of the sampling season, a quadratic adjustment of the regression equations was observed (Figure 6).

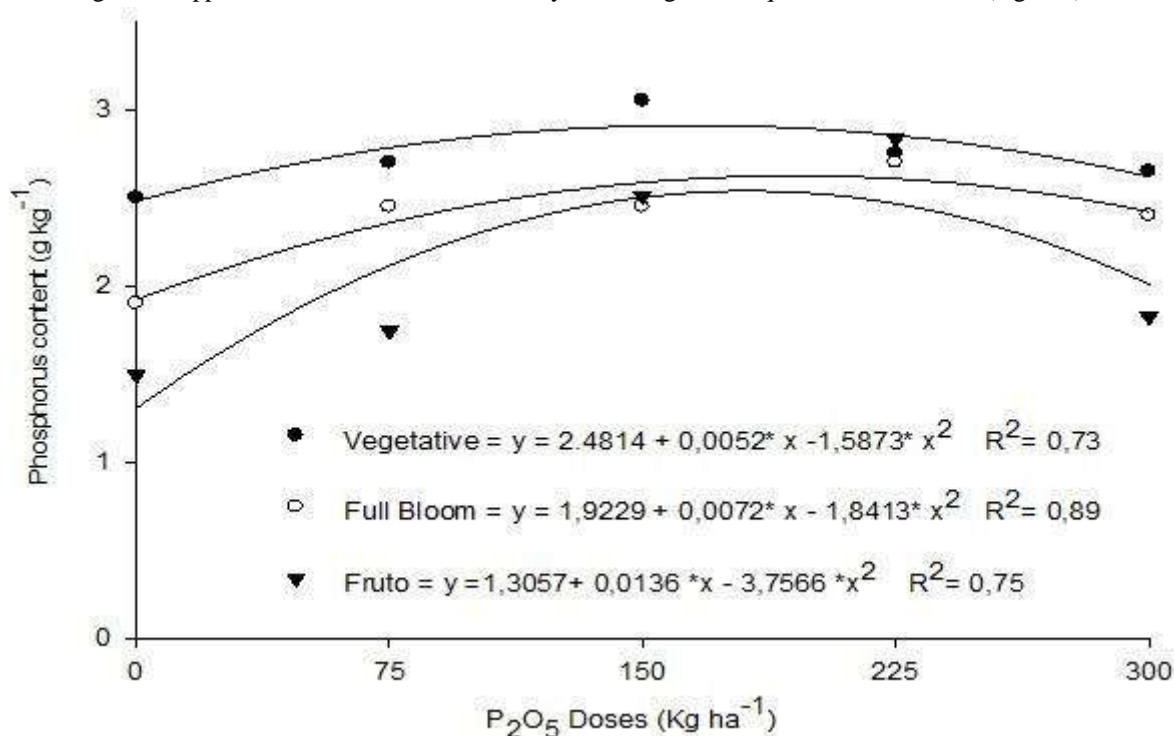


Fig. 6: Phosphorus content (g kg<sup>-1</sup>) present in leaves and fruits of Japanese squash produced as a function of P<sub>2</sub>O<sub>5</sub> doses. Gurupi-TO. 2017.

A sampling at the vegetative stage showed that the dose of 164.06 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> provided higher phosphorus contents in g Kg<sup>-1</sup> of plant, equivalent to 2.91 g Kg<sup>-1</sup>, representing about 17%. More than that observed in the witness. For the sampling in full bloom, the dose 195.7 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub>, was responsible for presenting the highest phosphorus contents, 2.53 g Kg<sup>-1</sup> of plant, representing an accumulation of 36% concerning the witness. The 181.64 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> provided the highest phosphorus accumulation in g kg<sup>-1</sup> of fruit, this accumulation being 2.53 g kg<sup>-1</sup> of fruit.

Silva et al. (1999) verified P<sub>2</sub>O<sub>5</sub> leaf content of 4.6 g kg<sup>-1</sup> in hybrid squash (Tetsukabuto), as well as Carmo et al., (2011)

working with leaf contents, accumulation and partition of macronutrients in the culture of pumpkin irrigated with saline water, the values observed by these authors are higher than the values observed in the present work, however, these values are very close to those obtained by Vidigal et al. (2007), in a study on mineral composition and macronutrient deficiency symptoms in hybrid squash, Tetsukabuto type, in this study the levels of P<sub>2</sub>O<sub>5</sub> in normal leaves were around 1.8 g kg<sup>-1</sup>, while the deficiency was only observed in leaf with contents equal to 0.8 g kg<sup>-1</sup>.

It should be noted that nutrient accumulation is dependent on the species, cultivar/hybrid studied, planting time, among other factors that may affect yield per plant, It should be noted that nutrient accumulation is dependent on the species, cultivar/hybrid studied, planting time, among other factors that

may affect yield per plant, because, as a general rule, the higher the DM production per plant, the higher the nutrient extraction per plant. For this reason, it is difficult to compare the extraction values obtained by different authors (Corrêa, 2016). Then, as a general rule, the higher the DM production per plant, the higher the nutrient extraction per plant. For this reason, it is difficult to compare the extraction values obtained by different authors (Corrêa, 2016).

#### IV. CONCLUSION

- The 300 kg ha<sup>-1</sup> dose of P<sub>2</sub>O<sub>5</sub> provided higher yield and average fruit mass in both growing seasons.
- Japanese hybrid pumpkin plants accumulated phosphorus up to the dose of 195.7 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>.
- The dose 181.64 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub> provided the highest phosphorus accumulation in g kg<sup>-1</sup> of fruit.
- Cultivation of Japanese hybrid squash between September and November showed higheryield.

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# Home Automation Using Arduino Platform on an Embedded Server

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**Abstract**— Home automation has increased its expansion worldwide, given the available technologies, this study aims to develop a wireless home automation system using the Arduino prototyping platform and the HTML language, where with this technology is elaborated a software for user interface and the wifi technology that the platform makes possible. Creating a platform where the user can monitor their home from anywhere, if there is internet, having more security and control of their home.

**Keywords**— Home Automation, Interface, Monitor, Platform and Security.

## I. INTRODUCTION

Since the 1980s, home automation has grown in strength and expression throughout the world, with the advancement of the internet and personal computer, a new culture of access to information has been created, thus enabling the emergence of home automation projects and small and medium sized building [7].

Home automation brings together a set of technologies that have as their main objective the automation of a home and which, besides performing some routine tasks, provide safety, reduce energy consumption, provide comfort and integrate with the user the system functionalities [11].

Given that most people spend most of their day outside their homes, the aim is for the interface to be always available for user access, not just at home, but anywhere that the user need to check and control the state of any device in his home.

The proposal was to develop a low-cost independent system, simple interface to configure, monitor and power devices. The user must connect to the internet by mobile or notebook, communicating from the browser to the platform, which will be connected to the devices, thus being able to control them from anywhere.

## II. HEADINGS

To develop a web-based home automation system on an embedded server, we used concepts of home automation, web structure and embedded web server.

### 2.1 Home Automation

The automation, goes far beyond the simple insertion of electric motors and controllers, refers to the control of

lamps, televisions, sockets, remote control doors that have electronic remote control [12].

Home automation systems can be classified as autonomous, integrated and intelligent. Where in an approach seeks to describe autonomous system, since it performs a control on and off of some devices, with a predefined configuration [5].

In this sense, the purpose of this paper is to offer a practical, fast and safe way to control the electrical and electronic components of the residence. The user can still set their preferences for lighting drives and other devices, so the house will always provide a pleasant environment for residents [16].

### 2.2 Protocol ISO and TCP

With the need to share data, the world wide web (WWW) was created, which addresses specific issues and has a text-only interface information exchange tool, which over time has been improved and made more accessible to millions of people. Thus, arises the need for communication between computational devices and international standardization between protocols, creating the International Standards Organization / Open Systems Interconnection (ISO / OSI) reference model and the Transmission Control Protocol / Internet Protocol (TCP / IP) model. These protocols divide the complex process of communicating into small layers, making tasks less complicated and sub tasks more efficient [10].

### 2.3 System Operation

Requests from a web system page, a web server is required, a process that constantly waits for the client request. When a customer request arrives, the system

interprets, if valid, executes and sends the response to the customer.

### III. MATERIALS AND METHODS

A survey was carried out on hardware platforms in the market with support through the embedded internet to compose the system. The platform that stood out was the Arduino Ethernet Shield Fig.3.1 coupled to an Arduino Mega 2560 Fig. 3.2 meets the needs of the project by having ethernet controller, TCP / IP libraries and low cost, Arduino has 54 input and output pins and 16 pin analog input, can connect multiple devices simultaneously.



Fig. 3.1: Arduino Ethernet Shield



Fig. 3.2: Arduino Mega 2560

It also has a MicroSD slot, which is required for storing files such as web pages, images, settings and scripts. Through the use case diagram Fig 3.3, it is possible to visualize the operation of the process that contemplates the modeling.

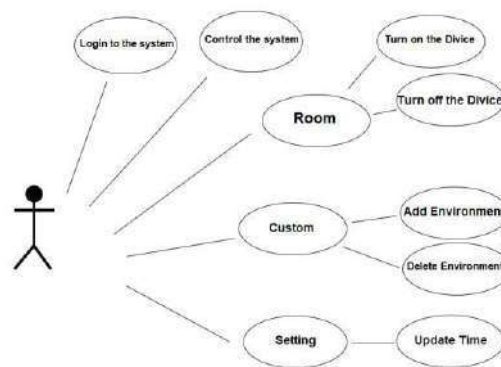


Fig. 3.3: Case Diagram

#### 3.1 Web Server on Board

Arduino is aimed at artists and amateurs alike, or it can enable you to create flexible, easy yet cost-effective designs. Arduino programming uses a programming language similar to C / C ++, making it easy to learn those who already have some knowledge in these languages. In addition, it covers over ninety percent of the sensors on the market [14].

The platform chosen for the web deployment was the Arduino Ethernet Shield coupled to an Arduino Mega 2560. Arduino is an electronic prototyping platform that has a microcontroller and is built on a library that aids in writing or configuring C / C ++ programming. The great differential of this tool is its development and improvement by a community that promotes projects and code, with the intuit that it is an open – source, that is, anyone who has programming knowledge can modify it and share it with others so that it becomes better, increasingly expanding the possibilities it can do [9].

Arduino Mega 2560 is an ATmega2560-based microcontroller board that has 256 KB of flash memory for code storage (of which 8KB is used by the bootloader), 8 KB of SRAM (Static Random Access Memory) and 4 KB of EEPROM (Erasable Programmable Read-Only Memory) [8]. Arduino Ethernet Shield allows an Arduino to be connected to the internet using the Wiznet W5100 ethernet controller, which communicates with both the W5100 and the microSD card via the SPI [3].

It is necessary to store device and environment configuration data in a structure with low processing cost, which can be an embedded system. Arduino has no operating system and there is no possibility of installing a conventional database, the data was structured in XML (Extended Markup Language) and the storage in the micros that Ethernet Shield has.

Using the library provides us with a broader and more diverse programming, for Arduino implementation we used the following Libraries: Webduino, SdFat and

LiquidCrystal. Webduino allows the Arduino card to connect to the internet, and provides some features like: handling of parameters passed by URL; implementation of handles for different resources; Handle the HTTP Methods: GET, HEAD, POST, PUT, DELETE, PATCH, HTTP Basic Authentication, Web encoding shapes and images; among others [10].

SdFat is a library written in C ++ that supports the creation, deletion, reading, writing and truncation of files. The LiquidCrystal library allows the Arduino board to control a liquid crystal display (LCD), showing the system time and signaling the server and the micros to start correctly or not [13].

### 3.2 Embedded Server Web Page

Over the years, developed Web systems have become increasingly complex. This design pattern has the great advantage of dividing a large project into smaller and less complex parts. Changes to one layer will not affect the others making it clearly simpler to perform maintenance such as layout changes, adding new features [15].

Web pages on the World Wide Web are usually implemented in HTML (Hypertext Markup Language) format. MyHOME has an HTML page, myhome.html, where it added all system screens because it reduces data traffic through Arduino, saving processing.

One of the technologies used in MyHOME was Ajax (Asynchronous JavaScript + XMLs), which merges Web technology, so the user's workflow is not interrupted by the need to communicate with the server as it allows some page features to remain available while the browser collects the new data and then sends it out at once, as Arduino is a low-processing tool, sending modifications one by one at a very high processing cost, delaying the activity.

To facilitate interface development and make it more agile, we opted to use the jQuery JavaScript library, which is supported by virtually all browsers. For user interface (UI) features, the visual part used the jQuery-based library, the jQuery UI [8]. It featured numerous graphical components for web development such as Windows, buttons, animations, advanced and high-level effects, etc. Fig 3.4 shows one of the system windows.

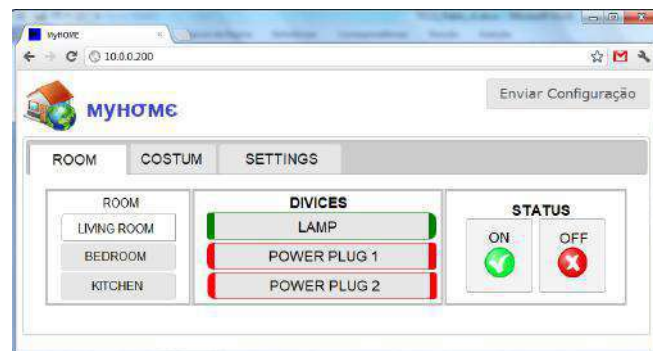


Fig. 3.4: System Room Window

In this window you can control the devices that the rooms have.

### 3.3 System Operation

The System is basically divided into three functionality topics: devices, environments and scenario.

In the System, a device is an object that needs electric current for its operation, and its power can be connected to a relay, for example: lamps, televisions, computer, router, fan, etc., system acting with the functionality of turning on and hang up.

An environment is a set of devices grouped together to better organize and improve user interaction with the system, so the user can create an environment called a room by grouping all equipment connected to the system.

The scenario is a set of actions with devices, which can be programmed to activate or deactivate devices at certain predefined times, so that some devices from the same or different environments can be set so that they can be activated or deactivated according to time. scheduled, the platform will perform at the specified time.

Thus, implementing a flow to access the System with different execution, by its memory and restricted server processing. After some testing it was identified that the time from reading files in microSD to browser could be improved by Google Code's Project Hosting, which offers a free collaborative development environment for open source projects. It will basically host some static files on the internet (unchanged files), such as the HTML page, images, scripts, and libraries, leaving out only the System database "XMLs".

## IV. SYSTEM TESTS

After the implementation of the new hosting functionality was completed, the system validation tests were performed, as shown in Fig 4.1.

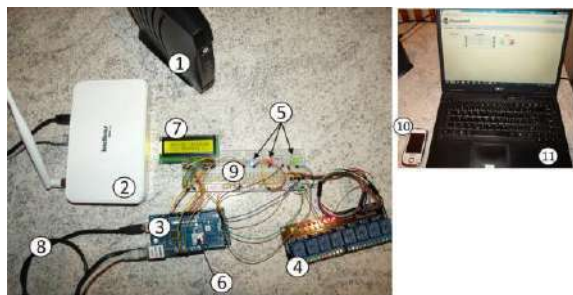


Fig.4.1: Test to validate the system

Fig 4.1 shows the test environment, where a Wireless Router (2) was used, with a Wide Area Network (WAN) port connected to a modem (1) that provides internet; the platform connected to the Router's Local Area Network (LAN) port; a SanDisk 2GB microSD inserted into the Ethernet Shield (6); a USB cable used for firmware transmission and System debugging (8); 8-channel YwRobot relay interface module (AC250V-10A; DC30V-10A), with relay output status indication LEDs (4); three distinct color Light Emitting Diode (LED) (5); 16x2 LCD display with Green Backlight (7); a protoboard with 830 holes (9).

For the browser device that accesses the MyHOME interface, a notebook (11) and a cellphone (10) connected to the router via wireless were used. As it is a Web System, all functionality is based on HTTP requests, and it is necessary to analyze these requests. For this function, the browser tool itself was used. In Google Chrome there is the tool called Developer Tool, it has a set of features to analyze a web page, such as debugging scripts, request monitoring, etc.

Another tool used was Arduino itself, through the Arduino IDE Serial Monitor, which monitors serial communication between Arduino and the computer (COM4 port).

For the functionality tests, such as the activation of the devices, three LEDs with different colors were used as seen in Fig. 4.1 item 5, to distinguish when changing the ports (Arduino output) and to see if it changed its state. After stabilizing the system, the relay drive module was operated with the system. The eight drive ports were connected to the Arduino ports for testing, and each port responded to its particular command, with great response time, both through the notebook connected to the same WI FI network, while on the mobile phone away from home, speed tests also yielded excellent results, sending several commands such as activating and deactivating the same device sequentially to see Arduino's response time, quickly turning on and off different devices. There were few cases where the devices took more than 1 second to switch states, but this was due to the mobile phone's

internet having a low network signal, affecting the test results.

## V. CONCLUSION

Given the current scenario of home automation, the solution to the problem proposed in this study was to develop a flexible and cost-effective home automation system named "MyHOME". It allows you to operate on your home devices with control, monitoring and personalization features through an easy and intuitive interface that can be accessed by a browser from anywhere with internet. Featuring extra functionality such as device grouping in environments and scenario creation with programmable on / off times, giving the user the power to monitor and control their home from anywhere.

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# Methodology for distribution network reconfiguration in smart grid system regarding power loss, grid reliability and the utilization factor of substations, considering a new reality of energy supply and consumption

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**Abstract**— This paper proposes a new methodology for distribution network reconfiguration (DNR), in a Smart Grid (SG) scenario, regarding power losses, grid reliability and the utilization factor of substations; as well as an approach to model the effects of electric vehicle charging stations, distributed energy generators and energy storage systems in the electric grid. The proposed methodology first deals with the problem setting, that is, it determines the state of the grid (in terms of electrical parameters and variables, power loss, reliability indicators and utilization factor for each substation) and its topology. Then, it's defined the universe of possible solutions, to which is applied a simple formulation of Genetic Algorithm (GA) that solves the optimization problem. To demonstrate the applicability of this methodology in a real network, the methodology was implemented in the specialized commercial power system simulator SINAP Grid and applied in a case study. Its results showed that it is possible to accommodate so many objectives in one solution, however, the state of the grid and its initial topology influence greatly in the outcome of the solution.

**Keywords**—Distributed generation, Grid reconfiguration, Grid reliability, Power losses, Smart Grid.

## I. INTRODUCTION

The new reality of energy supply and consumption (such as electric vehicle charging stations, distributed energy generators and energy storage systems) in distribution networks resulted in a new challenge for its planners: how to guarantee that the grid will be able to support this new reality while also trying to improve its reliability, operation cost and asset management<sup>[1]</sup>.

One way to adapt the grid in order to manage this new reality is to formulate network reconfiguration methods<sup>[2]</sup> able to consider many objectives that result in a grid topology that best fits the planner's goal.

In the past, the alteration of the topology of the distribution network was made only a few times a year -if made at all- given that most of the switchgear was not capable to be remotely controlled, which meant that the process of reconfiguration would have had to be done manually, that is, the process used to happen in a slower pace and be more expensive.

However, with the advent of Smart Grids, these predicaments could be resolved provided that remotely controlled switches -such as automatic circuit reclosers- could be distributed along the network.

Given that, this paper's main objective is to formulate a methodology that will provide an optimized topology that will best fit the planner's demands.

The solutions provided must consider the new reality of energy supply and consumption. The section II of this paper will discuss the impact of the elements of this new reality in the electric grid, as well as how they will be modelled for the simulation. The section III will briefly explain the handling of the GA. Then, the section IV will explain how the methodology will evaluate reliability, operation cost and asset management of the network. The section V will discuss the methodology to define the universe of possible solutions and, following that, the section VI will present the network selected to be a case study, and the results of the application of the

methodology. Finally, section VII will bring the conclusion of the study.

## II. MODELING THE NEW REALITY OF ENERGY SUPPLY AND CONSUMPTION

In the past, in a distribution network, there used to be a unique point of the circuit that would supply energy throughout the rest of it, accordingly to the other points of the circuit that would demand electrical power. The growing of this demand, classically, was easy to predict, in such manner that was not uncommon for planners to classify consumers in residential, commercial, industrial, etc., and get reliable results in their predictions. This scenario has, however, changed.

Firstly, now, it's easier to add distributed generation along the network, which would mean new points of energy supply, and certainly change the power flow.

Secondly, as consumption increases, the motivation for a redistribution of consumption along the hours of a day -the load profile- emerges; This process can be done with energy storage systems, which have become more accessible -financially and commercially- in recent years. To the planner's perspective this means that some points of the circuit would be able to produce and consume electrical energy, creating a new paradigm.

Thirdly, as energy storage systems, such as electric batteries, became more reliable, so did the production of electric vehicles and consequently their diffusion to the general public, which means the construction of charging stations became necessary. This indicates a problem for the planners because high levels of energy and power are needed to recharge an electric vehicle whereas it's harder to predict its consumption and consequently its impact in the network.

However, from a mathematical point of view, these new elements in the circuit can be modelled as simply as new points of production or consumption of energy, with some specific details for each new element. For this paper, in order to evaluate their impact in a future scenario, in many nodes of the network chosen for the case study, distributed energy generators, electric batteries and electric vehicle charging stations were inserted.

The distributed energy generators were treated as points of supply, that provide energy based on a typical load curve for each type of generator (solar powered, wind powered, etc.).

The electric batteries were modeled as consumers for the off-peak hours and producers of energy for the on-peak hours, in way that, from the perspective of the substation, less power would be demanded on-peak

hours. However, ignoring the losses in energy storage, there would not be a reduction in the energy demand, because the energy not-demanded in the on-peak hours was demanded in the off-peak hour. This process is usually known as "peak-shaving".

The electric vehicle charging stations were handled as points of high consumption, allocated in the residences of house-holds elected to have electric vehicles. It was considered that vehicles would be charged at night, as it more likely to happen.

## III. GENETIC ALGORITHM

The Genetic Algorithm (GA) is a metaheuristic very popular in many applications of engineering, biology and computer science, mainly because of the simplicity of its implementation, and the reliability of its results. Implementation is simple, and its results are very reliable, even when the problem in question becomes very complex due to, for example, non-linearities, multiple maxima and minima of the function and discontinuities<sup>[4]</sup>.

One great advantage of this algorithm is that its formulation depends on a very simple mathematical expression that describes the aim of the results, in such a way that it is not needed to indicate explicitly the steps to the result, which will be specific to each problem. Moreover, the GA works with a population of alternatives for the solution, and not only with one solution, which grants it a great robustness; also, the GA works directly with objective function and not with its derivatives; finally, the GA uses some stochastic elements, which help to capture more realistic solutions.

In the GA, each candidate solution is codified in a *string of bits*, which, in this context, will each represent a different grid topology; and each *string* will be rated accordingly to its fitness to the conditions of the problem. The implementation and the codification of each candidate solutions were made following the methodology described in [3].

## IV. EVALUATING GRID RELIABILITY, OPERATION COST AND ASSET MANAGEMENT

This section will explain how the GA will evaluate the candidate solutions (the candidates were generated in the Initialization Phase<sup>[3]</sup>) regarding the grid reliability, its operation cost and its asset management.

### 1. Global rate

The rate for the context of the static topology is calculated as shown in (1):

$$Rate = (\beta) \cdot [\mu_{transgression}] + (1 - \beta) \cdot [(\alpha_{loss}) \cdot (\mu_{loss}) + (\alpha_{continuity}) \cdot (\mu_{continuity}) + (\alpha_{SUF}) \cdot (\mu_{SUF})] \tag{1}$$

Where  $\beta$  is the level of grid restrictions, which can be interpreted as the tolerated voltage level and load transgression.

$\alpha_{loss}$ ,  $\alpha_{continuity}$  and  $\alpha_{SUF}$  are, respectively, the ponderation regarding the loss rate, the continuity rate and the substation's utilization factor rate. They are set in such manner that (2) is satisfied:

$$\alpha_{loss} + \alpha_{continuity} + \alpha_{SUF} = 1 \tag{2}$$

$\mu_{transgression}$ ,  $\mu_{loss}$ ,  $\mu_{continuity}$  and  $\mu_{SUF}$  are, respectively, the grades regarding the grid's equipment voltage and load transgression, the loss rate, the continuity rate and the substation's utilization factor rate.

2. Transgression rate

The transgression rate ( $\mu_{transgression}$ ) is defined as the lowest value between the rate given to the transgression of voltage in the load buses and to the transgression of load on transformers and generators. This analysis is made for all hours of the day, as shown in (3):

$$\mu_{transgression} = \min(\mu_{bus}, \mu_{transformer}, \mu_{generator}) \tag{3}$$

Each rate in (3) can be calculated by (4):

$$\mu = \frac{N_{total} - N_{precarious}}{(N_{total}) \cdot (1 - tol)} \tag{4}$$

In which  $\mu$  is the rate for the transgression of voltage in the load buses, transformers and generators.  $N_{total}$  is the total number of equipment in analysis.  $N_{precarious}$  is the number of equipment that were diagnosed as precarious according to the transgression of voltage or load.  $tol$  is the percentage of equipment transgression tolerated (its default value is set to 20%).

3. Loss rate

The loss rate ( $\mu_{loss}$ ) is calculated by (5):

$$\mu_{loss} = \frac{Loss_{ref} - Loss}{Loss_{ref} \cdot factor_{loss}} \tag{5}$$

Where  $Loss$  is the integrated technical losses in 24 hours calculated for the topology of the alternative in analysis.  $Loss_{ref}$  is the integrated losses in 24 hours calculated for the original topology of the network in analysis.  $factor_{loss}$  is a factor that indicates a possible goal in the reduction of technical losses (its default value is 0,3).

If  $\mu_{loss}$  is less than zero or if  $Loss$  is greater than 5% of the injected energy, the loss rate value becomes equal to zero.

4. Continuity rate

The continuity rate ( $\mu_{continuity}$ ) is calculated by (6):

$$\mu_{continuity} = \alpha_{SAIDI} \cdot \mu_{SAIDI} + \alpha_{SAIFI} \cdot \mu_{SAIFI} + \alpha_{ENS} \cdot \mu_{ENS} \tag{6}$$

In which  $\alpha_{SAIDI}$ ,  $\alpha_{SAIFI}$  and  $\alpha_{ENS}$  are, respectively, the ponderation regarding the network's SAIDI (System Average Interruption Duration Index), SAIFI (System Average Interruption Frequency Index) and ENS (Energy Not Supplied). They are set in such manner that (7) is satisfied:

$$\alpha_{SAIDI} + \alpha_{SAIFI} + \alpha_{ENS} = 1 \tag{7}$$

Each Continuity Index is calculated by (8):

$$\mu_{ContinuityIndex} = \frac{Index_{ref} - Index}{Index_{ref} \cdot factor_{continuity}} \tag{8}$$

In which  $Index$  and  $Index_{ref}$  are the index being evaluated for the topology in analysis and for the original topology.  $factor_{continuity}$  is a factor that indicates a possible goal in the reduction of the index. The default value for  $factor_{SAIDI}$  is 0,3, for  $factor_{SAIFI}$  is 0,2 and for  $factor_{ENS}$  is 0,3.

5. Substation's Utilization Factor Rate

The continuity rate ( $\mu_{SUF}$ ) is calculated by (9):

$$\mu_{SUF} = \sum_{j=1}^N \alpha_{SE_j} \cdot \mu_{SE_j} \tag{9}$$

In which  $N$  is the total number of substations in analysis and  $\alpha_{SE_j}$  is the ponderation regarding the substation  $j$ , they are set in such manner that (10) is satisfied:

$$\sum_{j=1}^N \alpha_{SE_j} = 1 \tag{10}$$

And  $\mu_{SE_j}$  is the rate regarding the utilization factor for the substation  $j$ , and is calculated by (11):

$$\mu_{SE_j} = \frac{SUF_j - SUF_{ref_j}}{SUF_{ref_j} \cdot factor_{SUF}} \tag{11}$$

In which  $SUF$  is the substation's utilization factor for the substation  $j$ , which is defined by (12):

$$SUF_j = \frac{PeakLoad_j}{RatedCapacity_j} \tag{12}$$

In which  $PeakLoad_j$  is the peak load of the energy demanded to the substation  $j$  in 24 hours, and  $RatedCapacity_j$  is the sum of the capacities of the transformers in the substation  $j$ .

Regarding (11),  $SUF_{ref_j}$  is the substation's utilization factor for the substation  $j$ , in the original topology of the network in analysis. And  $factor_{SUF}$  is a factor that indicates a possible goal in the increase of the substation's utilization factor, its default value is 0,5.

## V. DEFINING THE UNIVERSE OF POSSIBLE SOLUTIONS

This section will discuss the methodology applied to define the universe of possible solutions. This methodology was applied to the switchgear able to maneuver. For each able switchgear, two solutions are added to the universe of possible solution, for this switchgear may be closed or opened.

This means that the number of possible solutions grows exponentially with the number of switchgears added to the problem. Additionally, not all possible solutions will be valid solutions, for instance, the solution where all switchgear are opened will not be valid.

Thus, to define to universe of possible solutions, where the GA will be applied, solutions that the maneuvers result in disconnection of customers will not me considered possible.

Also, the radiality of the network will be kept. In such manner that solutions that result in mesh networks will not be considered possible.

## VI. CASE STUDY

In order to apply the methodology developed, it was implemented in the specialized commercial power system simulator SINAPGrid, and a case study was elaborated using the electric network of Ceilândia Norte (CN) e Ceilândia Sul (CS), two substations in Brasília, the Federal District of Brazil. These two substations belong to the electric utility CEB (Companhia Elétrica de Brasília – Distribuição S/A).

These electric networks, as they are today, do not have the elements (such as distributed energy generators, electric vehicle charging stations, and energy storage systems) of the new reality of energy consumption and production considered in this project. So, in order to adapt the grids, the new elements were inserted in the circuits.

For the distributed generators, 15 solar generators, of 2,5 MW<sub>p</sub>, were allocated along the 15 feeders with the higher load. For the electric vehicle charging stations, assuming a penetration of 80% in houses with a propension of having electric vehicles, 53 charging stations were allocated. Finally, 34 energy storage systems were allocated in the same buses of the solar generators and in the buses that had consumers charged by the power they consume and not only the energy; for these consumers, the use of an energy storage system capable of redistribute the consumption along the hours of a day would be advantageous because it would reduce the global cost of electrical power.

Each substation has 16 feeders with 130 normally open switchgear between them, some between two

different feeders, and some between buses of the same feeder. The consumption profile of the feeders is very similar, amounting each substation a consumption of 30 GWh/month.

Knowing these characteristics of the network, the methodology was applied with the parameters shown in Table 1:

Table 1 - Parameters for the optimization

Parameter	Value	Parameter	Value
$\beta$	0,3	$\alpha_{SAIFI}$	0,3
$\alpha_{loss}$	0,5	$\alpha_{ENS}$	0,3
$\alpha_{continuity}$	0,3	$factor_{ENS}$	0,3
$\alpha_{SUF}$	0,2	$\alpha_{SECN}$	0,5
$factor_{loss}$	0,3	$\alpha_{SECS}$	0,5
$\alpha_{SAIDI}$	0,3	$factor_{SUF}$	0,5

The result of the optimization is a network that managed to reduce the technical losses and increase the SUF of the CS substation. However, the results show an increase in the reliability indices and a reduction in the SUF of the CN, both of these result are not desirable but they expected in this type of optimization. The Table 2 show these results.

Table 2 - Results of the optimization

	Default Value	Result Value	Difference (%)
Losses (MWh)	105,458	85,288	19,13%
SAIDI (hours/year)	2,611	2,679	-2,60%
SAIFI (interruptions/year)	1,116	1,159	-3,85%
ENS (MWh/year)	190,833	196,407	-2,92%
SUF CN	0,277	0,259	-6,50%
SUF CS	0,258	0,275	6,59%

## VII. CONCLUSION

In conclusion, the developed methodology can be applied to real electrical networks and suggests a new configuration that will optimize it, regarding the parameters set for the calculations and the new reality of energy supply and consumption.

It's important to point out that the optimization process has multiple objectives, so the suggested topology will not necessarily be able to improve all the indicator individually, as the case study has shown. In addition, the original state of the grid is also a significant factor, as the rates utilized in the optimization depend on the differences between the suggested topology and the original.

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# Critical Review of Education Development and High Education Challenges in Brazil

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**Abstract**— This article aimed to present a critical review of education development in Brazil and its major challenges for high education. Data are presented that demonstrate the inadequacy of the school model created in the nineteenth century that is obsolete to educate our young people living in a technological age of great technical revolutions. Regarding higher education, data from the 2018 Higher Education Census provided by the Ministry of Education are presented and discussed. Emphasis is given to the brain Executive Functions considered essential for the individual to be able to manage their learning processes through sustained attention and generalization of concepts. Training should be based on a didactic-pedagogical action aimed at the formation of professionals capable of formulating and solving problems, questioning and reconstructing realities at the internal, regional or national levels. It is concluded that it is essential to use active learning methodologies that have the characteristic of providing the best development of knowledge (learning to learn) and skills and attitudes (learning to do and to be).

**Keywords**— High Education, Executive Functions, Challenges.

## I. INTRODUCTION

Education is the area of our collective life that most closely relates to the future. Education works with the children and young people who will occupy the powerful, decisive workplaces that today are occupied by the elders. Therefore, education will shape the people who in turn will shape the world of tomorrow.

Perhaps the most problematic aspect observed in education today is the inadequacy of the nineteenth-century school model that is outdated to educate young people raised in digital technology environments that imply a whole concept of knowledge, work, and full attention, distinct from the previous one. It is not possible to ignore the importance of this debate and the urgent need to adapt the proposal of a new school adapted to this reality.

The evolution of societies has shown us that the future is rupture, it is crisis, it is revolution, it is the unexpected and not only mild alterations of the present. Who could, 30 years ago, predict the impact our Internet, social networks and smartphones would have on our lives?

Another interesting point is that we are all so much more than what we learn in school. Fortunately, we have outgrown and changed what we live and learn in school. How many people remember that the school they attended was a school that promoted social inequalities and

injustices, and that didn't stop them from being militants of the values of educational equity? Thus, the values that the school conveys are not automatically assumed by those who were raised in them. Fortunately, people's evolution does not crystallize after they finish their school attendance.

## II. HIGHER EDUCATION IN BRAZIL

Concerning Higher Education, the Anísio Teixeira National Institute for Educational Studies and Research (INEP), a federal agency linked to the Ministry of Education (MEC), recently released the Higher Education Census for 2018. In this document, national data are presented with comparisons with other countries that allow us to reflect on the present and the future of our education.

An important finding revealed by this Census is that only 19.6% of people aged 25 and over have completed college. In South Korea this percentage is 69.6%. Therefore, we still have much to do to reach the percentages comparable with countries that have developed on the basis of education.

The challenges are great to accelerate the pace and direction of the expansion of higher education in Brazil and its actions should be in line with the goals specified in the National Education Plan (PNE) for the period 2014-

2024. The GOAL 12 of this plan envisages raising the gross enrollment rate in higher education to 50% and the net rate to 33% of the population aged 18-24.

General statistics for this Census show an average annual growth rate of 3.8% over the last ten years. In this period, enrollment in higher education grew 56.4%. These undergraduate enrollments are distributed as follows: 2.1 million in Public Higher Education Institutions (HEIs), and 6.3 million in Private HEIs. That is, the private network has 3 out of 4 undergraduate students (75%). In São Paulo, there are almost 5 students in private schools for each student in public schools.

Among the Federative Units, 7 of them have a higher relation than the Brazilian average. Paraíba and Rio Grande do Norte have the same enrollment ratio between private and public and only in Roraima, there is a higher number of enrollments in public institutions than in private institutions. In Brazil, there are 299 public HEIs and 2,238 private HEIs.

This expansion of private higher education in Brazil is characterized by a greater number of courses that do not require laboratories or teachers with higher remuneration, as in Social Sciences, Administration and Law. However, it is important to mention that in recent years there has been a growth in the offer of courses in the health area that require high investments, such as Dentistry and Medicine. The fees charged in these courses are around R\$ 10,000 / month (about 2,5 thousand US dollars/month) and there are institutions that specialize in this niche market.

The number of places in undergraduate education by type of education is distributed as follows: 722 thousand in-person courses in public and 5.6 million in private ones. In terms of distance education (ODL) courses, we have 108 thousand in public institutions and 7 million in private institutions.

The evolution of these modalities was as follows: in 2014, we had 5 million in-person and 3 million distance learning courses; In 2018 we have 6.3 million in face-to-face mode and 7.1 million in distance learning. Interestingly, only between 2017 and 2018 did the number in distance learning grow by 51%.

These data indicate that the number of tickets in distance learning undergraduate courses has grown substantially in recent years, doubling their share of total entrants from 20% in 2008 to 40% in 2018. In contrast, in the last 5 years, admissions in on-campus undergraduate courses decreased by 13%.

Another interesting aspect is the number of enrollments in face-to-face undergraduate courses per shift. In private institutions, 68% are in the night and 32% in the day. In public, we have the opposite: 69% day and 31% night.

Regarding the technological courses, higher education specialized courses, characterized by technological axes, and short courses (2 years) that offer the higher degree technologist, in 2008 we had 539 thousand students, in 2018, this number almost doubled, reaching 1.098 million.

Among the students of technological courses, 85% attend the private network and 60% of this network is offered through distance learning (EAD). With over 160,000 students in public schools, the State category corresponds to more than half of these enrollments. Unlike the private network, in the public network most students in technological courses study in classroom courses.

When considering postgraduate programs, the situation is reversed because of the costs involved with laboratories, libraries, and teacher salaries. At this level, the participation of the private sector corresponds to 43 thousand enrollments while in public this number is 245 thousand.

In public schools, the full-time teacher prevails (86%). In the private network, there is a tendency to reduce the number of "hourly" teachers and to increase the number of full-time and part-time teachers, with the figure of the part-time teacher prevailing (42%).

An alarming fact taken from this Census concerns the dropout rate of students, that is, those who fail to take the course to its final stage to obtain the title. In 2016, 47.6% of students from the federal public school did not complete their course; in the private network this percentage is 59.9%. Apart from financial issues, it is necessary to rethink pedagogical models that cannot motivate students and seek to investigate other factors that lead them to drop out of their courses.

### III. NEW TECHNOLOGIES AND SKILLS

A key aspect of education today is the importance of new technologies. We imagine totally different forms of teaching, which make traditional schools unnecessary and that promote the individualization of teaching. Education can happen anywhere and anytime, with real or virtual teachers as a reference. Several authors point to technology as the key to future education: "Schools as we know them will cease to exist. In its place, there will be learning centers that will operate seven days a week, 24 hours a day. Students will have access to their teachers, but at a distance. The classrooms will be inside your computers." Phrases of this kind are heard every day. It is a future in which enormous advances in the production of interactive learning "tools" make it increasingly possible. For the most part, the school continues to operate in a class regime and on the basis of a curricular structure organized by disciplines, that is, of a fragmented

knowledge, surrounded by little porous boundaries that do not favor interdisciplinary dialogue and have not allowed any hiccups by the teachers. In fact, not even making curricular articulation a major aspect in the external evaluation of schools has made the disciplinary boundaries more permeable.

The second aspect, which follows from the previous one, concerns the fact that we continue to insist on a school of contents, of disciplinary preferences, when we live in a society that demands skills to face the different challenges that are imposed today. What we really need is a school whose main purpose is not simply the transmission of knowledge, but the development of questioning and investigative attitudes towards scientific, humanistic and, above all, ethical knowledge.

At bottom, a curriculum that, in addition to the knowledge essential for each young person's education, encompasses other skills, competencies and sensitivities that students need to develop and that Suárez-Orozco (Harvard Educational Review: July 2009, Vol. 79, No 2, pp. 327-340) groups into five categories:

- Critical thinking: necessary to structure the mind of the future; It allows each individual to make autonomous judgments, which are essential for a competent understanding of the observations he makes and the realities he encounters on a daily basis;
- Communication techniques: essential for students to communicate effectively and interact correctly with individuals of different nationalities and ethnic backgrounds;
- Language skills: enabling them to communicate in more languages, not merely by choice, but because of an increasingly pressing need in the global society;
- Collaborative skills: to help students in and out of class, as many organizations today are looking for people with good social and relational skills;
- Technological skills: if possible in all areas and dimensions of the curriculum, considering the correct mastery of technologies as an evaluation criterion.

Thus, we need instruments of political and pedagogical action that guarantee the global and critical formation for those involved in the process, as a way to enable them to exercise citizenship and professional training of excellence and full personal development. Training that includes contents and activities that articulate skills (knowledge, skills and attitudes) necessary for the full professional exercise.

Executive Functions

Among these competencies, those related to executive functions (EF) deserve attention.

Executive Functions are considered essential for the child to be progressively able to manage the different aspects of his life with autonomy and thus be able to make decisions independently, take responsibility and insert themselves in society (Scientific Committee Nucleus, Science for Childhood, 2016). These functions are composed of a variety of organizing and self-regulating behaviors, often associated with maturation of the prefrontal cortex (SHAHEEN, 2014). Executive functioning regulates goal-oriented dynamic behaviors that require memory-based action planning, past experience and learning, and require individual self-control, action flexibility, and self-monitoring of strategies and actions as a means of assessing achievement of previously established goals (MIYAKE et al., 2000; TAVARES and FREIRE, 2019).

Taken together, executive functions enable thinking before acting, reasoning, problem solving, flexibly adjusting to the demands and priorities of the environment, and viewing the world from a different perspective, critical skills for the socio-emotional development of child and required throughout life (DIAMOND and LING, 2016). From this perspective, executive functioning is represented by a set of cognitive skills that are fundamental to conscious and deliberate control over actions, thoughts and emotions. These functions are significantly related to many aspects of child development, but their effects extend far beyond childhood. A robust body of evidence indicates that good executive functioning extends beyond childhood; it is critical for success in acquiring and maintaining a job and achieving career achievement (BAYLEY, 2007), as well as for establishing and maintaining work. social bonds (HUGHES & DUNN, 1998), marital harmony (EAKIN et al., 2004), decreased risk behaviors in adolescence (such as avoiding drug use and staying out of jail) (MOFFIT et al., 2011; MILLER et al., 2011) and is also associated with better performance in academic life, greater acquisition of human capital, personal satisfaction and quality of life (MOFFIT, 2012).

In the same vein, studies point out that executive functions are critical to success in various aspects of life as they are predictive of academic success throughout school years (from preschool to university) (DUCKWORTH and SELIGMAN, 2005; ALLOWAY & ALLOWAY, 2010; LOOSLI et al., 2012), of achievement, health and quality of life throughout life, in greater proportion than variables intrinsically associated with these aspects such as intelligence coefficient or socioeconomic level (DIAMOND and LING, 2016).

Strengthening these skills helps to promote socio-emotional and school competence in children at high risk of school failure, developing readiness for early school work (BLAIR, 2013), helping students achieve academic and social success (DIAMOND and LING, 2016), support the overall development of the individual and are in line with what is achieved in terms of future education.

Given the relevance of executive functions to the multiple dimensions of healthy development in childhood, there has been a strong interest in ways to promote executive functions, accelerate their development, halt or delay their decline in aging and/or remedy their deficits (DIAMOND and LING, 2017). In addition, studies highlight the constant need to identify specific aspects of experience and specific pedagogical approaches aimed at the exercise of executive functions as a potential target of pedagogical efforts (BLAIR, 2013).

#### IV. FINAL CONSIDERATIONS

It is essential to use active learning methodologies that have the characteristic of providing the best development of knowledge (learning to learn) and skills and attitudes (learning to do and to be). Vocational training should be based on a didactic-pedagogical action aimed at the formation of professionals capable of formulating and solving problems, questioning and reconstructing realities at the internal, regional or national levels, especially through the critical formation that must be outlined in the pedagogical proposals of the students. courses.

It is interesting to note that the National Curriculum Parameters elaborated by the Secretariat of Fundamental Education of the Brazilian Ministry of Education (MEC), emphasizes that are objectives of the elementary school that the students are able to:

- understand citizenship as social and political participation, as well as the exercise of political, civil and social rights and duties, adopting, in everyday life, attitudes of solidarity, cooperation and repudiation of injustices, respecting each other and demanding for themselves same respect;
- To take a critical, responsible and constructive position in different social situations, using dialogue as a way of mediating conflicts and making collective decisions;
- Know the fundamental characteristics of Brazil in the social, material and cultural dimensions as a means to progressively construct the notion of national and personal identity and the sense of belonging to the country;
- Know and value the plurality of the Brazilian socio-cultural heritage, as well as the socio-cultural aspects of other peoples and nations, against any discrimination

based on cultural differences, social class, beliefs, gender, ethnicity or other individual and social characteristics;

- perceive themselves as integral, dependent and transformative agent of the environment, identifying their elements and the interactions between them, actively contributing to the improvement of the environment;
- develop adjusted self-knowledge and a sense of confidence in one's affective, physical, cognitive, ethical, aesthetic, personal interrelationship and social insertion capacities to act perseveringly in the pursuit of knowledge and the exercise of citizenship;
- Know your own body and take care of it, value and adopt healthy habits as one of the basic aspects of quality of life and act responsibly in relation to your health and collective health;
- use different languages - verbal, musical, mathematical, graphic, plastic and body - as a means to produce, express and communicate their ideas, interpret and enjoy cultural productions in public and private contexts, meeting different intentions and communication situations;
- know how to use different sources of information and technological resources to acquire and build knowledge;
- question reality by formulating problems and finding solutions using logical thinking, creativity, intuition, critical analysis capacity, selection of procedures and verification of their adequacy.

It is, therefore, a broad view that places Education as a form of development of people and of the country (s). It is in this direction that the future of education seems to us to be in the responsible construction of our tomorrow.

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# Traces of corrosion and air pollution dominate the vision of the common man in any city

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**Abstract** — This article presents the critical vision of a common man, a worker, who lives and works in a district of a Brazilian city where pollution and atmospheric corrosion are the main focus of his concern in the daily journey that he makes from his home to the factory and the return from factory to house. In this journey made by bicycle, bus and on foot he feels, he sees and he registers with his critical eye and photographic camera the evil traces that the atmospheric corrosion leaves in the concrete lighting poles, the viaducts and the gates of the houses. In the semi-structured interviews carried out with this common man it is verified that the irreparable damages caused by the pollution and the atmospheric corrosion can compromise the safety and quality of life of the population.

**Keywords** — corrosion, pollution, semi-structured interviews, common man, viaducts.

## I. INTRODUCTION

Each city is forming its own and logical design, based on the configuration of its morphology and the scenarios that reflect the social dynamics replicated in the production of the urban space [1]. Urban growth without proper planning often leads, in contrast to economic and social development, to a marked decline in the standard of living of the population. In this way, large cities end up concentrating noise, air pollution, dust, garbage, scrap, too much gray, ugliness, agglomeration, dependence, stress, delinquency, etc. The reduction of physical spaces, microclimatic changes due to deforestation, pollution, inadequate projects end up, directly or indirectly, bringing problems to the development and the daily life of a city [2-6].

This city can be defined as the set of architectural and engineering works according to its geographical dimension. It contemplates a series of everyday events that intertwine with the past and its historical evolution, establishing a coordinated system of community actions that bring a gate with streets, sidewalks, public squares, parking lots, shopping centers, schools, hospitals, gas stations, small and medium factories.

In order not to identify and penalize the district of this city and also preserve the identities of common man, a drawing was made, shown in Figure 1, representing the main places where the common man makes his home-work-home daily journey.

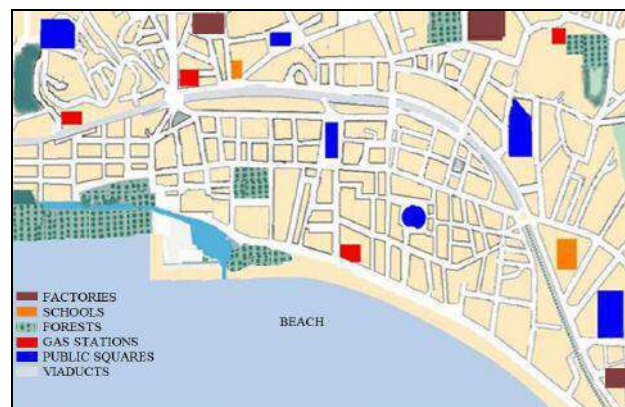


Fig. 1 – Drawing of the district of a city where the common man lives and works

This residential and industrial district belongs to a Brazilian city that based on the parameters of atmospheric corrosion is classified as having an urban, industrial and marine atmosphere. The climate is tropical; the average temperature is 23°C and average rainfall of 1100 mm/year. The urban atmosphere composed of contaminants such as CO<sub>2</sub>, CO and NO<sub>x</sub> is due to the intense traffic of cars, trucks and buses. In the industrial areas are SO<sub>x</sub>, CO<sub>2</sub> and NO<sub>x</sub>, while in the marine areas a sodium chloride (NaCl) mist is common at some times of the year.

The objective of this article is to show that, unrelated to the broader and more complex scenario of production

relations, the common man in any city he lives and works in his day-to-day life, the resident and worker sees and registers with his critical and photographic vision, the evil traces that corrosion and air pollution promotes on his every day journey (home-work-home).

## II. ATMOSPHERIC CORROSION ASSOCIATED WITH POLLUTION

Firstly, it should be noted that natural phenomena and human activities are the factors responsible for the presence of pollutants in the atmosphere, whether it be an active volcano or a capital goods industry that generate corrosive or toxic gases such as CO<sub>2</sub>, SO<sub>2</sub> or H<sub>2</sub>S.

Emissions from the chemical, petrochemical, metallurgical industries, automotive and waste incineration industries are largely responsible for the pollutants found in the atmosphere. These pollutants may be gases, fine chemical mists, dusts, fumes or combinations of these emissions. Primary pollutants are those emitted in the direct form while the secondary pollutants are generated by chemical atmospheric processes that act on the primary pollutants. Sulfur trioxide (SO<sub>3</sub>) and sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) are produced from the oxidation of the primary pollutant SO<sub>2</sub>. In the same way, NO<sub>2</sub> is generated from NO oxidation and ozone (O<sub>3</sub>) is produced from oxygen or from photochemical processes in the presence of hydrocarbons and NO<sub>x</sub> [7-9].

Among the most common are carbon dioxide, carbon monoxide, sulfur dioxide, ammonia, hydrogen sulfide, nitrogen oxides, hydrogen fluoride and some organic compounds such as methane, ketones, alcohols, benzene, etc.

Even with the restrictions imposed by the anti-pollution laws and the awareness that begins to take shape, however, certain chemical contaminants are still detected in the atmosphere by the environmental agencies, incompatible with the demands of current scientific and social progress.

Consequently, all this polluting potential ends up being transformed into the cycle of pollution→corrosion → pollution→ corrosion that generates problems intrinsic to cities and the population.

According to Mainier et al. [10], atmospheric corrosion can be classified with based on two types of mechanism: the chemical corrosion that occurs in the absence of an electrolyte and the electrochemical corrosion that occurs in the presence of an electrolyte deposited on a metallic surface.

Figure 2 shows an attack of H<sub>2</sub>S (moisture-free) on a ferrous surface. The formation of the sulfide deposit

(FeS) depends on the temperature, pressure and physical-chemical characteristics of the metal in contact with H<sub>2</sub>S.

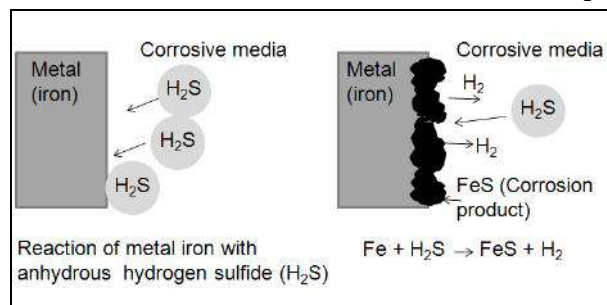


Fig. 2 - Chemical corrosion mechanism to H<sub>2</sub>S [10]

According to Mainier et al. [11] in this process show in the Figure 3 are expected reactions of SO<sub>2</sub>, water and sulfuric acid with calcium hydroxide free (Ca(OH)<sub>2</sub>), dicalcium silicate (2CaO.SiO<sub>2</sub>) and tricalcium aluminate (3CaO.Al<sub>2</sub>O<sub>3</sub>), cement constituents, forming crystals or precipitates in concrete matrix with volumes 30 times greater than the initial volumes of these crystals. That way, the increase of the volumes of these crystals will cause a high internal pressure in the cracks causing, consequently, the failure or desegregation (disagreement) of concrete, according to the following reactions:

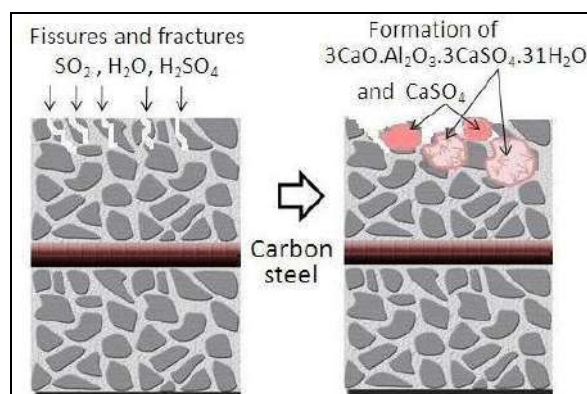
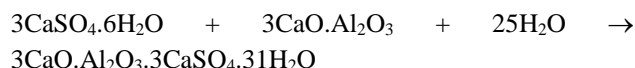


Fig. 3 - Chemical corrosion mechanism of concrete

It is important to note that in chemical corrosion, according to the examples presented, there is no transfer of electrons.

In the electrochemical corrosion the transfer of electrons from the anode to the cathode region is done by means of a metallic conductor (Fe) and a diffusion of anions and cations in solution closes the electrical circuit. The

intensity of the corrosion process is determined by the number of ions that discharge in the cathode, or by the number of electrons that migrate from the anode to the cathode, according to the model and the reactions involved (Figure 4).

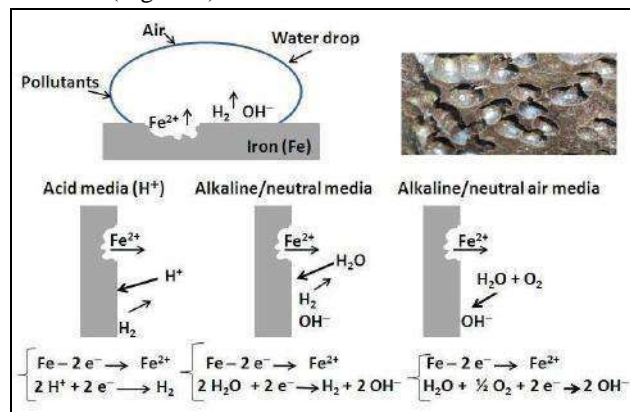


Fig. 4 – Electrochemical corrosion mechanism for atmospheric corrosion [11]

The anodic and cathodic reactions shown in figure 4 show the electron transfer in three corrosive media usually found on metal surfaces, such as acidic, alkaline or neutral and aerated. Pollutants such as SO<sub>2</sub>, SO<sub>3</sub>, NO<sub>x</sub>, CO<sub>2</sub> and H<sub>2</sub>S can provide corrosive acid media. Ammonia (NH<sub>3</sub>) can be an intense corrosive agent for copper and nickel alloys while the sodium chloride mist from the marine environment promotes the increase of the electrical conductivity consequently accelerating the corrosive process [12-14].

### III. THE CORROSION SEEN BY THE COMMON MAN IN HIS HOME-WORK-HOME TRAJECTORY

The semi-structured interviews (SSI) technique has been designed to determine people's subjective responses to a specific situation or phenomenon that they have experienced. From the simple theoretical basis of how the phenomenon of atmospheric corrosion associated with pollution occurs scientifically, sought to rescue, through SSI made with this ordinary man about what he sees, he feels and thinks about the deterioration registered in his path home-factory-house. In semi-structured interviews it is essential to preserve the respondent's identity [15-17].

The knowledge of these individuals usually arises as a result of their experiences, their continuous service, the tools they use and all the social relations developed during their work, thus generating a totally practical, conscious or unconscious, innocent or critical knowledge [18].

Referring to writer Umberto Eco [19], it is worth to consider the concepts that scientific humbleness is to

recognize that everyone can teach someone something; that he who does not seem to be of great value has hidden qualities and quantities; and that those who intend to do a research cannot, on principle, despise any source.

In this article the common man identified as a factory worker working at a factory located four miles from his home. He is 40 years old. He works as a mechanical parts assembler, has a medium level of education and has not attended any university. In the displacement, he uses the bicycle, urban bus or on foot, usually when he has time, mainly, in the return of work. In this work-home-to-house trajectory he began to observe and feel the emissions of pollutants generated by the nearby factories and by cars, buses and trucks. He also went on to record the deterioration of viaducts, concrete lighting poles, facades and building structures, leaks from underground water and sewer pipes, recreational areas where his children play, etc.

Corrosion and environmental pollution are phenomena that can be considered as omnipresent, global, penetrating and diffuse in the ordinary man's life. Political consciousness emerges when he begins to understand, for instance, that such phenomena can be results of neglect in the conservation and maintenance of materials, in the undue use of the components, in the lack of inspection in the emissions of pollutants, mainly when it comes to public projects, whose budget it is one of its contributors through direct and indirect tax payments.

Figures 5 and 6, below, shows photographs taken on the viaduct showing intense corrosion of concrete and carbon steel reinforcement. Probably, the viaduct is not in danger of collapsing, however, lack of conservation shows that inspection and maintenance are not carried out by public conservation agencies.

The fragment of the interview conducted on the basis of figures 5 and 6, the common man says:

"I go through this viaduct every day on top and bottom. I've been following this corrosion on the concrete that leaves the carbon steel armature exposed. I am concerned about the lack of recovery of these affected parts. The continuous deterioration can be disastrous for our community who need this viaduct to get around."

"The smoke that is released by the buses and trucks is very large; the smell is strong and causes burning eyes. I think the pollution is great when the smoke from factories and buses and trucks intertwine. I think residents in this district are disadvantaged in relation to Public Health. In the end both the viaduct and our lungs are affected by this killer pollution. Does the



Prefecture and the Health Posts know about this contamination? We pay taxes for what?"



Fig. 5 – Aspects of corrosion in the reinforced concrete viaduct



Fig.6 – Aspects of corrosion in the reinforced concrete viaduct

“Today, I’m 40 years old, 25 years ago, at my school I’ve never been alerted to these facts. Today, in the school of my children, pollution around our homes is discussed by teachers. My son said to me: Dad the teacher said that the factory you work for is the great polluter of the area. I heard and I was silent. In my heart I know it’s true. Maybe if I say something I can be sent away from the factory.”

Another point that attracted the attention of the worker was the deterioration shown in Figure 7 by the concrete lighting poles. Figure 8 presents details of concrete corrosion and corrosion of carbon steel reinforcement.

The fragment of the interview conducted on the basis of figures 7 and 8, the common man says:

“I am a factory worker and I can say, just look at the poor quality of these concrete lighting poles. They are not prepared to withstand the corrosion and pollution of this area which in addition to residential has factories that pollute. The workers of the electricity network do not keep, when the pole is to fall or already broke they exchange for another equal. I've

seen several post exchanges. I do not understand why this disregard for the population, because in the end that pays this irresponsibility are all of us”.



Fig. 7 - Aspects of intense corrosion of public lighting poles



Fig. 8 - Corrosion detail of the of public lighting poles

“The steel armature is exposed by showing that they were not made using the standards or assembly procedures. In my work we follow the rules and procedures that must be done in an assembly. Quality control does not leave a part that does not conform to the standards. I believe that in these post mills quality control does not exist or is not applied.”

“These posts have already caused several accidents and can put the lives of walkers in constant danger.”

Nor have the two gates of his neighbor's house escaped from their critical observation. One gate is made of galvanized grid and the other of carbon steel profiles coated with paint. As can be seen the lock itself also presents corrosion.

The fragment of the interview conducted on the basis of figure 9, the common man says:

“The gate is made with a galvanized grid that should not corrode; therefore, I have always heard that this zinc coating lasts a long time, more than 20 years. From what I heard from my neighbor this gate is 5 years old. Quality should not be the same as

advertising claims. Sometimes I become quite skeptical of these materials that should last longer.”

“I kept noticing that in the lower part of the gate the corrosion is more intense because the water becomes stagnant.”



Fig. 9 - Intense corrosion of the gates and the lock

“This lock is simple and inexpensive, which is why it does not withstand pollution and atmospheric corrosion. I never worried about this thing, corrosion, in locks. But on second thought, in my house, I changed two locks one by internal defect and the other one because the handle already had points of corrosion. I dismantled the two locks and I saw that they were corroded on the inner parts.”

The facts narrated in the interviews can lead the common man to the comprehension and dimension of the irreparable damages that can be caused to the environment by the pollution and the atmospheric corrosion that show their trace and consequently compromise the security and quality of life of the population.

#### IV. CONCLUSIONS

Based on this study, the following conclusions are presented:

- corrosion and pollution are a permanent challenge to man, because the more science creates and evolves and technology applies and advances, the more they find spaces and ways to be present;
- the lack of inspection, conservation and maintenance are responsible for the deterioration of poles and viaducts as evidenced by the photographic documentation made by the common man;
- the organized society is doubly penalized: by the environmental contamination that it breathes every day and also by the payment of the additional taxes to repair the damages caused by the corrosion.

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# Application of NR-10 regulatory as a method of accident prevention in electricity in two companies from Manaus industrial district in Brazil

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**Abstract**— This paper aims to analyze through field research the effects of Brazilian regulations, where the main focus is on accidents related to work with electricity (NR-10), although NR-10 is a mandatory regulation in Brazil, not all companies are using them as internal control rules, especially those in which external oversight is not as effective, thus comparing one large-sized company with a medium-sized company, the data collected were able to express the main concern of these companies regarding the safety of their employees and the imminence of fines and legal proceedings.

**Keywords**— Rules, companies, safety, electricity.

## I. INTRODUCTION

The use of electricity in Brazil started in the end of nineteenth century, when in 1879, Dom Pedro II inaugurated the first permanent electric lighting installation in the country, at Dom Pedro II Central Station in the city of Rio de Janeiro [12].

Since then, with increasing population, the demand for electricity has been growing exponentially and its use is necessary for the functioning of many processes and products of modern society, making it essential for the social and economic development of the countries, among other purposes.

According to data from the demographic research of 2010, conducted by the [7], 97.8% of the population has access to electricity or services involving the use of electric energy, and this demand is in a continuous process of increase, with high probability of occupational accidents occurring in electrical installations, [11] highlights that the occurrence of fatal accidents involving electricity in Brazil is even greater than the fatal cases caused by dengue.

According to data from [3], between 2013 and 2015, an average of 830 cases per year of accidents involving tasks with electricity and about 36% of these occurrences resulted in death. In 2016, occurred an average of 749 accidents with electricity, and 250 of these accidents resulted in death. [10] mentions that 70% of the patients who were victims of electric shock who were treated at a

Burning Treatment Center in the State of Ceará were caused by work accidents.

Based on this information, it is important to apply the applicable regulatory standards, as protective measures always seeking to ensure the safety and health of the worker. Thus, this paper aims to describe the application of Regulatory Standard number 10 (NR-10) in two companies of Manaus, Amazonas, being them medium-size and large-size, in order to classify them as to compliance with the application of NR-10 identifying possible changes to the facilities required to prevent accidents.

## II. THEORETICAL REFERENCE

Works with electricity started in Brazil in the nineteenth century, which was produced by generating plants formed by farmers, businessmen and local traders. Only with the arrival of the Canadian company Light in 1899, which started with incentives for structural actions such as the construction of large electric utilities so that they could meet the growing demand for this service [12].

The 80 decade were marked mainly by the beginning of operation of the Itaipu Hydroelectric Power Plant, and its activities started in 1984, a binational plant in Brazil and Paraguay [10]. For [8], electricity is the main driver of society, governing the functioning of important parts, such as the social and economic development of countries, where the advancement of technology and the structuring of information technology should directly

contribute to the elevation of quality of life of the population.

Considering only households in urban areas, only 0.9% of the Brazilian population has no access to electricity services and only 2.2% considering the entire Brazilian population in urban and rural areas. According to [7], through the demographic research, the value quoted describes that the population is almost entirely affected by electricity [11].

Through a study conducted in the USA, from 1982 to 1994, by the National Institute for Occupational Safety and Health (NIOSH), it was found that the most common accidents occur in five different contexts [15]:

- a) Direct contact with energized line;
- b) Direct contact with energized equipment;
- c) Contact of vehicles with energized line;
- d) Equipment incorrectly installed or damaged;
- e) Contact with energized conductive equipment.

Between 2013 and 2015, an average of 764 cases were registered per year and about 75% of these occurrences died. According to [2], in 2016, using data from Agência Nacional de Energia Elétrica (ANEEL), for occurrences involving only the electrical network, 209 deaths involving only the electrical network were registered and 605 deaths occurred involving both the electrical network and other accidents with electricity.

The losses caused by accidents at work, being physical, material, psychological or any other nature, are unimaginable. For accidents with registered workers who are notified and identified in official statistics, the costs generated in Brazil are around R\$ 70 billion, and the country spends on average R\$ 100 billion per year, with compensation and treatments to occupational accidents. With this, behind only China, the United States and Russia, Brazil occupies the 4th position in the ranking of the worst country in the world in work safety [10].

For [2], professionals who are exposed to electricity in everyday life, the risk of suffering an accident such as shock and electric arc, increases significantly, and the worker can suffer from serious injuries, or even die. [10] defines electric shock as the disturbance of nature and various effects that manifests itself in the human organism when it is crossed by an electric current. [5] mentions that the two factors that determine the severity of the injury caused by shocks are:

- a) The intensity of the circulating electric current (amount of electric current that will circulate through the body);
- b) The path of the electric current (depending on the path taken by it, being greater severity those in

which electric current passes through the heart) (Table 1).

Table.1: Electric current effects

Electric current intensity (Amps)	Consequences on the human body
1-10mA	Creeps sensation.
10-20mA	Painful feeling.
10mA<or<20mA	Breathing difficulties, may die or suffocate.
100mA	Cardiac fibrillation
200mA	Severe burns and cardiac arrest
1A	Severe burns, necrosis and instant death

For [5], the factors that most cause accidents are seen as: a personal factor of insecurity, this factor takes into consideration human behavior such as: excessive worker self-confidence, carelessness, the rush to finish the service, among others, and also the unsafe condition of the environment: services done under hazardous conditions.

For [2] occupational safety is a grouping of measures applied in the prevention of occupational accidents and diseases, aiming to protect the health and integrity of the worker. The author also reports the creation of official document number 3.214 that sanctions regulatory standards, and have the necessary requirements related to occupational safety and medicine, as in the case of NR-10 that directs such objectives to workers who interact directly or indirectly in facilities.

[13] cites several benefits regarding the application of NR-10 in table and flowchart format. An example of the benefits cited by the author concerns the industry point of view as shown in Fig.1.

Through Social Security data, [17] mentions that between 2000 and 2017, 4,466 accidents with electricity were recorded in Brazil and that with the update of NR-10 by Ordinance MTE No. 598, of December 7 As of 2004, it was expected that the occurrence of these accidents would decrease as a result of the companies' obligation to implement control measures and preventive systems, in order to guarantee the safety and health of workers who, directly or indirectly, interact in electrical installations and services with electricity, a fact that did not happen as shown in Fig.2.

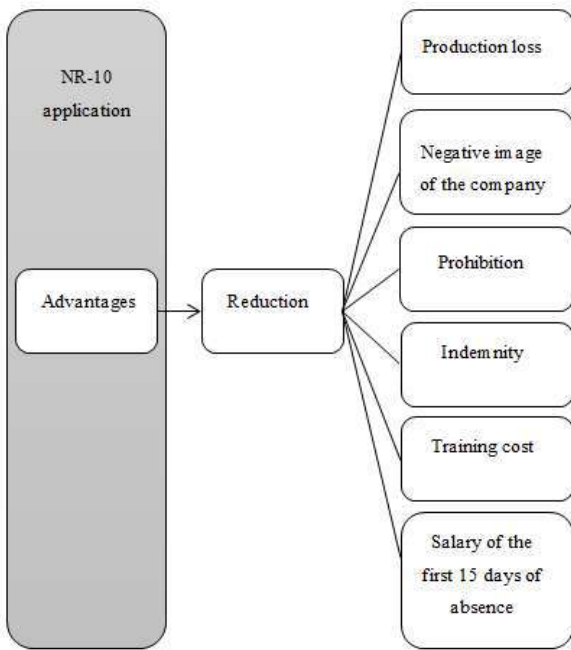


Fig.1: Benefits of NR-10 from an Industry Perspective

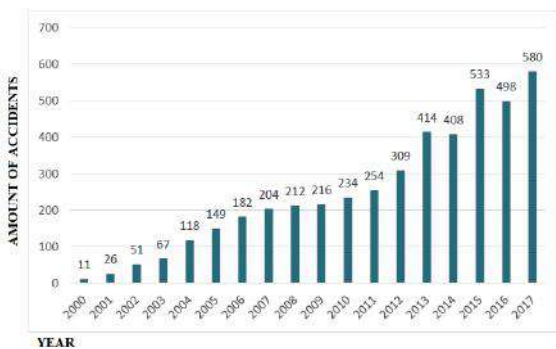


Fig.2: Evolution of the frequency of work accidents with electricity according to the year of occurrence. Brazil, 2000-2017.

### III. MATERIAL AND METHODS

Data collection was performed through on-site visits to one of the two companies studied in this research, and was accompanied by a professional responsible for the visit. The data of the second company were obtained through official documents made available by it.

In addition to NR-10 as an analysis tool in companies, bibliographic and electronic materials on work safety and electricity were also used to better understand the preventive measures and the risks to which workers are exposed to each type of service. The companies that participated in this research have a security policy that prohibits the reproduction of photographs in their internal environment, so that no confidential information leaks or

industrial secrets do not occur, so we did not use images of the companies in this article.

As for the evaluation method, the two companies studied were divided into two categories:

- a) Large-sized Company (LS);
- b) Medium-sized Company (MS).

In addition to the annual business turnover and the activities performed by a company, the main aspect of differentiation between the types of companies is their number of employees. For industry, medium-sized companies have between 100 and 499 employees and large companies over 500 employees [14].

Although some companies have their productive sector divided into some subsectors, this research aimed to analyze all of them in general as a single sector, considering that this is the space where there is the largest transition of people in most companies, and where there is a greater need for risk prevention measures.

The aspects analyzed by this research in each company were:

- 1-The Low Voltage Distribution Board (LVDB);
- 2- Substation, signaling and single-line schemes;
- 3-The qualification of employees and punishments applied to employees who perform any activity with electricity in non-compliance with [4].

Finally, when the evaluation process regarding the application of NR-10 was concluded, these companies were classified according to conformity, indicating whether they need adjustments in their preventive methods.

### IV. RESULTS AND DISCUSSIONS

#### 4.1 Large-sized company (LS)

The law requires companies to maintain up-to-date single-line wiring diagrams of their establishment with the grounding system and other equipment specifications, as well as protective devices. Establishments with an installed load greater than 75000 watts shall constitute and keep current, in addition to the single-line diagrams, the electrical installation chart consisting of: single-line diagram, descriptive memorials, maintenance reports or operation manuals that must be accessible to workers, kept organized and updated for consultation and inspection [16].

Through official documents obtained by this company, it was found that the application of NR-10 is always essential, because it goes through constant external audits because it is a worldwide known company. Therefore, LS meets all points proposed by NR-10, such as the provision of collective and individual protection equipment, updated availability of the chart of

electrical installations and single-line schematics, additional risk analysis and control and the selection appropriate of safety signs.

#### 4.1.1 Substation, signaling and single-line scheme

According to the analysis of the application of NR-10 in LS in the substation, the announcement signs and single line scheme are in compliance, it was found that the company also meets all the requirements described in the topic above.

#### 4.1.2 Training and appropriate punishments

According to [1] the design, execution, verification and maintenance of electrical installations should be made only for qualified persons.

LS offers free and frequent internal training programs to its employees, such as: safety in electrical installations and services (NR-10); safety at work in machinery and equipment (NR-12); unhealthy activities and operations (NR-15); dangerous activities and operations (NR-16); explosives (NR-19); Safety and health at work in confined spaces (NR-33); work at height (NR-35); fire brigade, and others (each employee is required to have at least ten training courses per year).

As for the punishments, LS has a monitoring system with over six hundred surveillance cameras scattered throughout the production complex, internal and external, which record 24 hours a day, 7 days a week, so any accident is recorded. If it is not possible to determine the causative agent of the accident, an internal investigation is made with people who were close to the scene of the accident and also with the boss of the injured person to find out the reasons and causes as well as a technical analysis of the equipment where the accident occurred.

At the end of these investigations was possible to define whether or not human error has occurred, whether or not the injured person was using the appropriate Personal Protective Equipment (PPE) for the activity, so that, depending on the degree of the offense, appropriate punishments are applied between verbal warning, written warning, temporary suspension of activities and company termination (just cause).

#### 4.2 Medium-sized company (MS)

The on-site visit to this company was so important, as it was observed, the non-correct application of the NR-10, because there are not any electrical document about the LVDB of this company, though the physical structure it was in accordance with the current standard, it had the acrylic protective cover, the components such as busbars and circuit breakers, were correctly fixed, clean and without heating signal.

The cables and wiring were unorganized and was not properly identified, there was no way to detect the circuit

breakers of each circuit, it was only possible to be identified by people who worked for a long time in contact with the this electrical cabinet.

#### 4.2.1 Substation, signaling and single-line scheme

During the period of the visit to the MS, the company's substation was in the process of refurbishing and maintaining the generator motors to bring about improvements to it, however, what was observed was the non-availability of PPE's for people who may have access to the site, poor signage with fallen signs and printed on ordinary paper on which the rain had already degraded.

The substation is located next to part of the production process, that is, there is a large movement of people around it, and due to no proper signage or supervision these employees circulated freely near the substation, where could not be accessed by unauthorized and untrained persons but it is incorrect to say whether this part of the company is compliant or not, given that many changes occur in the period of maintenance and renovation in an environment in general.

#### 4.2.2 Training and appropriate punishments

According to information obtained from the local Serviço Especializado em Engenharia de Segurança e em Medicina do Trabalho (SESMT), the company annually offers the courses of NR-10, NR-33, NR-35 and SEP (Electric Power System), however according to some employees who was explaining some procedures performed within the company, the company does not oblige to take the training course, they hires employees who are already qualified that can perform any activity that is necessary in the company.

According to [6], it is understood by personal insecure factor: when the activities are performed by people with lack of practice, training, ill will or bad physical condition. In addition the author still defines unsafe act, when the worker does not take proper care or make a task, or still does not respect the safety standards.

When the employee is not properly trained, automatically, when performing tasks outside his or her purview, the employee is performing acts without the security necessary to perform that task. For proper employee punishment, companies must empower their employees to be aware of the risks to which they are exposed.

When the employee is not properly trained, automatically, when performing tasks outside his or her skills, the employee is performing acts without the necessary security. For proper employee punishment, companies must empower their employees to be aware of the risks which they are exposed.



Some companies are supervised by the ANEEL as generation, transmission, and distribution companies of electricity and it is responsible for supervising them in order to ensure the provision of quality services. [9] state that when these companies do not comply with the rules and laws of the electricity sector, they are subject to punishments ranging from warning and fines until up termination of the concession, in this context, the control of these companies and even of the service providers became more rigorous.

## V. CONCLUSION

Based on the study, during the on-site visit and through official documents made available by the company, in general, several non-conformities were observed in one of the companies studied in which some NR-10 items are available or not available preventive measures through risk analysis, lack of supervision by the employer for irregular practice in activities that are outside the employee's training, poor signaling or even lack thereof, among other requirements imposed by this standard.

One of the first thoughts that was taken into account regarding the non-compliance of this company was the fact that it is not a worldwide recognized company and does not have rigorous supervision by public or private agencies regarding the application of the rules governing the safety of your employees.

As for the problems encountered on the premises, the following solutions are suggested, the implementation of a periodic program of evaluation, preventive maintenance and corrective maintenance, the application of the necessary signs in places that require this procedure, installation of substation identification, protection of switchboards and identifying circuits, creation of a single-line diagram, strict supervision on the use of PPE in the activities practiced in the companies and the rigorous supervision on the access of people to substations.

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# Interdisciplinary Health Practices for elderly people with Chronic Diseases: Self-Care Impact

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**Abstract— Objectives:** to check the perception of elderly people living with chronic diseases regarding the interdisciplinary health practices focused on self-care. **Methodology:** It is an analytical study with a qualitative approach, carried out in the period from October 2018 to June 2019, with 22 elderly people as participants from an interaction group. Eight fortnightly meetings were carried out with preventive activities and workshops focused on self-care. For the data collection, there were used as instruments a biosocial questionnaire and a semi-structured interview designed by the researchers. Data analysis was carried out based on the methodological theoretical assumptions of the Collective Subject Discourse-CSD. **Results:** The majority of the participants were female (96.2%), with a prevalent age group of 71-75 years (32.7%), white people (42.1%), widows (52.6 %) and of catholic religion (76.3%), with incomplete elementary education training (39.5%), monthly income between 1 and 2 minimum wages (55.3%), living alone (42.1%) and that have children (94.7%). Concerning the clinical aspects, most of them have more than one chronic disease (84.6%) and lives primarily with systemic arterial hypertension (63.5%), diabetes mellitus (32.7%), dyslipidemias (23.0%). When analyzing the Collective Subject Discourse in relation to self-care impact, four central ideal arose: eating habits; conscious use of teas; prevention of falls; mental health and memory. **Conclusion:** the elderly people reported that the participation in programs with the focus on health was essential to increase knowledge, make clarifications, guide, and modify the life habits that were mistaken. That is to say, it helped to improve self-care which directly affected health and quality of life. **Keywords—** Aging. Elderly people. Health Education. Chronic Diseases.

## I. INTRODUCTION

The growth of elderly people in Brazil is a visible reality. Due to this phenomenon, human aging researchers are committed to comprehending the causes of this growth and understanding longevity, taking into account the autonomy and independence and their links with an increased life expectancy [1],[2].

Among the major health conditions that affect the elderly person are Chronic Noncommunicable Diseases (CNCDS) [3] which are composed of a set of chronic conditions, with multiple causes, characterized by a gradual start, commonly with an unknown prognosis, with long or

undefined duration. They display a clinical course that changes over time, with possible exacerbation periods, which can generate disabilities [4]. The World Health Organization [5] describes as chronic diseases the cardiovascular diseases (cerebrovascular, ischemic), neoplasms, chronic respiratory diseases and diabetes mellitus also comprising those diseases that lead to the suffering of the subjects, families and society, like mental and neurological disorders, oral, osseous and joint illnesses, genetic disorders and ocular and auditory pathologies.

CNCDS if not treated properly can result in several complications as hospital admissions, having as a

possibility the subjects' death, particularly in elderly people with circulatory system diseases [6].

Due to this fact, prevention and health promotion have a key role in the lives of elderly people who display health problems, since such problems could be prevented or altered by the knowledge and adoption of healthy practices [1]. That way, public policies targeting the treatment of elderly people with chronic illnesses have been oriented to the prevention of complications through the control of disease progression using preventive care practices and health education emphasizing the change of life habits and behaviors [7].

Studies display that education and health practices directed to the quality of life have a significant role in the fight against inequality and social exclusion [8], [9]. Besides that, they seek to decrease the populations' vulnerability and health risks through participation and social control. This also allows people to realize their potential for physical, social and mental welfare during their lifetime and to take part in society according to their needs and capabilities, providing proper protection, safety, and care [10], [11].

For that matter, this study has as a goal to check the perception of elderly people living with chronic diseases regarding interdisciplinary health practices focused on self-care.

## II. METHODOLOGY

This is an analytical type study, with a qualitative approach, carried out in the period from October 2018 to June 2019, with 22 elderly people as participants from an interaction group designed and developed by the Nursing Collegiate Body of a Higher Education Institution, located in a city of southwestern Bahia. The study comprised elderly people who filled the following inclusion criteria: to be 60 years or older, with medical diagnosis of chronic noncommunicable diseases through medical reports or examinations, the ones who agreed to volunteer in the research and who did not display cognitive deficit assessed with the Mini Mental State Examination (MMSE) that had the cut point of 27. The ones who participated in the interaction group but did not fill the inclusion criteria were excluded from the study.

Eight fortnightly meetings were carried out with the themes: hypertension and diabetes; falling risks; self-esteem; elderly person's rights; medicinal plants and herbal medicines; healthy nutrition, short and long-term memory; and balance and breathing. Besides, in all meetings dance was a key practice as an encouragement to do physical activity. Two celebrations were also performed with the themes of June and Christmas festivities. All meetings took

place in the auditorium of the institution, with the establishment of preventive and self-care activities using the popular health education methodology to enhance the quality of life of the elderly people of the group.

For the data collection, there were used as instruments a biosocial questionnaire and a semi-structured interview designed by the researchers. The biosocial profile was examined by variables like: age, gender, color, marital status, schooling, profession, monthly individual income, monthly family income, religion, with whom they lived, which other relatives, if they have children and how many children, and chronic illnesses.

The semi-structured interview was designed with questions to check the impact of the activities developed on the daily practice of the elderly people composing the group. The questions were drawn based on others ones such as: what was the most significant meeting and why; changes regarding the self-care behaviors after the meetings; relevance of the practices developed in their lives; health changes after the meetings; recommendations for new meetings and actions to be undertaken. For the interviews, home visits were conducted at preset time defined by (the researcher and elderly person), taking on average 30 minutes, the interviews were recorded through digital recorder with the participants' knowledge and authorization.

Data analysis was carried out based on the methodological theoretical assumptions of the Collective Subject Discourse-CSD, a method designed by Lefevre and Lefevre (1990), which has as its foundation getting the subjects social representations on a particular theme or phenomenon. Data with similar meanings were arranged into semantic categories, which enabled us to collect beliefs, values, thoughts and representations of a group on a specific theme through scientific methods [13]. For analysis purpose, *DSCsoft software* was used, and it was also designed by Lefevre and Lefevre [12] for qualitative and quantitative research.

All ethical and legal factor of 466/12 [13] and 510/16 resolutions [14] were thoroughly followed and only after approval by the Research Ethics Committee / REC of the Northeast Independent College / FAINOR under protocol opinion No. 2.960.922, data collection was started. This was a part of the main project called "Education and interdisciplinary health practices for elderly people with noncommunicable chronic diseases."

## III. RESULTS AND DISCUSSION

The outcomes indicated that the majority of the participants were female (96.2%), with a prevalent age group of 71-75 years (32.7%), white people (42.1%),

widows (52.6 %) and of catholic religion (76.3%), with incomplete elementary education training (39.5%), monthly income between 1 and 2 minimum wages (55.3%), living alone (42.1%) and that have children (94.7%). Concerning the clinical aspects, most of them have more than one chronic disease (84.6%) and lives primarily with systemic arterial hypertension (63.5%), diabetes mellitus (32.7%), dyslipidemias (23.0%).

When implementing the methodological systematization and the analysis instruments of the Collective Subject Discourse (CSD) corresponding to the influence on self-care in an elderly group, four respective fundamental ideas appeared for this thematic axis, according to Table 1:

Chart 1 –Thematic axis and Central Ideas regarding the analysis of the Collective Subject Discourse(CSD) on the research. Bahia, Brazil, 2019.

THEMATIC AXIS	CENTRAL IDEAS
1 Impact on self-care	1 CI Eating Habits 2 CI Conscious use of teas 3 CI Prevention of Falls 4 CI Mental Health and Memory

Source: Study’s data.

**1 CI – Eating Habits**

With the population aging and the growth of elderly people affected by Chronic Noncommunicable Diseases, researchers have advised about the importance of the nutritional condition and diet of the elderly person for healthy aging and welfare [15].

The main ideas that came up in the collective subject speech below showed the elderly’s preoccupation regarding the decrease in the consumption of food rich in salt and fat, just as the overuse of sugars and the acknowledgement of the new eating habits benefits, as stated below:

I’m eating better, in a more natural way, healthier, I quit some habits that weren’t compatible with my age and my well-being like a decreased ingestion of salt, fats. I withdrew sugar and I look for doing a proper diet. So it was beneficial, there were actual changes, and I feel the results. It changed a lot, I became another person, I was happy and stimulated to be more careful with food (E-01, E-05, E-07, E-08, E-09, E-16, E-19, E-20, E-21, E-22).

People who have CNCDS usually have trouble following a diet and eating healthy, because they consider in their daily routine only the drug treatment of CNCDS, and there is no incorporation of other control measures for these illnesses[16].

A study performed with 50 elderly with an average age of 69 to 82 years in an interaction elderly center in Goioxim-PR [17] indicated that the presence of CNCDS in this population was high, reaching 60%. In this research, it was noticed that there was a prevalence of increased daily consumption of meats, eggs, fruits, legumes, milk and dairy among the elderly people that did not have CNCDS, in contrast, the elderly people with CNCDS had increased consumption of sugars and fats, oils and greenery. Getting positive points only because of the greenery [17].

Therefore, it is necessary the orientation of health professionals to readjust the nutrition of these subjects, stimulating the exchange of food that can cause imbalance or aggravation symptoms of CNCDS for a more balanced and healthy diet.

The Health Ministry provides the Elderly Person Health Handbook “ten steps towards a healthy diet”, which is offered to the elderly person in the Brazilian Health System (SUS) holding many necessary guidelines for healthy aging and steps to keep healthy eating habits providing an integral health care [18]. Following these steps makes it easier for the elderly to carry on with a daily routine of healthy eating. Nevertheless, it should be highlighted that sometimes the elderly person does not have the financial funds to afford buying certain food, being essential to adjust the diet to the socioeconomic conditions of the elderly person.

Through the collective subject’s speech, it was noticed that the gains for the elderly people surpass the physiological matters linked to their health and affect the social psychic field, since positive alterations in mood were mentioned as a factor of motivation taken by them to keep eating healthy.

A study performed in Pato Branco-PR with a group of elderly people participants of an extension project of a higher education institution, administered a socioeconomic questionnaire and a nutritional knowledge survey concerning the classes given during the research period in order to set the questionnaire’s parameters before and after the interventions. On the outcomes, there was progress in knowledge about food and nutrition education is being fundamentally important, since in this age group the elderly people are susceptible to diseases and the knowledge about food is essential for their prevention and control [19].

An observational study, implemented in a long-term institution in the city of Viçosa-MG, conducted

nutritional education activities using instruments to realize the previous knowledge of the elderly people. Some of them already knew that processed products, sugar-rich foods, oils and excess salt are bad for the health and they were aware that vegetables and minerals were ideal. Since then there were activities to find out information about food, being significant for them to actively realize the importance of eating in a healthy way [20].

Facing the study proposed here and the ones above-mentioned, it is of great importance to conduct actions that look for assessing and orienting about the nutritional aspects in a wide manner, with health actions focused on the adoption of healthy eating by the elderly population with the purpose to prevent, control and treat CNCs and their consequences regarding the elderly people quality of life [21].

## 2.1 Conscious use of teas

The participants' speeches indicated the importance of the meetings to enlighten some doubts concerning the use of medicinal plants, like teas.

The absence of information regarding the rational use of medicinal plants and the necessity of knowing drug interactions, side effects and contraindications was reported in the collective subject discourse, with reflections concerning the overuse of these substances according to the speech:

I didn't know that there was any side effect, on taking more, these information I will carry for the rest of my life, forever. I became more prudent, I stopped taking too much tea, when I used to take it. Now I look for having it in a correct way. (E-01, E-08, E-10, E-12, E-15, E-18, E-20).

Studies reveal that the elderly people misusing medicinal plants reach 81%, these are times employed to treat a disease or even with the purpose to prevent possible diseases, of these elderly people 53% live with CNCs, especially systemic arterial hypertension [22].

For Dantas (2018) [23] the custom of using medicinal plants is a culture that has been passed down through generations. This assertion was in their own study, as it was identified that 66.7% of the elderly people who used medicinal plants said they have learnt this habit with their parents, 21.7% with grandparents, 3.3% with neighbors, and 1.7% with health professionals.

It is of great importance that the elderly comprise groups that work with health education, as they support the knowledge about crucial information for healthy aging, primarily about the risks associated to the unawareness about the misuse of teas. Machado et al. (2015) [24] presented that of 12 elderly people who were respondents in their research, only four participants informed about the use of medicinal plants during their appointments. Researchers say that this information is significant because many plants are contraindicated for people who present CNCs.

A study performed in an elderly's foster home with 13 participants determined that the majority of elderly people got the plants from their neighbors' backyard, their own backyard or in the philanthropic institution. It was also noticed that most of them have no orientation regarding the plants' use [25].

It is valuable to know about the correct use of medicinal plants, as the elderly can start to manage the use and the choice of teas that are more appropriate to the symptoms displayed avoiding drug interactions. Qualified health professionals should guide the use of medicinal plants and it shall comprise in the elderly's clinical assessment questions concerning the use of teas, the periodicity, types and intake amount. This way, guidelines linked to the use of teas like the correct use, considering toxicity issues, side effects and drug interactions that can happen with the misuse, which will interfere with the health promotion for the elderly person [26].

## 3.1 Prevention of Falls

The prevention of falls was one of the self-care relevant variables stated by the elderly people in this research, and it was one of the main reasons for the functional dependence of the elderly person with a strong potential for issues that can result in death [27].

The information transmitted at the meetings concerning this theme, with experiences taken from the practical reality of the daily lives of the elderly people, was important for them because it helped to modify risk behaviors linked to falls, besides favoring a debate on how to prevent situations of falling vulnerability, as can be observed in the discourse below:

I became more careful after the information about the risks of falling, everything that you know you can't, but when you find someone to explain it to you, you get it. I worry when I walk into the bathroom, in my bathroom, there is no handrail for me to grab, I'm always worried. I put my flip flops to get in the shower, I walk slowly so I don't fall and I don't go up on stools anymore. I wear shoes



instead of flip flops. My bed has a good height, I just have one rug, but it's not slippery and I always talk to myself and my daughters, when we're younger it's different, when we get old it's something else (E-02, E-03, E-07, E-11, E-12, E-22).

In a research performed with 127 elderly people that lived in the city of Itabira-MG and were participants in the City Hall Project, it has become clear that the main causes of falls in the elderly people occurred because of tripping, imbalance, slip and dizziness. Only 5.5% of the elderly people stated they fell because of lower limb instability. Among the elderly people who fell 11% had their fall linked to a risky behavior. The major vulnerability was in the female gender regarding the fall occurrences [28].

Unlike the collective subject discourse shown here, the elderly people in Morsch et al. (2016) [29] study, even though they were aware that they could fall, several of them reported that they were not afraid and said that falling may happen to anyone, that is to say that they have not noticed the matter of age as a risk factor, neither that it would be a situation with serious consequences for the elderly people, demanding changes in their routine to prevent falling. A similar outcome was seen in the study of Neto et al. (2018) [30], who check the perception of 473 elderly people regarding falls and exposure to risk factors in the home environment and the conclusion was that most elderly people are not aware of the risks and do not recognize that their household can produce these risks.

These studies, may display the absence of programs for this population with the goal of preventing falls, an important situation that can lead to significant consequences, such as a fracture, immobility in the bedside, dependence and also death as a result of complications, negatively interfering with the health and quality of life of the elderly person. For this fact, it is vital in interaction groups to work on themes regarding falling, with interventions, guidance and simulations of risk factors, in a way to avoid risks to their physical integrity.

Besides orientation and suitability of the physical environment for the prevention of falls in the elderly people, studies have indicated that physical activity produces health benefits and help to prevent the chronic noncommunicable diseases [31], [32] with these measures to avoid falling situations, enabling the elderly person with increased safety to carry out their daily living activities [33].

Melo et al. (2017) [34] highlights the involvement meaning of the whole health team in intervention actions emphasizing the elderly's fall prevention. It is required a careful examination of the use of prescription drugs that

lead to some type of symptoms that may raise fall risks, as the environment and other elements that may increase to the risk of falling at home.

#### 4 CI Mental Health and Memory

Another manner of impact on the elderly people self-care is linked to their mental health and memory fixation. Participation in interaction groups, in line with the participants it benefited socialization, supported well-being, enhanced self-esteem, creativity and willingness for daily activities, as noted in the collective subject speech:

The meetings stimulate me a lot, I'm more pleased to go out, to attend the group, more motivated to get up early and do the house chores. It changed my behavior, sometimes I do the mental tasks, when I wake up or when I go to bed, I keep thinking about what I did today, exercising my mind. I achieved good results. I'm happier, I used to be shy and reclusive. I became someone else, thank God, I'm not sad, it has increased my self-esteem. I think I'm beautiful, young, as if I were 15 years old again (E-05, E-14, E-15, E-16, E-17, E-21).

It is essential to work on aspects of the elderly people mental health, because to have a physical well-being it is mandatory to feel good about yourself, since this well-being will reflect on the day-to-day activities and on how the elderly person interacts with the society, their surrounding environment, with the search for self-care generating a better quality of life.

A study performed with 122 elderly people, of both sexes without cognitive deficit, of different age groups in a city in the western region of Santa Catarina, assessed mental health state, depression and mood index, and the quality of life of the elderly people treated in Primary Health Care (PHC). The Geriatric Depression Scale was used, and 61.5% of the elderly people displayed depressive characteristics. In this research, the elderly people without depression or with mild depression showed a better quality of life within the physical domain in relation to the ones with severe depression, obtaining a lower impact on daily activities and well-being [35].

A study performed with elderly women aged over 60 years old, that were participants of a physical activity group, indicates through the interviews that according to psychosocial aspects, physical activity has the strength to make the elderly people interact, to be more excited and with a good mood, quitting a sedentary lifestyle and not

being isolated, making new friendships, with the last characteristic being the most described as positive [36].

A study carried out with 292 elderly people, with the majority of female gender (62%), aged 60 to 69 years. Among them, 53 displayed signs of depression, which is 18.2% of the population studied. Concerning the health (80.8%) reported having health issues. In this research, depression was associated with hypertension, diabetes, osteoporosis and heart disease. It may be linked to the quantity of medication intake that the elderly were having, since the kind of medication can be changing their lifestyle [37]. This way, it is essential to work with the elderly people's mental health, particularly with the ones who display one or more CNCDS, because the existence of pain, functional limitation, dependence and other health issues can provoke problems of solitude, isolation and depression. A study conducted with elderly people with the average age of 75 years old, who participated in a memory workshop exhibited the significance of memory perceptions for them, reasons for attending the workshop, workshop impact on metamemory and quality of life. The elderly people in this study described memory as their own identity, considering it crucial for the existence process, as a target organizer. Besides that, they revealed the importance of socialization and the prevention of difficulties regarding memory. In the workshop, they noticed the benefits and met the processes of memory functioning, motivation for interpersonal relationships, which increases quality of life and they also felt contentment, with it being funny and pleasurable [38].

It is realized that it is imperative to work with the elderly people activities for the fixation and active preservation of memory as a form to conserve the elderly's person cognition, their autonomy and independence for a longer period. Working with the elderly's memory influences a better quality of life, because they exercise memory through games, which help the fixation work and influence the elderly person to keep exercising their memory the whole time. Due to this fact, it is important to be implementing actions that allows the elderly's socialization, looking for the promotion of mental health and activities that contribute to memory fixation.

#### IV. CONCLUSION

The perception of elderly people who live with chronic illnesses regarding health interdisciplinary practices concentrated on self-care was exposed through speeches related to eating habits, conscious use of teas, prevention of falls and mental health and memory.

This way, health education is required to stimulate health promotion, just as a better quality of life and well-being for the elderly people, and mainly the comprehension

of carrying out practices that enable active aging. The elderly's discourses stated that participation in programs with health practices was vital to increase knowledge, clear doubts, to orientate and modify lifestyle habits performed in a wrong way. In other words, it helped to improve the elderly's self-care, which influenced the health and quality of life.

Therefore, health professionals have to develop more activities like these ones, stimulating the elderly person to search for self-care. It is said that more effective interventions need to be multiple and ideally implemented by a multidisciplinary team, focused at promoting self-care and consequently healthy aging with a better quality of life.

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# The Influence of Organic Fertilizer on the Seedling Growth of an Oleaginous Species from the Amazon: Andiroba (*Carapa Procera* Aubl.)

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**Abstract**— *Andiroba* (*Carapa Procera* Aubl) belongs to the *Meliaceae* family and is a plant of great importance for the traditional medicine in the Amazon. Also, the oil obtained from its seeds is widely used in the cosmetics industry. The following study was carried out at the Tropical Silviculture Experimental Station of the National Institute of Amazon Research (EEST/INPA), where the growth of andiroba seedlings was evaluated using three types of substrates which received daily irrigation, according to the following treatments: T1 = sand/clay; T2 = clay/organic fertilizer and T3 = forest topsoil. The following data were collected monthly: height, neck diameter, and number of leaves. The results showed a non-significant difference with a *t*-test at a *p*-value of 0.05 for seedling height. For neck diameter, there was a significant difference, especially in T2 and T3, which presented higher average values, indicating that the use of both commercial organic fertilizer and forest soil which particularly has a high concentration of decomposing organic matter, are beneficial to seedling growth. However, the usage of forest topsoil as a substrate must be taken carefully due to the large amount needed that may harm local ecosystem. Therefore, seedling production with organic substrates is a viable alternative for local producers disposed to produce better quality seedlings.

**Keywords**— *andiroba*, *oil*, *seedlings*, *seedling nursery*, *substrates*.

## I. INTRODUCTION

Andiroba (*Carapa Procera* Aubl.) stands out among the oilseeds tree species due to its productive and economic potential. It is a multiple-use species of great economic, ecological and social importance for the Amazon region [1]. This tree is of great importance in the pharmacopeia of the Amazonas State. Amazon traditional people use its products – made with the oil extracted from seeds, for medicinal purposes such as healing ointment, insect repellent, external anti-inflammatory, febrifuge as well as anthelmintic. The cosmetics industry uses it to make shampoos, moisturizers, and soaps [2]. Andiroba seeds contain 56% of a clear, liquid and light-yellow oil that, when subjected to temperatures below 25 ° C, it solidifies to a similar consistency of petroleum jelly. Also, andiroba timber is used in construction, furniture, veneer and plywood [3].

Studies with andiroba have shown that it has the potential to adapt to anthropized environments [4]. That makes it a promising species for restoration and enrichment of degraded areas [2]. Despite all existing forms of use and their importance to traditional populations, many trees have been cut down, often illegally in order to support the woodworking sector, leading to the reduction of natural populations and the loss in production of tons of seeds, which could have been produced throughout the lifecycle of an Andiroba tree.

In the Amazon around two hundred thousand families profit from the use of non-timber forest products (NTFP) of various species [5] as a source of income. Andiroba seed oil provides additional profit for the Amazon traditional people but seedling production of this species is irregular and highly predated by the *Hypsipyla ferrealis* Hampson and *Hypsipyla grandella* Zeller, which are insects that decrease the germination percentage [6], besides high cost



added due to the need for chemical fertilization. Rural producers find it difficult to produce seedlings on farms via germination. Given this fact there is a need to try alternatives to reduce the costs in the phase of seedling production and provide technical support to the traditional populations of the Amazon.

The aim of this paper is to evaluate the nursery growth of Andiroba seedlings, submitted by different substrate types, including the use of organic fertilization.

## II. METHODS

### 2.1 Description

#### 2.1.1 Genus

The genus *Carapa* is widely distributed in Africa, South America and Central America. There are two genetic varieties: *Carapa guianensis* and *Carapa procera*. Due to its use as a NTFP, the extractivist exploitation of the species is increasing, leading to the need of conservation strategies of natural resources, such as projects to develop its adequate management [2].

#### 2.1.2 Species

The species is commonly known as *Andiroba*, *Andirobeira*, *Andirobinha*, *Igapó andiroba*, *Carape*, *Andiroba*, *Penaiba*, among others. The synonyms *Carapa guianensis* and *Carapa procera* are known by the same common names and are also commercialized as the same species [7]. *Carapa guianensis* is found throughout the Amazon basin mainly in *várzeas* (floodplain areas in the Amazon basin) whereas the *Carapa procera* species is more restricted to the Amazon, but also found in Africa [2]. It is a leafy tree that can reach up to 55 m in height. The species *C. procera* is smaller and can reach up to 30 m in height. Its stems are cylindrical and erect, and might present buttresses. Its barks are gray, thick and bitter. Its leaves are dark green and elongated and display small, cream-colored flowers.

Its fruits are globe-like and may contain from 4 to 16 seeds, which are released when it gets in contact to the ground. Its seeds float and can be dispersed through the watercourse stream, but on forests in *terra-firme* (upland areas in the Amazon basin), most fruits and seeds are found under the parent trees. During the dispersal period, seeds are sought out by rodents, armadillos, wild pigs, lowland pacas, deer, cotias, etc.

#### 2.1.3 Usage

The species presents a wide range of usage. Its wood can be easily handled, due to physical-mechanical qualities and is sought after for building houses and manufacturing furniture. The bark is used by the traditional population to treat fever, worms and bacteria. Its seeds are used for oil production, used in the region as local medicine to treat

tumors, rheumatism, worms, muscle strain, healing as well as insect repellent. The cosmetics industry also uses the oil to make shampoo, body oils and soaps. The seed residue is used for candle making as a mosquito repellent against *Aedes aegypti* which is responsible for transmitting the dengue fever. The candle is not toxic and does not produce smoke while burning [9].

In the cosmetics market, there are three noteworthy companies that profit from Andiroba oils: Cognis do Brasil, CRODA and BERACA, which provide the raw material for large cosmetics companies both intern and foreign market [9].

#### 2.1.4 Seedling production

The seeds used for seedling production should be obtained by collecting the previously selected parent trees, not containing pests or diseases, presenting a well-developed crown and good growth in height and diameter.

Seed extraction should take place as soon as possible by manually opening the fruits and placing for germination shortly after harvesting, covered with a layer of rich organic matter substrate and should be irrigated twice a day in a semi-shaded environment [10]. In order to obtain good quality seedlings, it is necessary to evaluate the type of substrate and the size of the recipient that will be used. It must also provide root development and nutrition during the seedling nursery period.

#### 2.1.5 Forest seeding market

Forest establishment for industrial purposes has expanded, making it a challenge to produce good quality seedlings at a lower cost on a commercial scale [11].

One of the biggest problems for the practice of environmental restoration in the Amazonas State is the scarcity of native forest species seedlings produced in seedling nurseries accredited by Environmental Agencies. The lack of knowledge in seedling production techniques means that the population does not possess a viable alternative to develop a potential economic activity.

## III. STUDY DELIMITATION

In order to develop better quality Andiroba seedlings at a lower cost, the study was developed by using different types of substrates. The results obtained could be used by farmers and nurseries in the region to enhance production performance. The study was conducted in the seedling nursery of the Tropical Silviculture Experimental Station of the National Institute of Amazon Research (EEST/INPA), located at BR-174, km 42.

Due to the fact that the 2006 seed production failed to present the expected production at the time. It was not possible to use seeds for seedling production. However, in



order to carry this study, seedlings were obtained from natural regeneration.

### 3.1. Natural Regeneration

Seedlings were collected under primary forest parents trees at BR – 174, km 42. The seedlings were approximately ± 10cm tall and were left in the nursery for 30 days. After this rustification period, the seedlings were placed in 20cm x 32cm recipients containing the three different substrate types.

### 3.2 Organic Fertilization

It was added 150g of commercial organic fertilizer per seedling, and the same amount continued being added every 2 months. All seedlings were distributed in seedbeds under 50% shading. The treatment were the following ones: T1 = sand/clay, T2 = clay/organic fertilizer and T3 = forest topsoil, which were daily irrigated.

### 3.3 Data Gathering

Growth data were collected monthly. The seedlings remained in the nursery for 212 days including the entire experimental period, and the following variables were monitored: overall height, seedling neck diameter and number of leaves.

All seedlings containing greenish-colored stems, regardless of the presence of leaves, were considered alive.

### 3.4 Experimental Design

The experimental design chosen was the DBC with 6 replications of 7 samples each per treatment, coming to a total of 126 seedlings that were submitted to t-test at a p-value of 0.05 and the analyzes were obtained by the Sisvar statistical program.

## IV. RESULTS AND DISCUSSION

According to the results achieved, after 180 days, the analysis of variance of height growth of Andiroba seedlings did not show significant interaction (p-value < 0.05) among the tested substrates. The forest soil substrate presented higher average values during the months of observation.

For the seedling neck diameter, the data showed a significant difference, especially for treatment T2 which obtained higher average values when compared with different treatments. When it comes to the T3 data, it can be seen that the high concentration of decomposing organic matter contained in the forest soil was beneficial to the diameter growth of the seedlings. However, the removal of large amounts of forest soil superficial layers can impair the ecosystem dynamics.

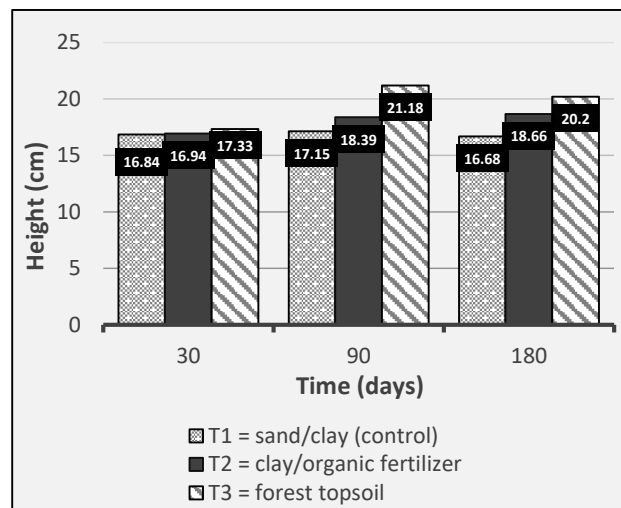


Fig. 1: Growth in height of Andiroba (*Carapa procera* Aubl.) seedlings submitted to different substrates (T1, T2 and T3).

Table 1. Means of variables: Height and neck diameter as a function of different substrates and organic fertilization of Andiroba (*Carapa procera* Aubl. seedling after 180 days).

Treatment	Composition	Height*	Diameter*
1	sand/clay (control)	17,04 A	4,08 B
2	clay/organic fertilizer	<b>18,90 A</b>	<b>4.67 A</b>
3	forest topsoil	18,51 A	4,56 AB
CV( % )		5,51	4,24

\* Averages followed by the same letter do not differ significantly by the t-test (p-value < 0.05).

## V. CONCLUSION

The production of seedlings using forest soil as substrates presented the best results. However, this soil has a seed bank and nutrients for plant development. Large-scale use may affect the forest successional stages.

The given results presented above show that the treatment using clay and organic fertilizer is viable for local producers disposed to produce better quality seedlings. This fertilizer can be produced by the farmers themselves or purchased in local trade market. The use of this substrate is indicated as a source of nutrients and at a low cost besides not affecting the environment.

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# Road Safety Analysis at Intersections: Case of the North Entrance of Porto Nacional - TO

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**Abstract**— The present work aims to analyze the efficiency of the intersection located at the TO - 050 at the entrance of the city of Porto Nacional - TO, the chosen location presents negative points regarding the safety of the drivers, due to the connection of the expressway with highways. Without the addition of auxiliary lanes and poor signage, generating dangerous intersections and overtaking, and the existence of the entrance port of the municipality at the intersection that impairs the visibility of drivers. The region has large movement of cargo and passenger vehicles due to agricultural production and because it is the connecting section of the capital of the state of Tocantins (Palmas) with the municipality of Porto Nacional, consequently increasing the likelihood of accidents on the site. Therefore, the need to study conflict points and their origins is identified, guaranteeing efficient traffic flow and safety for drivers.

**Keywords**— Intersection; Safety; Signaling; Conflicts.

## I. INTRODUCTION

According to the National Transport Confederation (CNT), the Brazilian highway modal is the main means for product flow in February 2019, the highway's participation in cargo transportation was 61,1%, in addition to the constant growth of vehicle that between January 2015 and January 2019 grew 14.8%. Consequently, a demand is created that demands greater investments in infrastructure and inspection.

Second data from Denatran (2019) Porto Nacional has a route of 30230 vehicles showing a growth of 4,7% over the year 2018. Such growth increases the search for solutions with a view to meeting road needs in a viable, economical and safe manner.

It is recommended that road improvement projects be based on future road demand, making the investment more advantageous because they have long-term positive aspects, the actual data obtained represent the current road situation that ensures the analysis of future demand.

According to DNIT (2009) the highways have meeting points, which allow access to municipalities or the arterial roads, it is essential that in the project these places have more attention, due to possible intersections, which are points of accumulation of accidents and major cause of the malfunction of the way.

DNIT (2005) states that intersections are considered areas of potential conflict, as it is requested by more than one vehicle simultaneously performing different maneuvers, consequently, are the points where the highest number of accidents occur. The absence of signaling,

errors in maneuvering by drivers due to the short period to make decisions and faults in geometric characteristics aggravate possible conflicts.

Signaling contributes significantly to the proper functioning of the roads and is the main means of communication of intersection with the driver, it helps in regulating traffic and guiding drivers, minimizing accidents.

The operation of intersections significantly influences the performance of the road system, interfering with operating speed, capacity and safety. Traffic jams and functionality problems encountered on highways often occur because of inability to move traffic at intersections.

Geometrical sizing of roads considering future demand allows for better visibility, maneuverable areas with sufficient conductor reaction time, and peak flow throughput productivity minimizing congestion.

Thus, the objective of this work was to analyze the road request, proper sizing of lanes, efficient signaling, the use of auxiliary lanes, speed and proper visibility, for a good functioning of the road network under study.

## II. METHODOLOGY

The traffic study and the intersections of projects made in Brazil are based on s in Meto those indicated by Bring Manual TRAFFIC - DNIT (2006) and the Intersections Project Manual - DNIT (2005), and these literatures used in this work.

The site under study (Fig. 1) has a hollow knuckle-like intersection with a gantry in the central site and main and

secondary road connections that function as the entrance and exit of one of the townships, located on TO - 050 at the entrance of the municipality of Porto Nacional - TO.

To obtain the necessary answers to the case study will be done the signs and design are necessary in order to provide greater security for society.

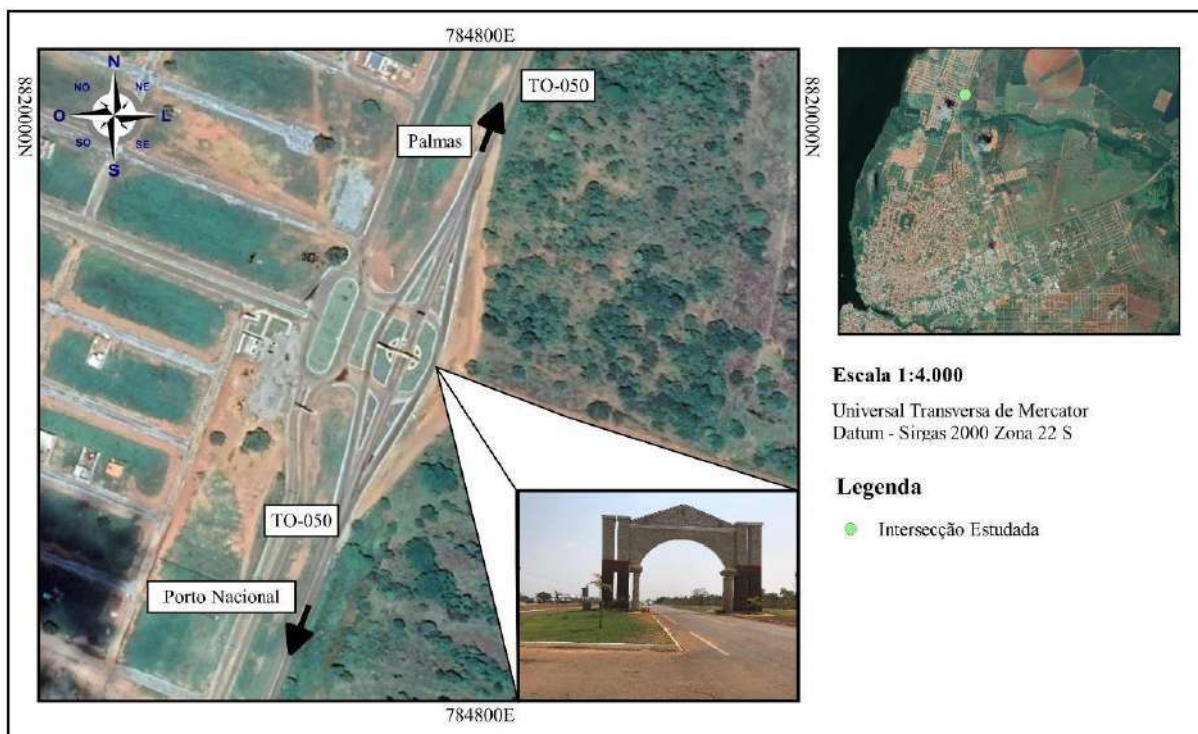


Fig. 1: Location in and study.

### 2.1 TRIANGLE OF VISIBILITY FOR TRAFFIC STOPPED

The recommended distances in the visibility triangles will depend on the type of traffic control adopted at the intersection. In the case of intersections controlled by mandatory stop signs on the secondary

road, turn left from the secondary road. The decision point shall be 4,40 m and 5,40 m from the edge of the main highway traffic lane.

Table 1 contains the intersection visibility distance (DVI) values controlled by the mandatory left-hand stop signaling from the secondary road:

Table 1: Visibility distance at intersections

.Project vehicle	Visibility distances required for a stationary vehicle to turn left on a two-lane, two-way traffic road, without center bed (m)										
	Main road directive speed (km / h)										
	20	30	40	50	60	70	80	90	100	110	120
Greide approaches up to 3%											
VP	40	65	85	105	125	145	165	190	210	230	250
CO / O	55	80	105	130	160	185	210	240	265	290	315
SR / RE	65	95	130	160	190	225	255	290	320	350	385
Greide approaches up to 4%											
VP	45	65	85	105	130	150	170	195	215	235	255
CO / O	55	80	110	135	160	190	215	245	270	295	325
SR / RE	65	100	130	165	195	230	260	295	325	360	390
Greide approaches up to 5%											
VP	45	65	90	110	130	155	175	200	220	240	265

CO / O	55	85	110	140	165	195	220	250	275	305	330
SR / RE	65	100	130	165	200	230	265	300	330	365	395
Greide approaches up to 6%											
VP	45	70	90	115	135	160	180	205	225	250	270
CO / O	55	85	110	140	170	195	225	255	280	310	335
SR / RE	65	100	135	170	200	235	270	305	335	370	405

Source: DNIT (2005).

### 2.2 MINIMUM RADIUS FOR INTERVENTION CURVES

For vehicles to be able to drive above 25km / h, it is necessary to give higher radius curves and consistent superelevation, such values as shown in Table 2.

Table 2 - Minimum radii for intersecting curves.

Design Speed (km / h)	25	30	40	50	60	70
Transverse Friction Coefficient - f	0.32	0.28	0.23	0.19	0.17	0.15
Superelevation (%)	0	2	4	6	8	9
Minimum calculated radius (m)	15	24	47	79	113	161
Minimum round radius (m)	15	25	50	80	115	160

Source: DNIT (2005).

Note:

- i) The above radii are preferably adopted at the inner edge of the track.
- (ii) For speeds above 70 km / h the values corresponding to the general roads shall be used.
- iii) For continuous flow the curve radii should be greater than 30m.

### 2.3 WIDTH OF RAMES

Table 3 shows the widths of the raceways for each type of traffic condition in combination with the type of operation, these widths will be compared to those existing at the study site. Always add the widths of the safety lanes to the widths of the rolling lanes.

Table 3 - Width of conversion lanes (m)

Runway Inner Radius (m)	Case I A lane with no foresight ahead			Case II A traffic lane predicted for passing a stationary vehicle			Case III Two traffic lanes, one or two way		
	A	B	C	A	B	C	A	B	C
15	5.4	5.5	7.0	6.0	7.8	9.2	9.4	11.0	13.6
25	4.8	5.0	5.8	5.6	6.9	7.9	8.6	9.7	11.1
30	4.5	4.9	5.5	5.5	6.7	7.6	8.4	9.4	10.6
50	4.2	4.6	5.0	5.3	6.3	7.0	7.9	8.8	9.5
75	3.9	4.5	4.8	5.2	6.1	6.7	7.7	8.5	8.9
100	3.9	4.5	4.8	5.2	5.9	6.5	7.6	8.3	8.7
125	3.9	4.5	4.8	5.1	5.9	6.4	7.6	8.2	8.5
150	3.6	4.5	4.5	5.1	5.8	6.4	7.5	8.2	8.4
Tangent	3.6	4.2	4.2	5.0	5.5	6.1	7.2	7.9	7.9
<b>Modification of width in face of pavement edge conditions</b>									



Shoulder Not established	-	-	-
Transposable curb	-	-	-
Insurmountable curb: One side.	+ 0.30m	-	+ 0.30m
Two sides.	+ 0.60m	+ 0.30m	+ 0.60m
Rigid Barrier: One side.	+ 0.60m	+ 0.30m	+0.60
Two sides.	+ 1.20m	+ 0.60m	+ 1.20m
Shoulder stabilized on one or two sides	Lane width for conditions B and C may be reduced by tangent to 3,60m if the shoulder is equal to or greater than 1,20m.	Subtract the width of the shoulder. The width shall not be less than that corresponding to Case 1.	Subtract 0.60m if the shoulder width is 1.20m or more.

Source: DNIT (2005)

#### 2.4 DECELERATION AND ACCELERATION RANGE SIZING

To determine the ranges of lengths will be used are Tables 4 and 5 to features in the lengths of the speed change ranges for grades up to 2% compared to the guideline speed and safe speed of the output curve / input (tracks acceleration and deceleration).

Table 4 - Length of deceleration ranges.

Guideline Speed	Taper (m)	Deceleration range length, including taper (m)							
		Exit curve safety speed (km / h)							
		0	20	30	40	50	60	70	80
40	40	60	50	40	-	-	-	-	-
50	45	75	70	60	45	-	-	-	-
60	55	95	90	80	65	55	-	-	-
70	60	110	105	95	85	70	60	-	-
80	70	130	125	115	100	90	80	70	-
90	80	145	140	135	120	110	100	90	80
100	85	170	165	155	145	135	120	100	85
110	90	180	180	170	160	150	140	120	105
120	100	200	195	185	175	170	155	140	120

Source: DNIT (2005).

Table 5 - Length of acceleration bands.

Guideline Speed	Taper (m)	Acceleration range length, including taper (m)							
		Input speed safety speed (km / h)							
		0	20	30	40	50	60	70	80
40	40	60	50	40	-	-	-	-	-
50	45	90	70	60	45	-	-	-	-
60	55	130	110	100	70	55	-	-	-
70	60	180	150	140	120	90	60	-	-
80	70	230	210	200	180	140	100	70	-
90	80	280	250	240	220	190	140	100	80
100	85	340	310	290	280	240	200	170	110
110	90	390	360	350	320	290	250	200	160
120	100	430	400	390	360	330	290	240	200

Source: DNIT (2005).

Note: The minimum length of the deceleration and acceleration range will always be the taper indicated in the tables.

### 2.5 SIGNALING ANALYSIS

The analysis of the signs of the place under study will be based on the Brazilian Traffic Signal Manual, the possible flaws found in the current situation will be corrected and added to the adequacy project.

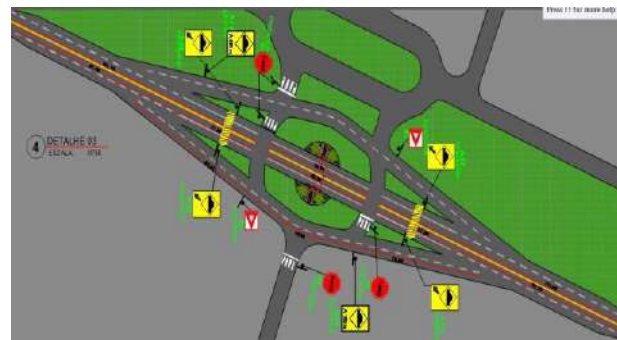


Fig. 2 - North Portal Intersection.

### III. RESULTS AND DISCUSSIONS

From the loco checks, the sizing and possible faults related to the signaling found at the intersection were analyzed.

#### 3.1 DIMENSION OF INTERSECTION ITEMS

The Porto Nacional City Hall made available the Portal Norte temporary signaling project, Fig. 2, which was used as a reference to verify the design of the intersection under study.

Based on the tables provided by DNIT (2005), it can be seen from Table 6 that the acceleration and deceleration ranges and the minimum radius of intersection curves are within the required dimensioning according to the design speed of 30 km / h, of branch widths, visibility triangles and tapers, they are smaller than those recommended by DNIT (2005), the tapers should be at least 40m.

Table 6 - Design Found in Design.

INTERSECTION ITEM DIMINATION SUPERVISORY REPORT				
ITEMS TO INSPECT	Ç	NC	COMP. (m)	NOTE
01 - East Acceleration Range	x		89,76	Palmas
02 - West Acceleration Range	x		89,20	Porto Nacional Direction
03 - Eastern Deceleration Range	x		89,81	Palmas
04 - West Deceleration Range	x		89,67	Porto Nacional Direction
05 - Taper East Acceleration Range	x		35,78	Palmas
06 - Taper West Acceleration Range	x		38,05	Porto Nacional Direction
07 - Taper Eastern Deceleration Range	x		36,54	Palmas
08 - Taper West Deceleration Range	x		38,80	Porto Nacional Direction
09 - Minimum radius of East intersection curves	x		61,30	Referring to the site where the portal is located

10 - Minimum radius of west intersection curves	x		61,22	Referring to the site where the portal is located
11 - East Visibility Triangle	x		24,72	
12 - West Visibility Triangle	x		23,39	
13 - East Branch Width	x		7,00	
14 - West Branch Width	x		7,00	
<b>EVALUATION CRITERIA: C - CONSTA NC - DOES NOT</b>				

Source: Prepared by the author based on the Temporary Signaling Project (2019).

The distance visibility triangle in the project is approximately 25 m and the table that the DNIT (2005) recommends is 65m for passenger vehicles, this difference in distance is discrepant to compared to reality found .

When analyzing Table 7 it is noted that in the real situation found at the intersection there is no acceleration

range, and the deceleration range is shorter than the design, since the acceleration tapers are within the length recommended by DNIT (2005).

Table 7 - Design in Loco.

<b>INTERSECTION ITEM DIMINATION SUPERVISORY REPORT</b>				
ITEMS TO INSPECT	C	NC	COMP. (m)	NOTE
01 - East Acceleration Range		x	0,00	Palmas
02 - West Acceleration Range		x	0,00	Porto National Direction
03 - Eastern Deceleration Range	x		39,70	Palmas
04 - West Deceleration Range	x		75,40	Porto National Direction
05 - Taper East Acceleration Range	x		43,00	Palmas
06 - Taper West Acceleration Range	x		50,00	Porto National Direction
07 - Taper Eastern Deceleration Range	x		30,80	Palmas
08 - Taper West Deceleration Range	x		38,30	Porto National Direction
09 - Minimum radius of East intersection curves	x		59,60	Referring to the site where the portal is located
10 - Minimum radius of west intersection curves	x		63,65	Referring to the site where the portal is located
11 - East Visibility Triangle	x		24,30	
12 - West Visibility Triangle	x		23,40	
13 - East Branch Width	x		6,84	
14 - West Branch Width	x		6,76	
<b>EVALUATION CRITERIA: C - CONSTA NC - DOES NOT</b>				

Source: Prepared by the Author (2019).

The compliment that of tapers deceleration, the rays minimum of curves, triangles visibility and the widths of the branches are close to the lengths project, but still lower than recommended by the DNIT (2005).

**3.2 INTERSECTION SIGNALING**

The Porto Nacional City Hall made available the temporary North Portal signaling project, which was used

as a reference to verify the intersection signaling under study.

Table 8 shows the signs found in the project, where the design speed is 30km / h and there is no kilometer nameplate.

Table 8 - Signage Found in the Project.

SIGNALING SURVEILLANCE REPORT				
ITEMS TO INSPECT	C	NC	AMOUNT	NOTE
VERTICAL SIGNALING	x		24	
01 - Mandatory Stop Sign	x		4	
02 - Maximum permitted speed plate	x		2	30km / h
03 - Spine Plate	x		16	
04 - Kilometer Nameplate		X	0	
05 - Sign give preference	x		2	
HORIZONTAL SIGNALING	x		7	
01 - Double Line Continued / Dashed	x		1	
02 - Runway Edge Line	x		2	Left and right side
03 - Stop Retention Line	x		4	
EVALUATION CRITERIA: C - CONSTA NC - DOES NOT				

Source: Prepared by the author based on the Temporary Signaling Project (2019).

Table 9 shows the actual signage found, which does not contain mandatory stop signs, speed bumps, mileage nameplate, preference signs and stop retention lines.

Table 9 - Signaling in Loco.

SIGNALING SURVEILLANCE REPORT				
ITEMS TO INSPECT	C	NC	AMOUNT	NOTE
VERTICAL SIGNALING	x		2	
01 - Mandatory Stop Sign		x	0	
02 - Maximum permitted speed plate	x		2	30 km / h
03 - Spine Plate		x	0	
04 - Kilometer Nameplate		x	0	
05 - Sign give preference		x	0	
HORIZONTAL SIGNALING	x		3	
01 - Double Line Continued / Dashed	x		1	
02 - Runway Edge Line	x		2	Left and right side
03 - Stop Retention Line		x	0	
EVALUATION CRITERIA: C - CONSTA NC - DOES NOT				

Source: Prepared by the Author (2019).

Fig. 3 shows the actual signaling situation at two of the conflict points, noting the absence of mandatory stop signs and horizontal signaling.



Fig. 3: Conflict Points.

Fig. 4 shows a point of conflict where we established the east visibility triangle, when checking it noted that the North Portal interferes with driver visibility, this interference can aggravate accidents at that location, as it is an intersection for entry into an allotment.

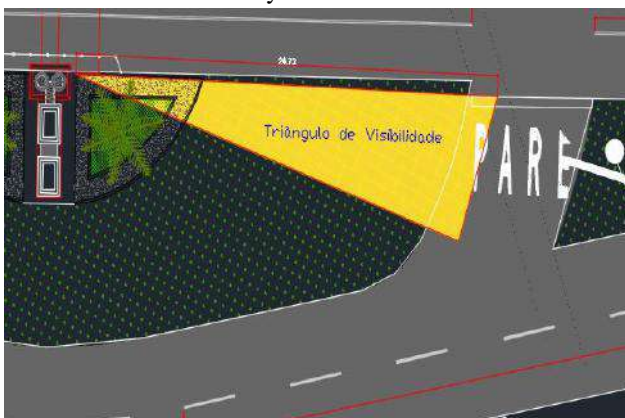


Fig. 4: East Visibility Triangle of the Temporary Signaling Project.

Numbered sequentially using 1, 2, 3, etc. Subheadings are numbered 1.1, 1.2, etc. If a subsection must be further divided, the numbers 1.1.1, 1.1.2, etc.

#### IV. CONCLUSION

The verifications made in this work pointed out the importance of the signaling and main and auxiliary lanes with proper dimensioning, when comparing the design and the intersection situation in loco we noticed several problems.

Initially we analyzed the acceleration and deceleration ranges, we found that the deceleration ranges were smaller than the design, in addition to the inexistence of the acceleration range that forces the driver to make sudden entries in the main lane, which can lead to several conflicts such as rear-end collisions. account of braking and design speed established.

One of the most alarming points of this project is the visibility of the drivers, they are impaired by the existence of the North Portal, it is within the visibility triangle and the intersection is close to a curve, with this dimensioning the driver ends up having a minor reaction, with the possibility of lateral collisions, and the intersection has virtually no signaling or speed reducers, as shown in Table 9 .

With all note - the importance of supervision of intersections in our country and implementation of signage projects where it has not been executed yet. The study showed the conflicts and problems that may occur in this location, enhancing the importance of not releasing works without the execution of these projects.

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# Social Network Analysis (SNA) and the Training Process of the Employees of the Federal Institute of Santa Catarina

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**Abstract**— In Brazil, law 8112/90 regulates the training of government officials; therefore, these employees are constantly subjected to processes aimed at improving their training and thus at improving the quality of public service. Social network analysis (SNA) has been widely employed in studies in various fields such as social science, psychology, health, business organization, electronic communications, and epidemiology. The objective of this work is the characterization of the capability indicators of the Federal Institute of Santa Catarina (IFSC) through SNA. In this study, teacher and technician employee data were used in qualification processes such as workplace and postgraduate programs. This information was provided as input to SNA with Degree and PageRank algorithms applied. In terms of quantity, the Florianópolis campus led with the largest number of qualifying employees; linguistics was found to be the most outstanding graduate program. In the administrative technical group, Florianópolis was the largest unit in terms of qualification; education was the most sought-after course. Finally, in the teacher's group, the Florianópolis campus had the largest number of qualifying teachers, and the most prominent courses were linguistics and computer science. Thus, the use of SNA can help managers offer postgraduate courses with higher demand indices.

**Keywords**— social network analysis, professional training, teachers.

## I. INTRODUCTION

The starting point of public policy concerning the establishment of professional education at the federal level is Decree No. 7566 of September 23, 1909. Artisan Apprentice Schools were established, with 19 units spread throughout the states of Alagoas, Bahia, Rio de Janeiro, Ceará, Espírito Santo, Goiás, Maranhão, Mato Grosso, Paraíba, Paraná, Piauí, Pernambuco, Rio Grande do Norte, São Paulo and Sergipe; courses in woodworking, mechanics, and arts were offered (SOARES, 1981).

The first restructuring took place between 1937 and 1942, with the creation of 21 Industrial Schools in the municipalities of Aracaju, Belém, Campos, Belo Horizonte, Cuiabá, Curitiba, Florianópolis, Fortaleza, Goiânia, João Pessoa, Maceió, Manaus, Natal, Niterói, Pelotas, Salvador, São Luiz, São Paulo, Recife, Teresina and Vitória. The curriculum already had an industrial profile, with courses lasting four years, offered in mechanics, electricity, crafts, and construction. During this same period, the S system of professional qualification

was founded as a result of the public-private partnership (SOARES, 1981).

The Federal Network for Professional Education, Science and Technology was sanctioned by Bill No. 11892 of December 29, 2008; the Network is composed of the Federal Institutes of Education, Science and Technology - Federal Institutes (38); Federal Technological University of Paraná - UTFPR; Celso Suckow da Fonseca Federal Technological Education Centers - CEFET-RJ and CEFET-MG (2); Technical Schools Linked to Federal Universities (26); and Pedro II College (1) (Figure 1) (BRAZIL, 2008).

The Federal Institute of Education, Science and Technology of Santa Catarina (IFSC) is part of the Federal Network of Professional, Scientific, and Technological Education. The IFSC is composed of twenty-two campuses (Figure 2) (BRAZIL, 2008).



Fig. 1: Map of the Federal Network of Professional, Scientific, and Technological Education



Fig. 2: Campus distribution in the state of Santa Catarina.

**1.1. Training of Federal Public Servants**

Law 8112/1990 establishes the Legal Regime of Civil Employees of the Union of municipalities, including those in a special regime, and of federal public foundations. Articles 81 and 87 in particular ensures that employees are removed from their day-to-day activities to perform their training duties according to their level of qualification:

“Art. 87. After each five-year term, the employee may, in the interests of Administration, withdraw from the effective position, with the respective remuneration, for up to three months, to participate in a professional training course” and / or

“Art. 96a. The employee may, in the interest of the Administration, and provided that the participation cannot occur simultaneously with the exercise of the position or by means of time compensation, may withdraw from the exercise of the effective position, with the respective remuneration, to participate in a postgraduate

program *stricto sensu* in a higher education institution in the country.”

Institutions of basic and technical education are constantly producing qualitative and quantitative educational data. However, such information is published by each institution and is publicly available; in very few instances has this information been subjected to statistical and social networks analysis techniques for purposes of obtaining a wider view of the data used for decision-making.

**1.2. Theoretical Reference**

**1.2.1. The Training**

There is an understanding within institutions of basic and higher education that teacher training has contributed to improved learning. Duarte (2004) explains that teacher qualifications have not only impacted student learning but have also improved the quality metrics of public and private educational institutions.

**1.2.2. Graph Network**

According to Freitas (2018), a graph (figure 3) is defined as “a set of vertices and a set of edges that connect pairs of vertices”. Each vertex is represented by a circle and the edges by lines.

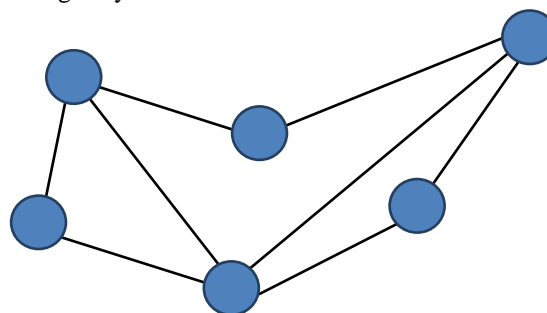


Fig. 3: Example of simplified graph network.

**1.2.3. Social Network Analysis**

For Serrat (2017), social network analysis (SNA) is a method with increasing application in the social sciences and has been applied in areas as diverse as psychology, health, business organization, and electronic communications. Arag o *et al.* (2018) have used the method of SNA through graphs to represent the movement of animals present in the state of Par . (Arora, 2019, Alamsyah, 2019, Jacomy *et al.*, 2014; Hongyi *et al.*, 2019; Saheb, 2019; Zhao, 2019).

**1.2.4. Objective**

The objective of this work is the characterization of the training indicators of the IFSC through SNA.

**II. MATERIALS AND METHODS**

For the development of this work, quantitative data from the Administrative Technicians (28) and Teachers (140) were used in the *stricto sensu* qualification process,

distributed in groups by location and registered postgraduate program.

This data was then entered in a spreadsheet. The field "ORIGIN" describes the student capacity of the institution, the field "DESTINATION" indicates the postgraduate course taken by the employee, and finally the field "SIZE" describes the number of campus employees taking a certain postgraduate course.

Edge: Responsible for expressing the relationship between student capacity (origin), graduate program (destination), and number of people (size) (Table 1).

Table 1 - Example of relationship between employees (source), graduate program (destination) and the number of employees.

ORIGIN	DESTINATION	SIZE
College	Course	Quantity
CANOINHAS	Computer Science	1
CANOINHAS	Linguistics	1
CANOINHAS	Public Health	1

Workplace information, number of employees, and graduate programs were submitted to social network analysis (with Degree and PageRank both used) for characterization.

### III. RESULTS AND DISCUSSION

The quantitative information analyzed by the Degree algorithm demonstrated (Figure 4) that the Florianópolis campus is the unit with the highest number of qualified employees, followed by Joinville, São José, and Jaraguá do Sul.

In the PageRank analysis (Figure 5) of all people in qualification, the highlight is students attending the postgraduate program in linguistics, followed by computer science, mathematics, and visual arts.

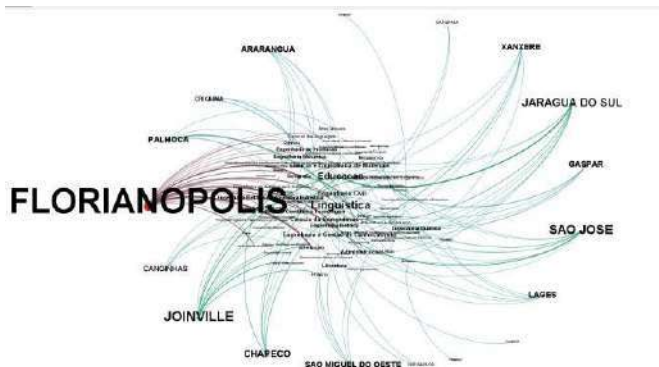


Fig. 4: Social Network Analysis of all employees by Degree algorithm



Fig. 5: Social Network Analysis of all employees by PageRank algorithm.

As for the results of the Degree algorithmic analysis of only administrative technical employees (Figure 6), it appears that Florianópolis is the unit with the largest number of qualified employees, followed by Joinville and São José.

The results of the PageRank algorithm (Figure 7) for the master's and doctoral programs show Education as the most sought after, followed by Mechatronics, Administration, Technology and Society.

In the teaching group, when performing Degree algorithmic analysis (Figure 8), we can notice a large number of Florianópolis campus students in attendance, followed by Jaraguá do Sul, Joinville, and São José.

Finally, PageRank's algorithmic analysis (Figure 9) found strong demand for the course in linguistics, followed by computer science, mathematics, and civil engineering.

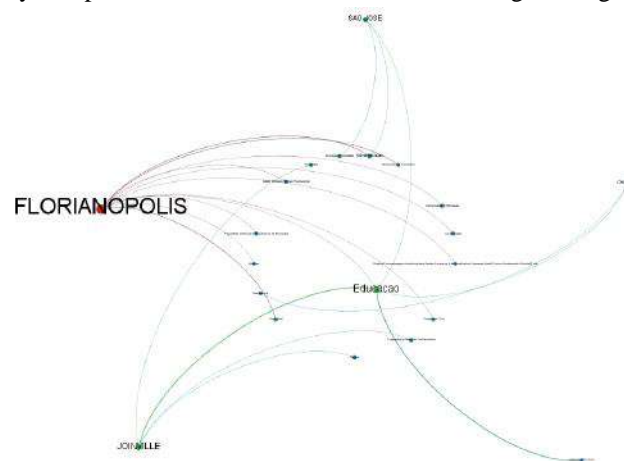


Fig. 6: Social Network Analysis of all employees Administrative Technicians by Degree Algorithm



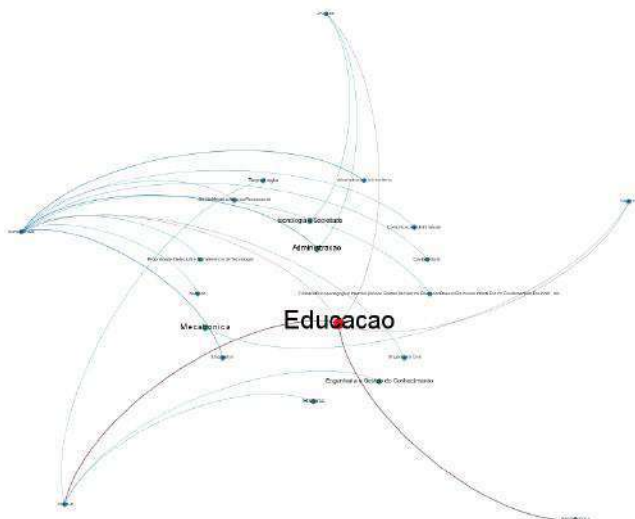


Fig. 7: Social Network Analysis of all students Administrative technicians by PageRank algorithm.

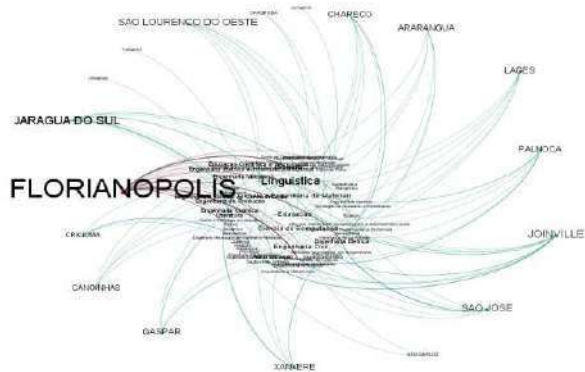


Fig. 8: Social Network Analysis of all Teachers by Degree algorithm.

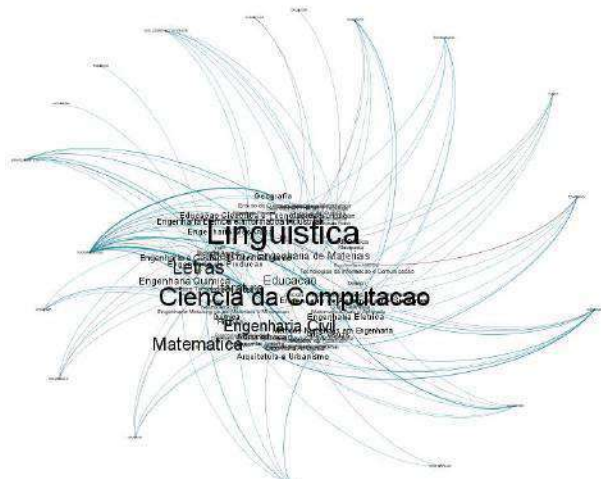


Fig. 9: Social Network Analysis of all Teachers by PageRank algorithm.

#### IV. CONCLUSION

The present study showed that the use of SNA, as applied to qualifying employees at the Federal Institute of Santa Catarina, allowed a complete and accurate visualization of qualifying employees in relation to postgraduate programs (in *stricto sensu*). Thus, the use of SNA can assist managers in offering postgraduate courses with higher demand indices. Also, such networks can be improved as additional data from Federal Education Institutions becomes available.

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# Characterization of the Mechanical Properties of Concrete with Addition of Bamboo Fiber - Porto Nacional/TO

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**Abstract**— The search for materials which do not unduly the environment by reducing the cost of production is increasing throughout the world. In the construction sector, concrete is the most consumed material in the world. Its production with bamboo fiber addition can contribute to minimize environmental impacts and production costs by reducing the extraction of natural resources. This study aimed to investigate the mechanical properties of bamboo located in the region of Porto Nacional - TO, Brazil and its application as a binder (Portland cement) in the production of concrete. The research aimed at results that allowed to verify the behavior of the concrete in relation to its uniaxial compressive strength at 28 days of the specimens produced with the addition of bamboo fibers, replacing the cement binder. Bamboo fibers and aggregates were characterized and evaluated according to the material and defined by the trait (1: 1.68: 2.68: 0.482), with replacement percentages set at 3%, 4% and 5%. Therefore, through the tests that were performed, the possibility of replacing the Portland cement binder with natural polymeric bamboo fibers was verified, which proved to be viable and quite advantageous not only for the environmental and economic, but also in the material strength gain.

**Keywords**— Concrete, Bamboo fibers, Mechanical properties, Resistance.

## I. INTRODUCTION

Concrete, a structural material widely used worldwide, has been the subject of continuous research (SALVADOR; FERNANDES; DE FIGUEIREDO, 2015), due to its wide importance and application in the field of construction (BARBOZA; DE ALMEIDA FILHO, 2018; BITTENCOURT, 2009). With the growth of urbanization and industrialization, the demand for concrete is increasing day by day. Therefore, raw materials and natural resources are required in large quantities for concrete production worldwide (S, 2017). According to Zein (2017) cement is the main constituent of concrete.

In the civil construction sector, applications and productions of cement, is seen as one of the processes more aggressive to the environment (FERNANDES, SERPA, 2017). It is estimated that only the cement industry is responsible for about 7% of the entire CO<sub>2</sub> generated throughout the world, for a ton of cement produced are released a ton of CO<sub>2</sub> in the atmosphere, and to produce 1 ton of ligand, are required 2.8 tonnes of raw materials (APRIANTI et al., 2015; wholesale; Forest, 2018). This information shows how important it is to reduce the consumption of Portland cement due to the

environmental problems caused by their production (MORAES et al., 2015).

In Brazil, civil construction, besides consuming about 80% of all-natural resources available in the environment, is also responsible for consuming about 44% of all energy produced in the country (CORDEIRO et al., 2017).

The search for new alternatives that will contribute to the efficiency of the Concrete in its production, today, has been growing significantly (CAMPOS, 2015). Several studies have focused on finding an alternative that can be used as material for replacement of cement (S, 2017), thus various categories of fibers are used as reinforcement in concrete, being the main, steel fibers, polymeric fibers and natural fibers (AMARAL JÚNIOR; SILVA; MORAVIA, 2017).

Recently, the natural fibers have been highlighted in studies such as the additions more used to improve certain characteristics of concrete, primarily to reduce the effects of cracking in your state hardened (FIGUEIREDO, 2017). In addition, were developed various research programs of the use of bamboo and natural fibers (sisal, coconut, carbonized rice, sugar cane bagasse, lump of açai, piassava, bamboo pulp, among others) for the production

of concrete, so as to provide improvements related to durability and mechanical resistance of the materials (GERALDO, 2017; FIGUEIREDO, 2017), also, are characterized as materials with low environmental impact to be employed in buildings (GERALDO, 2017).

Therefore, bamboo is a plant raw material that has efficient mechanical properties and great potential to be explored by civil engineering (BRAGA FILHO et al., 2010). In addition to adding great ecological benefits, it absorbs CO<sub>2</sub> from the atmosphere, generates less environmental impact and reduces the final cost of the work, thus becoming a renewable resource in civil construction compared to conventional inputs (GHAVAMI; MARINHO, 2005; SILVA et al., 2015).

Therefore, in order to reduce energy expenditure and increase sustainability in civil construction by reducing the extraction of natural aggregates and constituting a plausible and viable option in the production of concrete in the region of Porto Nacional - TO, an experimental study was conducted with the objective to evaluate the influence of the addition partial (3%, 4% and 5%) of polymeric fibers of bamboo on mechanical properties of concrete,

being possible to analyze their influence on the resistance to the uniaxial compression test, in order to assess its feasibility for use in constructions sites.

## II. METHODOLOGY

Initially, for this study the polymeric fibers of bamboo were produced for partial addition of cement (binder) in the production of concrete. The acquisition of material (culms of bamboo), were collected in the urban area of the municipality of Porto Nacional - TO.

The bamboo fibers used in the concrete mass were produced through a manual shredding process. For the extraction and production process, the stems were initially cut, and the knots removed from the bamboo. After they were washed and dried at an ambient temperature of ( $\pm 40$  °C), then the stems were cut in strips in a horizontal direction to make the production of polymeric fibers. The fibers were cut with lengths of five (5) cm, as shown in Fig. 1.

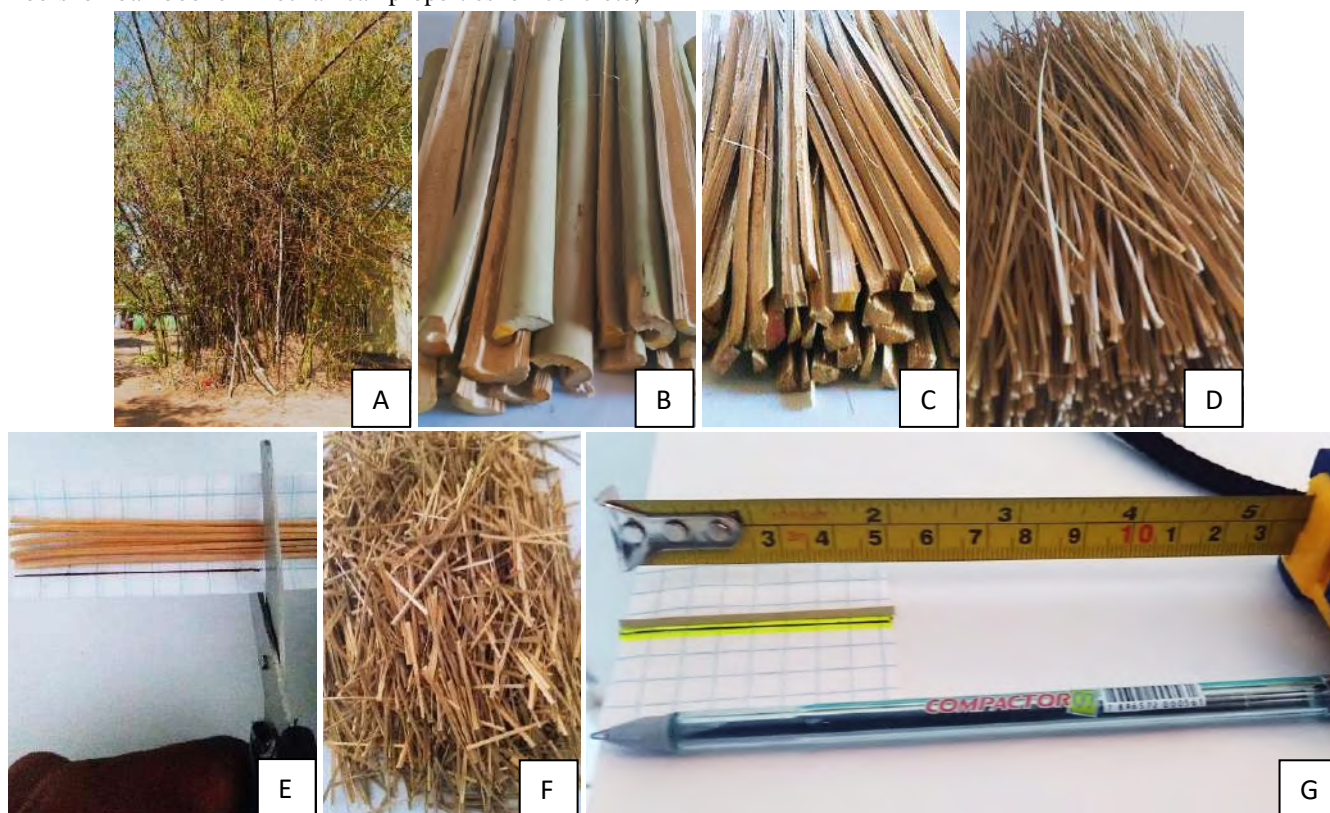


Fig.1: Extraction and cutting of fibers, (A) Bambuzal, (B) (C) and (D) Extraction and manual production, (E) Cutting of fibers on graded paper, (F) Cut polymeric fibers, (G) Fiber Length.

It is worth mentioning that the fibers of bamboo were placed submerged during 24 hours in water, for analysis and verification of the quantity of water absorbed by the

fibers. The absorption of water is the value in percentage, of the weight of water absorbed by the body after

immersion (BARBAR, 2017), this percentage is calculated and expressed by equation 1.

After 24 hours of soaking, the bamboo fibers were removed for the weighing process and the absorbed water content calculated. The bamboo fibers absorbed 16.06% of water, ranging from 0.965 g to 0.810 g immersion, difference of 28.66 g compared to dry weight, i.e., twice the weight of its natural mass of 19.87 g. To be a plant material, bamboo absorbs water with ease, recent research shows that the material continues to absorb water after 24

h, reaching more than 30% of absorption (GERALDO, 2017). The Fig. 2, demonstrates the process of porosity of the material.

$$A(A)\% = \frac{[Pa - Pab]}{Pa} \times 100 \tag{1}$$

- (A%) = Water absorption in percentage;
- Pa = Weight of Water;
- Pab = Weight of Water absorptio.

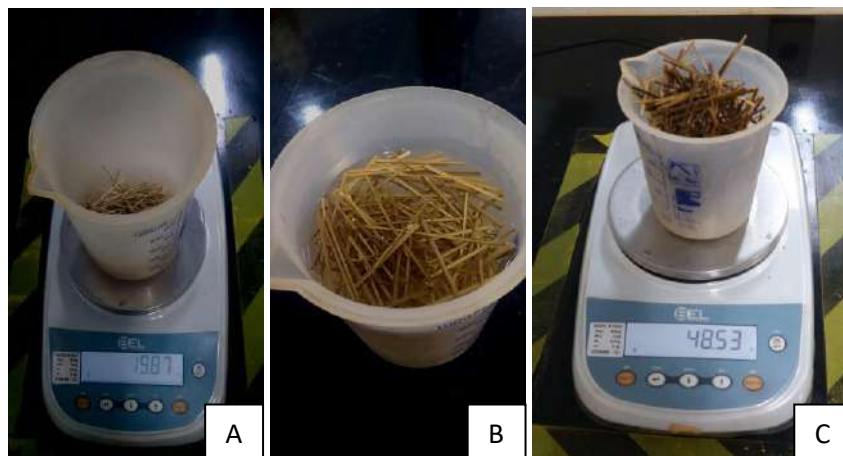


Fig.2: Determination of water content absorbed by bamboo fibers, (A) Weight in dry natural state, (B) Immersion in water, (C) Weight of fibers (post) immersion.

When absorbing water, bamboo vegetable fibers undergo dimensional variations, their dimensions increase when they absorb and decrease when they lose it (GERALDO, 2017), so the dry base and wet base content can vary from 4.85% to 4.65 %. This happens because the specific mass of the bamboo culm walls is lower than water, ranging from 0.8 kg / dm<sup>3</sup> to 0.95 kg / dm<sup>3</sup>, in the most suitable species for construction (GERALDO, 2017), the water content in wet basis can be calculated by equation 2.

$$\%Bu = \left[ \frac{Pa}{Pa + Pfs} \right] \times 100 \tag{2}$$

- Pa = Weight of water;
- Pfs = Weight of dry fiber;
- %Bu = Percentage of moisture content on a wet basis.

The production of concrete consists of the composition of cement, aggregates and properly dosed water (RIBEIRO, 2013). For this study, the following materials were used:

- Small aggregate (Coarse Sand);
- Large aggregate (Gravel 1);
- Portland cement composed with slag CII F 32 TO;

- Water supplied by the supply company;
- Bamboo fibers.

The natural aggregate was collected on the Tocantins river, near the city of Palmas, Tocantins State, Brazil, and sorted by similarity of size ABNT NBR NM 7211:2005. Portland cement CII F 32 TO was used as a binder to obtain the concrete, according to ABNT NBR 5736: 1991 specifications. All raw materials used in the manufacture of the bodies of evidence, were weighed using a digital balance. The table 1 and 2 shows the proportions of materials consumed for each type of concrete studied and the levels of additions of dashes represented in percentage.

For the concrete trace, the following formulation was used: 1: 1.68 (cement: sand), 1: 2.68 (cement: crushed stone) and 1: 0.482 (cement: water) (ANTONIO et al., 2019), as there was a slight change from the amount of water (± 600 ml). The table 3 shows the compositions characteristics of determination of trace of concrete with and without the addition of fibers of bamboo. Note - if the only change that occurred was between the cement and the addition of fibers.



Table.1: proportions of consumable materials for each type of concrete

Concrete	Cement (g)	Sand (g)	Gravel (g)	Water (ml)	Fiber (g)
0%	22 000	56 960	58 960	11 200	0
3%	21 340	56 960	58 960	11 200	0,66
4%	21 120	56 960	58 960	11 200	0,88
5%	20 900	56 960	58 960	11 200	1,1

Table.2: levels of addition of Traces

Dash	Cement	Sand	Gravel
TC conventional	100%	100%	100%
TC3	97%	100%	100%
TC4	96%	100%	100%
TC5	95%	100%	100%

Table.3: Composition characteristics of determination of trace on the concrete.

Betonadas	Dash (Kg)	Rupture
0% (Fiber)	22.00: 50.40: 58.96:11.20	28 days
3% (Fiber) Bamboo	21.34: 50.40: 58.96:11.20	28 days
4% (Fiber) Bamboo	21.12: 50.40: 58.96:11.20	28 days
5% (Fiber) Bamboo	20.90: 50.40: 58.96:11.20	28 days

The concrete dosage was designed to obtain the 20MPa fck compressive strength, established by ABNT NBR 6118: 2003 at 28 days, using CII F 32 cement, without the use of additives. After production and characterization of the materials, the bamboo fibers were partially added to the concrete. Concrete preparation was performed with the aid of a stationary concrete mixer. After the preparation of the molds, the traces were made using bamboo fibers with substitution contents of 0% (conventional concrete), 3%, 4% and 5%. in the binder (cement CII F 32). Concrete production follows the specifications of ABNT NBR 7215: 1996, where dry materials were mixed in the order of coarse aggregate, fine aggregate and cement, then water was added, the

bamboo fibers were the last components to be added to the mixture to form a paste consistent and homogeneous.

The consistency of the concrete of each composition was evaluated through the Slump test, according to the specifications ABNT NBR NM 67:1998. The mixture of concrete was placed in the trunk of metallic mold - cone in three layers, each layer also distributed received 25 blows manual with the aid of a lawgiver, the mold was removed slowly in the vertical direction for checking the final reduction of concrete (difference between the height of the mold and the height of the mixture of concrete). The Fig. 3 shows the reduction in Slump test of the conventional mixture and compositions in fibers of bamboo.



Fig.3: Cone Trunk Discharge Test, (A) Conventional Concrete, (B) Concrete with 3% Bamboo Fiber Addition, (C) Concrete with 4% Bamboo Fiber Addition, (D) Concrete with 5% added bamboo fibers.

Once the proper consistency was reached, the molding process of the specimens was started, the concrete was placed in the molds with the aid of a trowel and the concrete compactor (AF 46 mm), to eliminate the voids of the mass, establishing its uniformity. Subsequently, 30 cylindrical specimens were made for each composition in

the dimensions of  $\Phi 10 \times 20$  cm. After 24 hours, the samples were removed from the cylinders, and placed in a tank of water saturated (hydration process) until they reach their ages (3, 7, 14, 21 and 28) days of curing, ABNT NBR 5738:2015, as shown in Fig. 4.

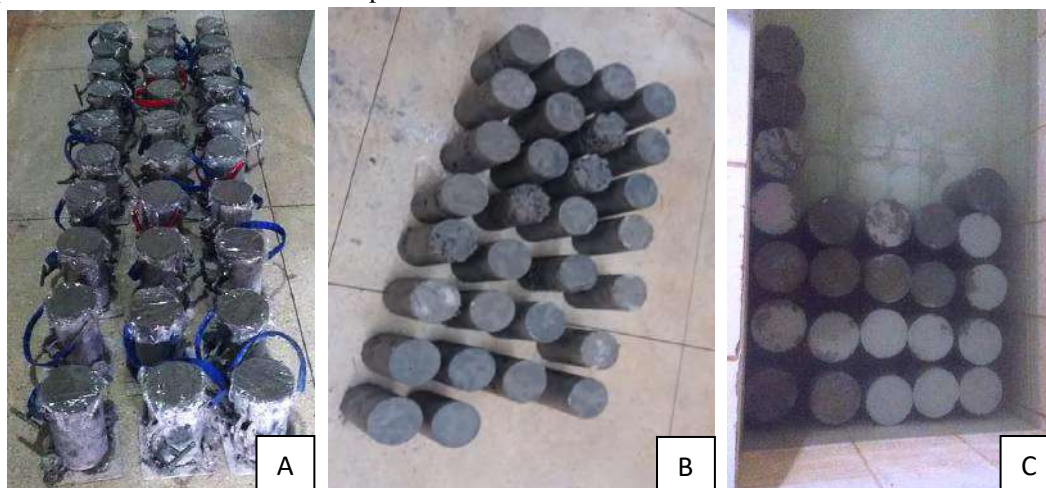


Fig.4: (A) forming the bodies of evidence, (B) Withdrawal of bodies of evidence, (C) hydration and healing of the bodies of evidence.

The samples of the formulated compositions, that is, with and without the addition of bamboo fibers, had their uniaxial compressive strength evaluated. The axial compression test consists of determining the maximum breaking load supported by the specimen.

The uniaxial compression resistance of the concrete was determined via the compression test in accordance with the specifications ABNT NBR 7215:1996. To this

end, six (6) samples were tested for each formulation and age (3, 7, 14, 21 and 28) days of curing, totaling in the end one hundred and twenty (120) bodies of evidence, subsequently allocated to each one, strictly centralized in the bottom plate hydraulic press mechanical (EMIC DL 3000), illustrated in Fig. 5, breakage and resistance determination were performed automatically.

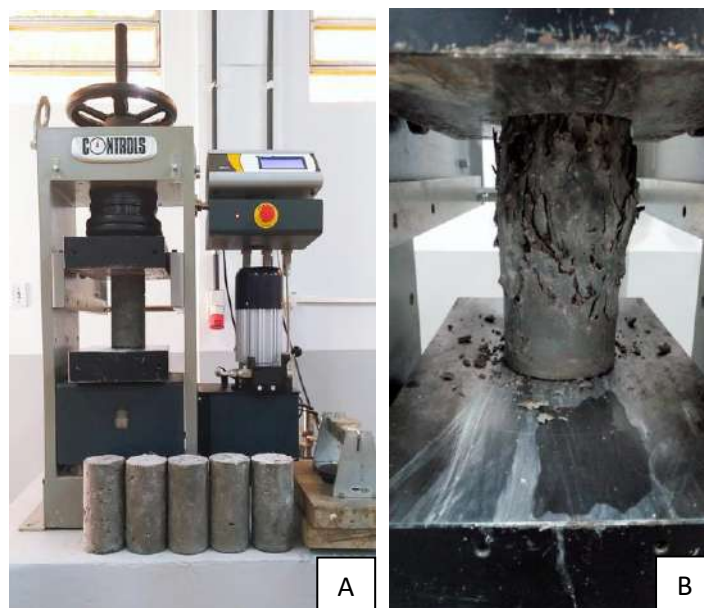


Fig.5: (A) Test of resistance to compression, (B) Uniaxial compression.



### III. RESULTS AND DISCURSSIONS

The test of abatement of the concrete with additions of bamboo fibers of 3% and 4% obtained satisfactory results of 55 mm and 40 mm in comparison to the conventional rebate of 0% of 65 mm, it is noteworthy that bamboo fibers absorbed about ( $\pm 16\%$ ) of water during the production process of concrete, the addition of 5% presented a rebate, not satisfactory, with dry consistency

and little homogenization, the table 4 presents the values of rebate of dashes.

Table.4: Trace Drop Values

Características	Dashes			
Contents	0%	3%	4%	5%
Rebate (mm)	65	55	45	-

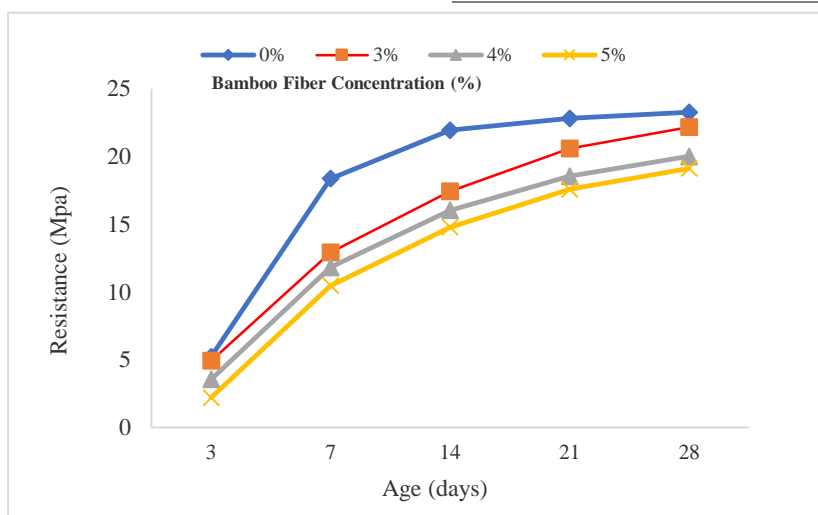


Fig.6: Graph of compressive strength gains after 3, 7, 14, 21 and 28 days with addition of 5 cm bamboo fiber concentration.

Fig. 6, demonstrates the compressive strengths achieved from (3 to 28) days, respectively, to determine the uniaxial compressive strength. It can be observed that the lowest value of compressive strength occurred in the composition of 5% of bamboo fibers at 28 days and the highest value occurred in concrete with the addition of 3% of bamboo fibers. Therefore, the obtained values demonstrate resistance gain gradually between the tests.

It was also observed that there was a significant decrease in the compressive strengths of both ages, between the conventional concrete (0% addition) and the concrete with the addition of cement by the bamboo fiber during the 3 days of hydration and cure, demonstrating that the composition of 3% was the most approached the resistance value of the conventional concrete, as shown in Fig. 7.

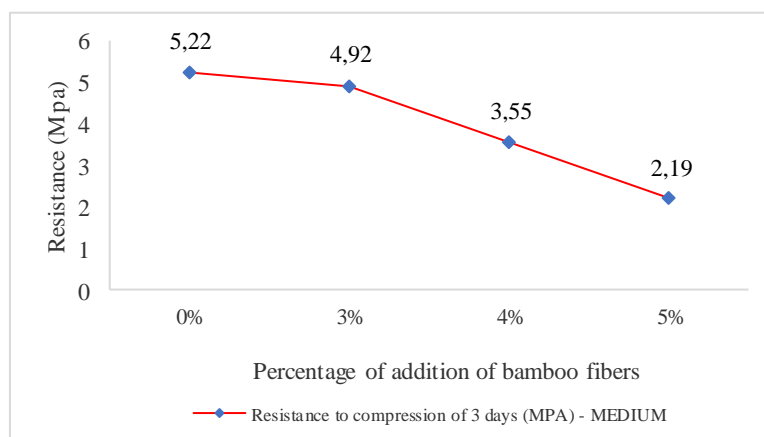


Fig.7: Graph of resistance to compression for 3 days.

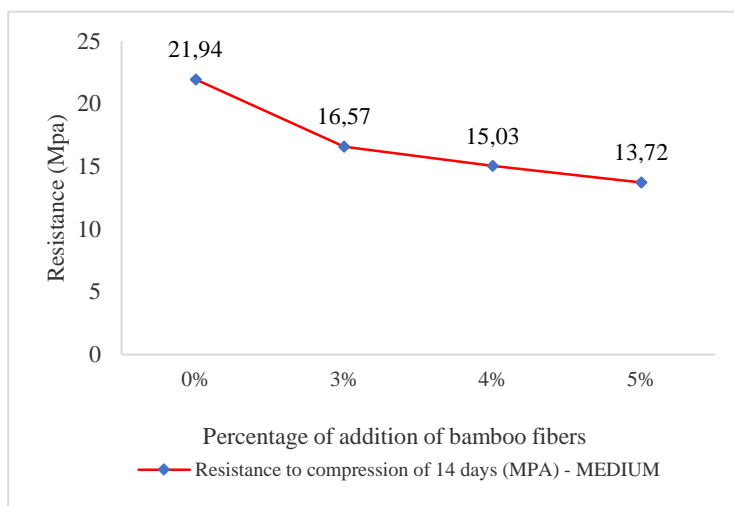


Fig.8: Graph of resistance to compression for 14 days.

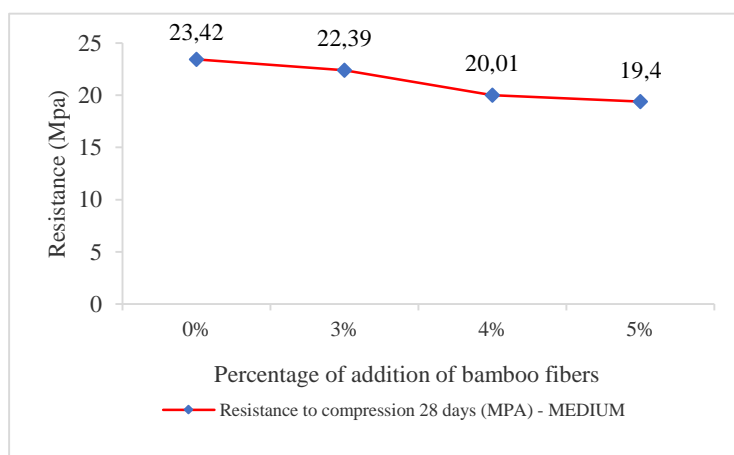


Fig.9: Graph of resistance to compression for 28 days.

In Fig. 8, shows that there was a minimal difference of resistance to compression between both compositions of bamboo fibers during the ages of 14 days, in relation to the concrete control.

Note that only the concrete from 5% was below the desired strength of 20 Mpa, shown in Fig. 9, the concrete with 3% and 4% of addition of fibers of bamboo to 28 days showed a tendency of significant increase of resistance with 22.39 Mpa and 20.01 Mpa respectively, next to conventional concrete (0%), with resistance of 23.42 Mpa.

Souza et al., (2014) in his research with the addition of fibers of bamboo analyzed results obtained between the compositions of 2% and 5% with the use of additives and obtained a gain of 34.04 Mpa resistors and 24.77 Mpa for 28 days. It is worth mentioning that all materials used in this study was composed of natural raw materials without the use of additive and showed a gain of resistance satisfactory.

Given the observed analyzes, it can be noted that both the conventional concrete (0%) and the concrete of 3% and 4% had satisfactory results in the tests performed, the concrete of 5% obtained results below the proposed goal, established by ABNT NBR 6118: 2003.

These results indicate the possibility of adding 3% of Portland cement by fibers of bamboo, without prejudice of resistance to compression. According to Souza et al., (2014) the use of natural fibers to the formulation of concrete is technically feasible for civil construction.

#### IV. CONCLUSION

The concrete is a material that gets high resistance to compression. The conventional concrete had resistance to compression of 23.42 Mpa for 28 days, by comparing, only concrete with a 5% addition content suffered a reduction in compressive strength, staying with 19.40 Mpa, in which becomes negligible. Already the additions of 3% and 4% resulted in a gain of resistance, getting close

to the conventional concrete, with respectively, 22.39 Mpa and 20.01 Mpa.

Therefore, the replacement of Portland cement by 3% and 4% addition of bamboo polymeric fibers did not affect statistically the compressive strength of the concrete in relation to the studied trait. The traces of 3% and 4% evaluated were adequate, however the rebate of 5% was not satisfactory, resulting in a lower resistance to conventional trait in parameter of water absorption by immersion, differing from the other traits.

Thus, with the considerations made and the results obtained, the work successfully achieved its objective, showing if feasible and with the possibility of increasing sustainability in constructions.

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# The Relevance of Gaudi's Work in the Architectural Context: bold, passion and creativity

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**Abstract**— *In this qualitative text, with a theoretical and empirical nature, we set out to make an initial reflection on the aesthetic and architectural dimension of the work of one of the most inventive Spanish creators. It is the work of Antoni Gaudi, renowned Catalan architect, artist and designer whose production impresses with boldness, imagination and sensitivity, which broadened the understanding of architecture and engineering. The passage through Barcelona, Spain, on the shores of the Mediterranean Sea, is such a remarkable experience that it makes it a must-stop for travelers. The Gaudian Architecture is basically inspired by the study of nature, since Gaudi, as a boy, constantly observed and learned from the lessons that he offered him.*

**Keywords**— *Art Nouveau, Design, Engineering, Patrimony.*

## I. INTRODUCTION

In this qualitative text, with a theoretical and empirical nature, we set out to make an initial reflection on the aesthetic and architectural dimension of the work of one of the most inventive Spanish creators. It is the work of Antoni Gaudi, renowned Catalan architect, artist and designer whose production impresses with boldness, imagination and sensitivity, which broadened the understanding of architecture and engineering.

He imagined a thing and also knew how to make reality. In addition, this could be because it was one of the few architects who associated much with the creation of artisans, and as he knew of sculptor, blacksmith, carpenter or other things, he could explain to men that he worked with him, as he had to do it. Tortuga that had to be supported by a column, that arch in the shape of a palm that mosaic echo of ceramics that wanted to place in those fantastic tan buildings that it constructed (Durán, 2003, p. 4).

The passage through Barcelona, Spain, on the shores of the Mediterranean Sea, is such a remarkable experience that it makes it a must-stop for travelers. Each year the city is flooded with students and tourists from all over the place, seeking to know the particular world in which Gaudi articulated each element in his compositions.

Antoni Placid Gaudi i Cornet was born in Reus, a town in the Spanish province of Tarragona, having lived from 1852 to 1926 in the splendor of modernism. Throughout

his life, he was criticized by some and praised by others, creating his own style, in which it is possible to observe the fusion of the neo-Gothic with the organic forms of art nouveau. All his designs were very bold for the time they were built: the early twentieth century. Probably this is one of the many reasons why such projects have marked the history of architecture and, at the same time, are considered World Heritage. For those who have a very technical and methodical view of architecture, to know and become familiar with Gaudi's work, he sees it through another bias: that of artistic creation, intensely predominant in the work of the architect.

He studied at the Barcelona School of Architecture since 1868, graduating ten years later. Gaudi has done works in different cities such as Astorga, Leon, Santander and Mallorca. However, in this explanation we will discuss only some works built in the city of Barcelona, our object of study, which we visited, on two (2) occasions, more specifically, in 2004 and 2015.

## II. THE GAUDI PATHS

Along the Paths of Gaudi Understanding the richness, plasticity, sinuosity and sensuality of the forms and elements that are part of the work in question are challenges that its author proposes. The Gaudian Architecture is basically inspired by the study of nature, since Gaudi, as a boy, constantly observed and learned from the lessons that he offered him. As Durán (2003, p. 2)



reports, “from so much walking around the countryside and contemplating it all you realize that the naturalness of the farm is solved and the problems that arise in your buildings. Therefore, I intended to convert into architecture what life has shown me.”

Gaudi justifies the use of flora and fauna by stating, “This tree next to my studio is my master” (Armengol, 2001, p. 49). From the study and observation of nature, especially that characteristic of Catalonia, new forms were derived that had never been used before in architecture.

Look at House Batló, with its spectacular architecture, which is very close to House Milà and opposite the charming Hotel Majestic, at Passeig de Gracia, 68. Known as “House de Los Huesos” because of its façade-like elements (Figure 01), this was the first large work completed by Gaudi in 1906. Its owners were fabric makers and commissioned Gaudi to renovate the facade of the old six-story building, originally dating from 1877.

To renovate the roof, Gaudi was inspired by the color and texture of a dragon's leather, as emphasized by Crippa (2007, p. 65), “the asymmetrical zoomorphic crest of the weave, with a marked vertical development, recoiled from the dragon's wing and is lined with bricks-scales of color-glazed ceramic that oscillate from yellow to blue, passing through the green”. Thus, this roof acquired the design of geometric shapes and a greenish tone. The columns of the façade were filled with ceramic motifs with very colorful floral motifs. Some say balcony balconies resemble masks; others clearly identify skulls, bones and joints as elements of façade composition.

Besides House Batló, House Milà, also called “La Pedrera”, also deserves to be visited. This building is a highlight on Barcelona's central streets, located on Passeig de Gracia, 92, right next to House Batló. It does not even have a straight wall, they are all curvy and tortuous, a boldness by the standards of the time, being one of the examples of Gaudi's free imagination, also known as the architect of curves.

Considered a World Heritage Site, House Milà haunted it is time for its boldness and originality. Commissioned to overshadow all the major works in the neighborhood, Gaudi was given an unlimited budget to complete this residential building, which allowed the architect not to skimp on creativity and innovation. It was built between 1906 and 1912, being one of Gaudi's last projects before he began to dedicate himself exclusively to the Holy Family Church.



Fig. 1: “Los Huesos” house

Facade of Batló House, 2004.

The iron frame design of the main door was inspired by the tortoiseshell designs (Figure 02). Another innovation in this portal was a ramp, which allowed the carriages of the time to lead their masters straight from the street to the interior area of the house. The entire undulating facade is a challenge to structural balance, like many of the architect's works. Visiting the interiors of this House-Museum it is possible to admire the furniture and crockery designed by Gaudi himself, because “Gaudi dedicated himself so much to the construction of his buildings that in this case even designed the furniture” (Durán, 2003, p. 8).

As for Park Güell, a park built between 1900 and 1914, the aesthetic richness of the colorful mosaics and the shards of tiles that make up its buildings is already worth a walk. On the colorful, winding bench made of small fragments of enameled pottery, you can sit and enjoy the view of the city, including the Mediterranean Sea.

Enthusiastic about Ebenezer Howard's views on garden cities, Eusebi Güell entrusted his friend Gaudi, who began to work enthusiastically, with the task of making a prototype on a ten-acre property of his own. The idea was to make a garden city for the bourgeois families of

Barcelona, with houses mingling with gardens, squares and trees, where children could play and adults walk, read or rest. By 1914, however, only two residences had been built in the park.

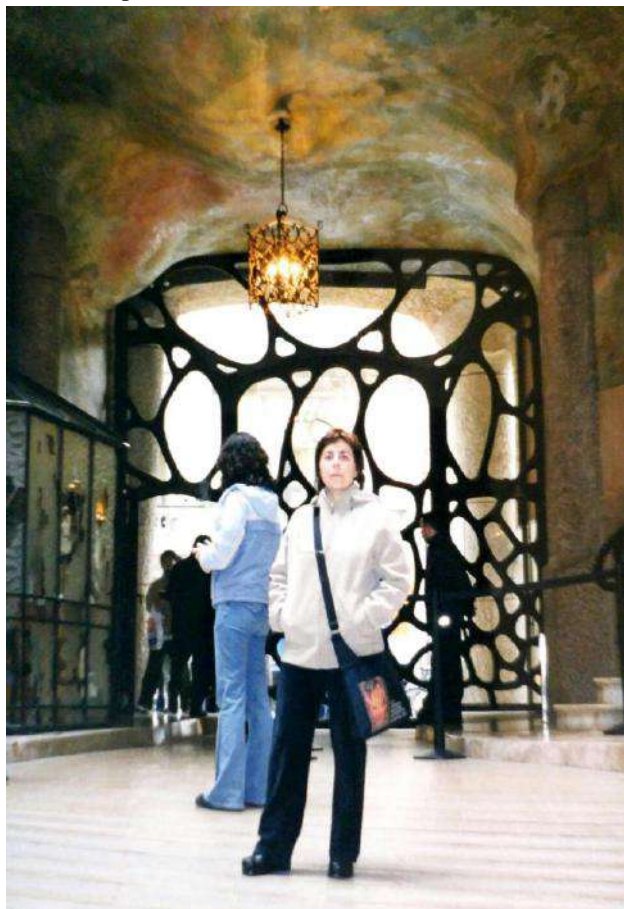


Fig. 2: "La Pedrera"

Inside House Milà, next to the access portal, 2004.

It is believed that the original project had 40 houses, but due to the almost non-existent commercial interest, Güell eventually sold the site to the municipality of Barcelona, inaugurating it as an urban park in subsequent years. Inside the park is the house museum, where Gaudi came to live for twenty years with his father and niece and where are exposed part of the drawings and furniture that belonged to the architect. Everything in this park is amazing and inventive.

A staircase adorned by Gaudi's iconic and well-known salamander (Figure 03), also seen by many as a dragon in the lookout position, gives access to the Hall of One Hundred Columns, home to 86 six-meter high Doric columns. On these pillars stands the Gran Circular Square, or Oval Square, open and paving-free place that houses the winding bench and one of the most beautiful views of Barcelona.

"The sloping columns of the outer boundary of this room support an architrave that will merge into an

exceptional dialogue with the square bench sinusoid," adds Güell (1994, p.107). Always concerned with preserving nature, it is relevant to bring here Durán's contribution (2003, p. 14):

There is an aspect of this construction that allows us to understand something better the way of proceeding of this man. In the place from which the church's ladder had to be created, it created a pin that was then centenary, hurt Gaudi a lot to think that it had to cut y, as it was so natural, I preferred to divert the ladder before cutting a tree that since so many years ago he was in that place.

In 1984, the park was listed by UNESCO and considered a Cultural Heritage of Humanity, when it was also included in the site "Works of Antoni Gaudi", which has seven monuments built by the architect, all in Barcelona. These include the Güell Palace and House Milà, also listed in 1984; and Vicens House, the Nativity Facade and crypt of the Holy Family, House Batló and the Güell Colony Crypt, all taken in 2005. For Carmel-Arthur (2000, p. 51):

Great artists often have precursors and then followers. Gaudi is an exception. His performance in the history of architecture can be seen as a genius-reserved hiatus, endowed with a very particular method and style. Gaudi used string, mirrors and small lead weights to create the models of what would be essential works of Modernism such as House Batló, House Milà, Park Güell and the famous Holy Family Temple.

The Holy Family Temple, Gaudi's masterpiece that cannot be left out of the traveler's art-and-architecture itinerary, began to be erected in 1882 by architect Villar, with the structure of a neo-Gothic church. The task of completing it was entrusted to Gaudi in 1883, then 31, considered the greatest exponent of Spanish modernism. Gaudi then introduced numerous modifications, imprinting on them his personal and avant-garde style. He dedicated about forty years to the fabulous project, with eighteen towers surrounding the ships.

Each of the eighteen towers would represent one member of the Holy Family: Christ (represented in the highest tower), Our Lady, St. Joseph, the Three Kings and the Twelve Apostles. Of Gaudi's works, this building is the



most crowded, it is the grandest building, even though it is still an unfinished church. Gaudi worked intensely on this work for twenty years, living in seclusion on it during the last years of his life. However, his project was so grand that when he died, only one of the eighteen towers was completed. At present, many others are ready. The design and design of the Holy Family Temple has been so significant that it is still being built and restored to this day as it is considered the postcard of the city of Barcelona.



Fig. 3: "The Salamander"

Next to the Park Güell Salamander, 2015.

This is the most peculiar church anyone has ever seen. Even incomplete, it is a majestic temple, unique and impressive not only for its grandeur, but for the rich details of its shapes and elements. It is an essentially original building, which does not come from any architectural tradition. Highlight for the abundant plant ornamentation, the columns of the three great facades of the Nativity, Glory and the Passion, and the towers that offer city views for those willing to climb the four hundred steps of the spiral-shaped stone staircase. An important detail: once you start the climb you can no longer go back or give up, because its steps are narrow, so that only one person per step. Although you can rest and stop every hundred steps, there is breath! On one side is the ladder to go up, and only on the other side is the ladder to go down. Nevertheless, nowadays there is also the option of climbing to the top by a lift.



Fig. 4: "A Majestic Temple"

Nativity Façade, 2015.

The temple was designed with three facades, the Facade of the Nativity (Figure 04), almost completed by Gaudi still in life, is like a huge crib with all the scenes of the birth of Jesus. For Gaudi, this would be the façade that would arouse the dazzle of the public and urge people to continue their work.

There are over thirty different classes of plants, plus the Tree of Life, high on the porch, which symbolizes the legacy left by Jesus. In addition, the less ornate Passion Facade, begun in 1954, depicts the suffering of Christ in the crucifixion; and the Facade of Glory, considered the main one, started in 2002 and which refers to the ascension to God, the resurrection. Although Gaudi was well aware that he would not have completed the stone temple he had designed, he wanted it to represent the body of investigations, discoveries, and reflections he had made throughout his life. When asked when the temple would end, he would reply: "my client is in no hurry" (Armengol, 2001, p. 63). Gaudi referred to the Creator, for he was very religious.

"Want to know where I found my model?" - Once asked visitors to his studio. "See a right tree; it supports the branches, these the twigs and these the leaves. In addition, each part grows harmoniously and miraculously, since the artist, who is God, created them." In the main nave of the Holy Family is a veritable forest of columns, branching upwards (Zerbst, 1993, p.30).

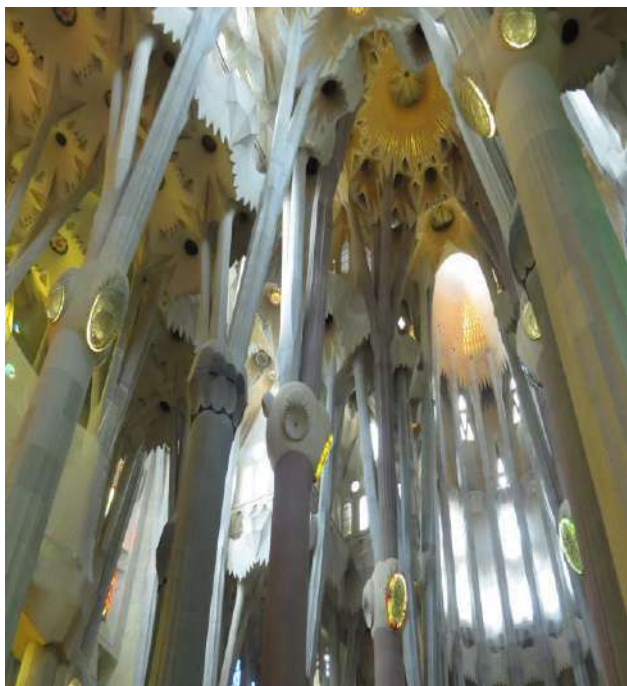


Fig. 5: "A Forest of Columns"

Columns inside the Holy Family, 2015.

The Holy Family Church, Gaudí's obsession, will probably still take some time to complete. There is a forecast for 2026, but not even many of those currently responsible for the work expect to be able to complete the project. Counting on public contributions; Engineers, architects and their teams are still there with their cranes and cranes, continuing construction in accordance with Gaudí's original design. It is interesting, above all, to analyze that the construction has been evolving over the years, both the techniques and the materials. New technologies were allied with the construction of the Holy Family. The teams responsible for the continuity of the work have always, however, taken special care: not to commit "false witness". That is, the visible difference of textures and materials present in this building is intentional, so as not to mislead the public eye as to what was built by Gaudí and what is still being built today. This is an important feature when it comes to historic buildings.

Considered a recluse genius, who used to sleep only four hours a night, he died at 74, hit by a tram, next to his masterpiece. What some natives of Barcelona comment to this day is that the great artist was admiring his work now it was run over. Rumors like this one make up a series of urban legends surrounding Gaudí's life and work. According to Carmel-Arthur (2000, p. 10), "his injuries disfigured him to the point of not recognizing him or giving him the emergency treatment he needed." The author (2000, p. 53) further reports that "Gaudí's end was the end of someone who embarked on a project greater

than one life, even the life of a genius." Gaudí's dedication to the temple was such that his remains are today in a crypt inside the church.

In 1982, Pope John Paul II visited the work, and Le Corbusier, another icon of architecture, after visiting it in 1927, declared that Gaudí was the great builder of the twentieth century, as Gaudí himself would have prophetically said about the temple: "He will sell people from all over the world to admire him" (Armengol, 2001, p. 61). In the basement of the church, in the area reserved for the museum, it is not without reason that scholars of the colossal architecture of the temple exhibit their innumerable studies, floor plans, projects, models and photographs. There are also the original models of the temple, as made by Gaudí and his assistants. In addition, in a specially prepared room, you can contemplate some of Gaudí's sketches and drawings, as vandals destroyed much during the Spanish Civil War. In November 2010, Pope Benedict XVI gave the church the status of the Basilica.

### III. CONCLUSION

It is essential to observe the influence and repercussion that these works continue to exert on the work of contemporary artists, designers and architects. The merit of these creations is their asymmetrical, winding, and irregular and, why not say, surprising, unusual, fascinating forms. We deduce from these considerations that Gaudí was a pioneer who changed the architectural paradigm prevailing until then. However, by his unique method and style, "Gaudí's work was not always well understood and when he built his houses and had my critics and buildings such as La Pedrera, for example, he received all kinds of criticism, including daily jokes in and out. Those who mock each other" (Durán, 2003, p. 25).

In this way, many jokes, debauchery, and derogatory jokes were directed at Gaudí, belittling him. In addition, its style was often considered loaded, with excess of ornaments. However, time has helped put things in its place, and the vast majority of his works in contemporary times are officially recognized as World Heritage. And, according to Carmel-Arthur (2000, p. 11), "[...] Gaudí's work was brought to the fore throughout the world during Barcelona's extensive urban renewal for the 1992 Olympics and the awarding of the city of Medal of the Royal Institute of British Architects in March 1999. Similarly, as Armengol (2001, p. 62) reports:

In Paris, in 1961, in the exhibition "The origins of the twentieth century", the values of Gaudí that had been understood in 1910 were recognized. In Italy, in England, in



the Netherlands, in Germany or in New Zealand, as In the whole world, the originality of Gaudi is considered today as the highest exponent of the art of all times.

In this sense, visiting Barcelona, the capital of Catalonia and checking in loco the follies and daring that Gaudi realized in the early twentieth century, led us to reflect and discuss about his work and its reflection for posterity, impressions that resulted in the present text. In short, we can say that Gaudi's unique, strange and bold creations, with their strength and creativity, will continue to impress the thousands of tourists who visit Barcelona annually to learn about its architectural legacy.

#### **ACKNOWLEDGEMENTS**

An acknowledgement section may be presented after the conclusion, if desired.

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# Road intersection Analysis - Case Study in an intersection in the City of Palmas - TO

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**Abstract**— This paper aims to perform an intersection analysis located in the municipality of Palmas - TO, the location was chosen due to the kneecap is suffering from major congestion at peak caused by the mixture of the traffic of the BR-010 with the urban traffic coming from from the Taquaralto and Taquari neighborhoods. The study site is an area with large population growth and with many traffic generating poles, causing long queues and consequently increasing the accident rate mainly at peak times. This work seeks the current flow of vehicles as well as future estimation, identification of conflict points and their proper origins. The traffic studies have provided the identification of optimal geometry for the roads that intersect in order to seek minimal solutions of boxes and shoulders as well as the ideal number of lanes on the roads and then provide the driver with safer and more comfortable traffic.

**Keywords**— Road intersection, Geometry, Road safety.

## I. INTRODUCTION

Currently in Brazil, the highway modal has a much higher demand in other modes, both for transporting goods and for people transport due to ease of access throughout the country. The big demand for road transport demands the same amount of investment in planning, projection, execution, conservation and inspection of road networks ensuring a safe, economical and efficient transport for the population. (VALIM; ALVES, 2016).

Intersections between highways where to give access to municipalities or roads represent a delicate challenge for Brazilian civil engineers, since it is the need for efficient and safe convergence needs to be met for all vehicle classes, from passenger cars to vehicle combinations of cargo (VALIM; ALVES, 2016).

The accelerated increase in vehicle fleets is a very important factor to be because it generates a demand that demands greater investments in the solutions for road modes that meet the new needs in a viable way and economic (FAVERO, 2017).

According to Valim and Alves (2016) the points considered most critical for a driver are at the road

intersections where in a short period the driver must make decisions about route changes, accessibility, and traffic preferences.

In the present study we collected recent data found through the Denatran (2019) and IBGE Estimated for (2018), referring to the newest capital of the showing that in Palmas - TO the index of people for each vehicle is equal to 2, thus proving a huge increase over the years and awakening the need for analyzes and measures to alleviate the negative effects of increased fleet and circulation of individual vehicles.

Road congestion is a negative point for transport where it affects not only the economy but also people, which due to the Waiting times can suffer from diseases such as stress and anxiety. (SOUZA, 2015).

According to Favero (2017) the modifications that affect the networks of transport have social consequences, and it is up to engineers to evaluate the negative and positive impacts to seek a broader social solution.

Given this need, a study of traffic, quality of flow and access to the highway in the city of Palmas - TO, using real data that presented a current scenario in the most accurate

way. For the improvements it was need to meet future demand so that road investments also have positive long-term impacts.

The objectives of this paper, therefore, is to evaluate the technical analyzes concerning the interpretation of traffic demands, classifications and limits geometry of roads in order to find the traffic scenarios and to evaluate the congestion at peak times relating to geometric measurements and thus seeking a conception of concepts and parameters in segments road.

**II. METHODOLOGY**

**2.1 PLACE OF STUDY**

The study site was an intersection on BR-010 where access to Taquaralto in the city of Palmas - TO. At this intersection, currently, conversions are carried out by means of a roundabout with central road traffic as for urban traffic where they intersect.

The kneecap intersection contains 5 branches and has a large congestion at peak times. This intersection is part of BR-010, a commercial avenue and other avenues with access routes to the bus terminal, schools, state and local authorities, hospitals, colleges, downtown and several other traffic generating poles.

Based on this data, the location (Figure 1) was selected as a point critical in the flow of vehicles in the city and for being of great social interest, as it aims to improvement for local traffic where growth in nearby neighborhoods is quite large.

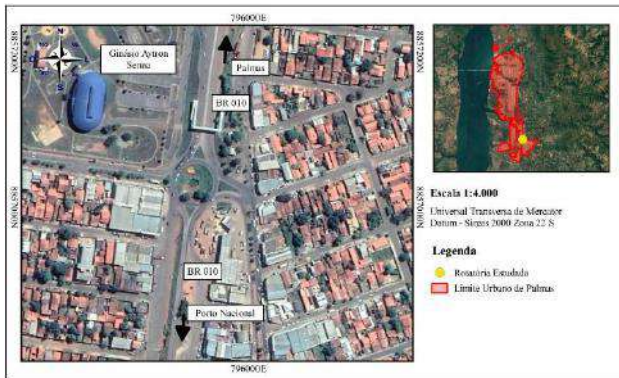


Fig.1 - Analysis Location

**2.2 TRAFFIC RESEARCH**

Traffic surveys were performed based on the Study Manual Traffic - DNIT (2006) through direct observation recording all traffic phenomena without disturbing it. The place of the research was exactly at the intersection site in order to raise flows from the intercept and their connecting branches. It took 4 counting points (Figure 2), then find the total number of vehicles passing at the roundabout.



Fig.2 - Location of counting points  
Source: Adapted from Google Maps (2019)

**2.2.1 Counting Method**

The counting method was the manual method. Counts were recorded data transcription cards and cameras for filming at higher flows for future counting. The grouping criteria adopted were: cars, buses and trucks.

It took a total of 4 people to do the counting simultaneously 1 researcher for each point, to have the total number of vehicles crossing the roundabout at the exact count time. The survey was conducted in 3 weekdays for a total of 3 hours per day divided into 15-minute intervals. Having no disruption to traffic caused by accidents, works or track sinking the survey then took place according to (Table 1).

Table 1 - Days and times of counts

Monday	Wednesday	Friday
07:00 to 08:00	07:00 to 08:00	07:00 to 08:00
12:00 to 13:00	12:00 to 13:00	12:00 to 13:00
18:00 to 19:00	18:00 to 19:00	18:00 to 19:00

**2.3 DETERMINATION OF CURRENT TRAFFIC**

Current traffic was determined from counts made in field and with that it was possible to find the day of the week and the time of greatest flow of vehicles that crossed the roundabout. After counting was necessary calculate the Peak Hour Factor that measures precisely the variation between the minutes of count and determine the degree of flow uniformity. For the calculation of the Time Factor Peak was applied the following formula.

$$FHP = \frac{V_{hp}}{4V_{15max}} \quad (1)$$

Where:

FHP = Peak Hour Factor;

V<sub>hp</sub> = Peak hour volume;

V<sub>15max</sub> = 15-minute period volume with highest traffic flow within the hour peak.

**2.4 DETERMINING FUTURE TRAFFIC**

Future traffic was found through the growth factor calculated by varying the fleet of vehicles for two different periods, the survey was conducted on the IBGE website. In

the calculation of the growth factor the following formula is used.

$$F_c = \frac{FV_{2017}}{FV_{2007}} \quad (2)$$

Where:

F c = growth factor;

F v = Vehicle fleet.

After finding the growth factor it was applied in the following formula to then arrive at the traffic result for the year 2027.

$$T_f = F_c * T_a \quad (3)$$

Where:

T f = future traffic;

F c = growth factor;

T a = Known traffic in a given year.

### 2.5 STUDY OF GEOMETRY IN RELATION TO TRAFFIC VOLUMES

This analysis required a field study to find the current measurements of the intersecting roads then were the studies focused on the tables will be presented below. In this analysis we considered only the points 1 and 4 represented in (Figure 2) which are the busiest roads and generate congestion at peak times.

Table 2 - Estimated values per hour

VALORES ESTIMADOS POR HORA NAS VIAS		
Local plano; Equivalência: 1 caminhão = 4 veículos de passeio	50veic/h	Largura inferior a 6 m
	190 veic/h	Largura inferior a 6 m
	620 veic/h	Largura mínima de 6 m
	1400 veic/h	Largura superior a 8 m
	> 1500 veic/h	Largura igual ou sup. a 12 m

Source: Fajersztajn (2012)

Table 3 - Road classes - Study of traffic volumes and relationships with their geometry

FUNÇÃO	VOLUME MÁXIMO/DIA		VOLUME MÁXIMO/HOR	GEOMETRIA NECESSÁRIA	
	VEÍCULOS LEVES	CAMINHÕES E ÔNIBUS	TOTAL DE VEÍCULOS	ESTIMADO 10% DO TOTAL	LARGURA DA CAIXA (m) / Nº FAIXAS
Via local residencial com passagem	400	20	480	50	4 a 5 / 1
Via coletora secundária	1500	100	1900	200	5 a 6 / 2
Via coletora principal	5000	300	6200	650	6-7 / 2
Via arterial	10000	1000	14000	1500	> 8 / ≥ 3
Via arterial principal ou expressa	> 12000	2000	20000	2000	> 12 / ≥ 4

Source: Fajersztajn (2012)

Table 4 - Basic dimensions in relation to box width

LARGURA DA RUA (A) m	LARGURA DA CAIXA (B) m	LARGURA DOS PASSEIOS (C) m
6-7	4	1,0-1,5
7-8	4 - 5	1,5
8-10	5 - 6	1,5-2,0
10-12	7	1,5-2,5
12-14	8	2,0-3,0
14-15	9	2,5-3,0
15-16	10	2,5-3,0
16-17	11	2,5-3,0
17-18	12	2,5-3,0
18-20	13	2,5-3,5

Source: Fajersztajn (2012)

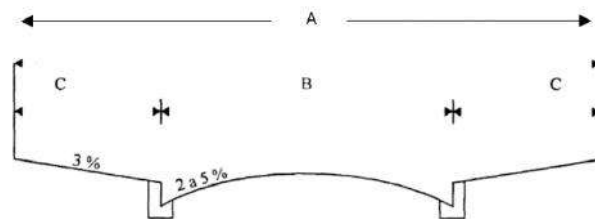


Fig.3 - Paving project model

Source: Fajersztajn (2012)

#### Note:

Equivalence adopted:

1 truck = 4 light passenger vehicles.

1 bus = 4 light passenger vehicles.

### III. RESULTS AND DISCUSSIONS

#### 3.1 CURRENT TRAFFIC

On Friday, in the period from 18:00 to 19:00 was finding the largest volume of vehicles that crossed the roundabout, a total of 3,808 during peak hours, 3,318 automobiles, 226 buses and 264 trucks. In the 15 minutes of highest flow It had a total of 1003 vehicles, of which 870 cars, 64 buses and 69 trucks.

So, we got a Peak Hour Factor of 0.95 indicating large volume of capacity-restricted traffic during peak hours, ie with congestion within the highest flow period, verified during the survey (Figures 4 and 5).



Fig.4 - Intersection congestion

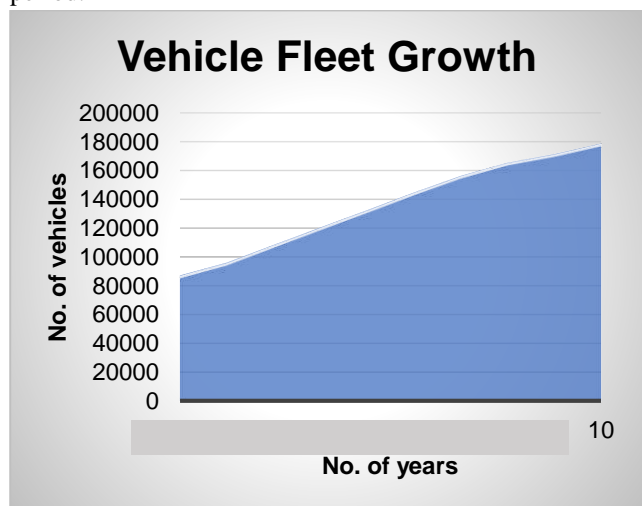




Fig.5 - Extended Congestion

### 3.2 FUTURE TRAFFIC

According to IBGE in 2007 there was a fleet of vehicles equal to 86,993 and in 2017 the fleet was 178,752 as shown in (Graph 1), ie increased more than double over a 10-year period.



Graph 1 - Vehicle fleet growth

With significant vehicle fleet data for a decade can find the Growth Factor equal to 2.05, with this result was future traffic of 367,297 vehicles is expected for the year 2027.

### 3.3 ROUTE GEOMETRY IN RELATION TO VEHICLE FLOW

In traffic studies it was possible to find vehicle volumes per hour for each point that enters the intersection in the current situation and with that it was possible calculate the flow estimate for the year 2027 at each counting point as indicates in (Figure 2).

The following results only presented the results from points 1 and 4. which are higher flow rotary access points that cause Traffic jams at peak times, these points are located on BR – 010 classified as the main or expressed arterial route.

#### 3.3.1 Relationship of current geometry to current vehicle flow

Table 5 shows the current box and ride measurements as well as the number of lanes per lane and the current volume of vehicles. The values presented are the highest flow roads where it gives access to the kneecap intersection in the BR-010. The following results indicate that in the current situation the measures of the do not meet the current flow (Table 2) and not even compared to road classification no (Table 3).

Table 5 - Current Situation

POINTS CRITICIS	VEHICLE VOLUMES	WIDTH FROM THE BOX	N° OF TRACKS	WIDTH OF RIDES
PONTO 1	1605 veic/h	10,65m	3	0,48
PONTO 4	1341veic/h	6,80m	2	1,55

#### 3.3.2 Relationship of current geometry to estimated vehicle flow for 2027

(Table 6) relates the estimated vehicle flow for the year 2027 to the current situation of the intersection access roads indicating the their inefficiency to meet future demand according to (Table 2).

Table 6 - Future Situation with Current Geometry

POINTS CRITICIS	VEHICLE VOLUMES	WIDTH FROM THE BOX	N° OF TRACKS	WIDTH OF RIDES
PONTO 1	3451 veic/h	10,65m	3	0,48
PONTO 4	2884 veic/h	6,80m	2	1,55

#### 3.3.3 Geometry Ratio Required to Meet Current and Future Flow

According to the studies by Fajersztajn (2012) the widths of the boxes, the width of the rides and the number of current lanes do not meet the needs or even of the current flow relating (Table 2) to (Table 5) and neither by (Table 3), thus (Table 7) presents necessary for the intersection access roads considering measures that meet the current situation and another decade.

Table 7 - Future Situation with Updated Geometries

POINTS CRITICIS	FLOW CURRENT	FLOW FUTURE	WIDTH FROM THE BOX	N° OF TRACKS	WIDTH OF RIDES
PONTO 1	1605 veic/h	3451 veic/h	>12m	≥4	2 - 3m
PONTO 4	1341veic/h	2884 veic/h	>12m	≥4	2 - 3m

## IV. FINAL CONSIDERATIONS

The analyzes reported in this work served to verify the importance of the traffic studies that allowed the identification of the current flow and made possible a future estimation and with it the assimilation to the common problems already in the current situation due to deficiencies in the road network.

Conflict identification occurred through on-site surveys intersection such as major congestion at peak times, this

being what drew the most attention to this study, since they provoke driver stress and anxiety even reaching the level of accidents serious.

When analyzing the intersecting roads, the most critical points were reported, or that is, the ones with the highest flows, so the study turned only to these points where the need for superior measurements was verified both in the boxes of the highways as in number of lanes and sizes of rides so it is suggested to future work that adequacy projects are carried out on the roads in conflict.

In the classification of a road, vehicle flows, speed maximum and its geometry if it is not possible at all to perform a adequacy in conflict roads, speed studies are suggested allowed on the roads, seeking to decrease the flow just as it was done in São Paulo in 2015 when the maximum permitted speed was reduced to 50km / h on the local avenue Tietê local track, where before the top speed allowed was 70km / h.

In this context the understanding of road concepts applied to traffic challenges ensures the maintenance and improvement of warranties citizens' rights through safe, economical and efficient transport.

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# Piezoelectric effect as an energy generator: A describal historic of its performance

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**Abstract**— Knowing that world population, process automation, energy demand and environmental impacts increase every day, the energetic efficiency analyses the supply possibilities of the increasing electricity usage. Thus, the article describes the historical performance of the piezoelectric effect studies implemented in Brazil and worldwide, represented as an alternative for power generation in small and large applications, comparing with other existing renewable sources and listing their advantages and disadvantages. It has gotten as a result it is an old technology, however low used in energy generation. The generation by piezoelectric effect does not emit greenhouse gases, does not work with combustion and does not need renewable resources such as sunlight, actions from wind or water. The PZT ceramics are deployed in urban and busy locations such as highways, airports, railways, sidewalks, supermarkets, and soccer fields around the world, attending the demand in small daily applications, getting great strides in reducing greenhouse gas emissions caused by non-renewable sources and some renewable sources. It was concluded that there is a possibility of diversifying the energy matrix with existing technologies, in simple applications such as residential and public lighting, as well as encouraging the elaboration of research and projects that can decrease the environmental impact and increase the energy efficiency.

**Keywords**— piezoelectricity, crystals, energetic efficiency.

## I. INTRODUCTION

Increasingly, the technology offers time and labor saving devices using just a power outlet or electric switch. Thus, any construction, new or reformed, causes an increase in demand [1]. The traditional sources are slowly decreasing their availability, so fossil fuels need to be reduced not only aiming its reduction, but also as a condition of mitigate the impact on the environment, which is primarily responsible for environmental change.

In the modern world, improved living conditions are linked to access to electricity, as per capita energy consumption is taken as a country's development index [2]. The importance of the energy matrix diversification, therefore, increases not only the energy offers, but also ensures the supply of demand.

According to [3], the energy issue in Brazil was only really felt in the early 2000s, with blackouts that lasted for hours. The [3] considers that generating a new MW costs 200% more than saving a MW. Given the energy incident in April 2001, a federal decree imposed emergency rationalization measures looking forward to demand reduction and electricity offer increases, determining to the federal government agencies the reduction of electricity consumption by 20% until December 31, 2002, which did not occur.

In addressing Energy Efficiency theme, the key question is how to innovate with as little environmental impact as possible and maximum performance, given the increase in energy consumption provenient from world population growth. The study of innovations in the field of power generation is justified, given the high demand of the current scenario, depending on non-renewable raw material and high cost works.

The most common examples are the wind actions, sunbeams, geothermal sources, hydro and biomass. A water turbine reaches up to 90% yield, a wind turbine can convert 59,3%, a steam turbine reaches 60% and a solar cell ranges between 6 and 40% [2].

The discovery of the piezoelectric effect occurred during 1880, by brothers Pierre and Jacques Currie, by attempting to electrify insulating materials to conductive crystals, being them aluminum paper, glue, wire, magnets, quartz crystals, topaz, sugar cane, Rochelle salt and tourmaline. The experiment resulted in creation of the piezoelectric quartz electrometer [4].

The following year, Gabriel Lippman discovered the existence of the reverse piezo effect through thermodynamic principles that occur in electronic circuits. The first piezoelectric effect applications were used by Paul Langevin in sonar development during the First World War [5].

In 1996, Thad Starner explored the possibility of harnessing energy eliminated during daily efforts to power computers and portable devices, while Mikio Umeda created a model to investigate the impact of a steel ball coated by piezoelectric material, in order to generate useful electricity [6].

The piezoelectricity is a phenomenon where certain crystal compositions generate electric charges, which appear as direct or reverse. The direct piezo effect generates the electric field when subjected to mechanical pressure action, already on reverse effect occurs deformations of the material resulting from an applied electric field [5].

The piezoelectric effect is applied at ultrasound devices, sound amplifiers, electric actuators, scales and impact detonators. [7] cite crystals as zinc sulphide, sodium chlorate, magnesium chloroborate or boracite, tourmaline, quartz, zinc carbonate or calamine, topaz, sugar and Rochelle's salt or Seignette's salt.

The objective of this study is aimed to describe the piezoelectric effect as an alternative energy source, evaluating the history of its performance over the years, seeking to describe a cost vs benefit ratio and possible reasons for their entry into the current scenario.

## II. MATERIALS AND METHOD

The research procedure is based on a case study with a qualitative approach, when it comes to the energy efficiency theme in a contemporary situation focusing on the study of previous phenomena, research data and applications.

The evaluated basis seeks to describe the history of use of piezoelectricity, citing its main activities and where it can be operated, also make comparisons of costs related to other energy production models and characterize advantages and disadvantages.

Documentary data were collected to produce a descriptive table about the projects applied in cities at Europe, America and Asia.

## III. RESULTS AND DISCUSSION

Each piezoelectric material has its own piezoelectric constant, the table 1 exemplifies some of these values for the respective materials, being the piezoelectric constant, given by  $10^{-12}$  m/V and the dielectric constant measured in  $C^2/Nm^2$ .

Table 1: Main values of the piezoelectric constant and dielectric constant of important piezoelectric materials.

Material	Piezoelectric constant (d)	dielectric constant
<b>Genuine piezoelectric</b>		
Quartz ( $SiO_2$ )	-2,3	4,5
Tourmaline	-3,7	6,3
<b>Ferroelectric</b>		
Barium Titanate ( $BaTiO_3$ )	390	2,9
PZT ( $Pb_{0,5}Zr_{0,5}TiO_3$ )	370	1,7

Source: Adapted from [8].

The piezoelectric constant has a higher index in ferroelectric materials, as they are made and synthesized in piezoelectric ceramics, obtaining better yield than genuine crystal. The Lead Zirconate Titanate (PZT), despite smaller constants than barium titanate, it is the most efficient material, reaching the 80% generation yield, being the most applied in large scale projects and works. The table 2 shows the estimated power per converter type.

Table 2: Estimated power in ideal model situation.

Conversion mechanism	Estimated power - ideal model
Piezoelectric converter using PZT	277
Piezoelectric converter using PVDF	260
Electrostatic converter	42,7

Source: Adapted from [9].

According to [9], a PZT piezoelectric converter prototype, on ideal situation, applying 100Hz frequency and  $2,26$  m/s<sup>2</sup> acceleration, can generate even 277  $\mu$ W, value quite above a conventional electrostatic converter. It is still possible to consider the use of fluorine polyvinyl in the same applicability, reaching an index five times higher than the electrostatic converter.

The sun contributes directly to the source of photovoltaic and thermal solar energy, wind energy, biomass and the water and tides course [10]. The various renewable sources have lower environmental impact, allowing to decrease greenhouse gas emissions and



improve the air quality, a necessary factor in the current scenario. Even decreasing the aggressions on the environment and diversifying its matrix, it is still visible that there are some instabilities (Table 3).

Table 3: Advantages and disadvantages of renewable energy

Advantages	Disadvantages
Infinite source of power generation	<u>Biomass</u> Bureaucracy for implementation Uses combustion method
Does not emit greenhouse gases	<u>Hydroelectric</u> Soil erosion Impacts on the local ecosystem
Energy matrix diversification	<u>Wave energy</u> High deployment cost Depends on coastal area
Investments in more jobs	<u>Wind energy</u> High deployment cost Depends on locations with high airflow index
Lower risk than nuclear power	<u>Nuclear energy</u> High risk of explosion High deployment cost
Increased energy autonomy of the country, besides investment in studies (new alternatives)	<u>Solar energy</u> High upfront costs <u>Thermal energy</u> CO <sub>2</sub> emitter Diesel oil usage

Source: Adapted from [10]

As seen in the table, renewable sources can be clean and inexhaustible. However, in terms of quantity, there is a time and place to use each one of them. Like the water resource, the hydroelectric plant imposes the displacement of an entire ecosystem. Tidal energy is limited only in the country's coastal area; Solar and wind power are the fastest growing today, but still have high implementation cost.

The piezoelectric power generation does not require sunlight for its generation, the place to be deployed can be in busy places inside the city and depending on the material achieves higher yield than other sources. The problem faced is low crystal production, often for restricted use, as well as high investment for large-scale projects due to the difficulty of storing energy.

Despite being a clean, profitable and old technology, its development was limited to the creation of sonar and ultrasound devices, explained by its piezoelectric coefficients and frequency ranges. Among the studies and

applications that contribute to the growth of piezoelectricity, table 4 shows the works applied in the world for power generation.

Table 4: Piezoelectricity applications in the world

Project description	Year	Company / Origin
Road, airport and rail studies and testing in Haifa, Israel	2007	Innowattech / Israel
Creation of Watt night club. The technology was titled Sustainable Dance Club (SDC) in Rotterdam, Netherlands	2008	Eindhoven University of Technology, Netherlands
Self-supporting system installation at Club Surya in London, England	2008	Andrew Charalambous and engineers in England
Piezoelectric installation at two train stations in Tokyo, Japan	2008	Soundpower / Japan
Floor installation on Bird Street sidewalk in London, England	2017	Pavegen / England
Ceramic installation in supermarket entrance of Barcelona, Spain	2019	Pavegen / England

Source: Own authorship, 2019

In the present scenario, international companies are the flagship for producing PZT ceramics applying at train stations in Tokyo, nightclubs in London and Rotterdam and the streets of Toulouse [7]. The companies apply case studies and projects to adopt energy efficiency through sustainable and durable solutions.

In Brazil, the British company Pavegen, in partnership with Shell Brasil, created a soccer field at Morro da Mineira, in Rio de Janeiro, with 200 plates, responsible for the generation between 20 and 30% of 2 kWh, capable of keep the reflectors on for up to ten hours [11]. Brazil has recently started piezoelectricity projects through partnerships between national and international companies, government and town hall (Table 5).

Despite being an old technology, Brazil only entered this branch of power generation from the 2010s, as a consequence of high investment for installation and difficult energy storage. However, important partnerships were obtained with international companies, in order to achieve better energy efficiency and matrix increase

results, besides including Brazil in the group of countries with piezoelectricity projects.

Table 5: Applications of piezoelectricity in Brazil

Project description	Year	Company / Origin
Sustainable soccer field at Morro da Mineira in Rio de Janeiro, RJ, Brazil	2014	Pavegen / England, together with Shell Brasil
Creation of the 'ciclovia do futuro', installing the system for public lighting in Curitiba, PR, Brazil	2018	Soundpower / Japan

Source: Own authorship, 2019

One of the problems faced in using large scale flooring is the difficulty of storing energy. It would be necessary to invest heavily in capacitor banks or find a more cost effective alternative. Another problem would be the durability of the ceramic, knowing that with the use and excessive stimuli, the material loses malleability, reaching up to five years of useful life.

#### IV. CONCLUSION

The importance of the piezoelectric effect phenomenon encourages the use of renewable resources in a less costly manner, depending on the material used, as in the case of PZT application, which occurs in sonar and ultrasound devices. However it would be appropriate to use to generate energy in applications that require low voltage and current levels. The case of residential and public lighting sectors being supplied with piezoelectric ceramics could give greater room for other demands.

With the need to increase the efficiency of energy production and consumption, electrical engineering is important, given the support and knowledge that the distributed generation sector observed in view of the expansion of its energy matrix, seeking income, economy and preservation of the environment, independent of the generation of plants that give high expenditure to the government and pollution to the environment, in addition to being the basis for new research finding alternatives that have less impact on.

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# Comparative analysis between reinforced concrete sill plate and prestressed concrete sill plate, equating construction costs for a residential development

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**Abstract**— The area of civil construction is responsible for developing new construction methods, with more efficient and economical technologies. The prestressed concrete sill plate is an example of engineering evolution when it comes to shallow foundation. The lack of planning in civil works can cause a number of problems and even overburden the work budget, especially in the case of sill plate execution service. For the accomplishment of this work, the case study methodology was used in a construction of a residential development located in the city of Manaus. Besides pointing out the economy consolidated by the project after adopting the new construction method based on economic feasibility studies, this quantitative work aims to compare two types of surface foundation: prestressed concrete and reinforced concrete sill plate. The prestressed sill plate, no matter how much it requires skilled labor to perform, allows for a significant reduction in one of the heaviest items in a budget spreadsheet: concrete. Thus, it can be observed through the analysis that the prestressed concrete sill plate method is the most viable for the construction company because it presents cost reduction and improvements in the ability to resist the loading of structures.

**Keywords**— Sill plate; Foundation; Reinforced concrete; Prestressed concrete.

## I. INTRODUCTION

Brazil undergoes several changes of government over the years, and with this, new construction methods are brought from several other countries. One such technique is the sill plate foundation. With Romanian origin, it was known to be used in the construction of aqueducts, however, in Brazil, this system was widely used to support only small structural loads. This method was used in larger works only in the 90s, with the arrival of prestressed concrete sill plate, in the construction of housing works in the city of Fortaleza - CE because it is considered a simple and economical foundation. Regarding the main materials that make up the sill plate, we find the concrete, passive reinforcement for reinforced concrete sill plate and active reinforcement for prestressed sill plate.

The objectives of this work are: to compare, in full, two construction methods of foundation, both executed in a real estate development with 42 residential blocks located in the west of the city of Manaus, to point out and prove, through budget data, the economy consolidated by the construction company after study.

## II. THEORETICAL REFERENCE

### 2.1 Sill plate Basics

Sill plate is a structural element, a type of surface foundation in direct contact with the ground and is responsible for supporting and distributing building loads evenly to the ground. (11)

The expression sill plate should be used when the shallow foundation distributes the loads of all or part of the pillars of a structure (2). Its main purpose is to withstand the loads applied through the permissible ground capacity tension, thus reducing the stresses on the structures.

Ground strength and subgrade are as important as the sill plate itself as both are directly linked to the performance for which it was designed.

Given this, it is clear the importance of “requesting a geotechnical engineer, the classification of this soil, the tests for particle size, liquidity limit, plasticity limit and CBR in the natural conditions of humidity and compaction.” (5).

The sill plate should be used when: the ground load capacity is low; if you want to make the repression proportional; the foundation area is larger than half of the



construction area; the shoe areas are close to each other. (5).

## 2.2 Sill plate Basics

When it comes to structural systems, sill plates are designed according to four main types: plain sill plates; pedestal sill plates; ribbed sill plates, coffin sill plates. (5).

Smooth sill plate - easy to perform for its simplicity. It can be used as under floor and is widely used in popular housing because it is economical and safe;

Pedestal or Mushroom Sill plate - Increases the thickness at the base of the pillars, thereby improving resistance to shear forces. The pedestals can be either at the top or bottom of the sill plate, the advantage of choosing the bottom is to leave the floor surface flat.

Ribbed Sill plate - Runs with main and secondary ribs, which may be inferior or superior and placed under the structure. In the upper ribs, a fill for the floor leveling is required. In the case of the lower ribs, it is performed at the time of excavation.

Coffin Sill plate - Can be made with multiple floor levels to increase stiffness.

The types of sill plates mentioned above are of increasing order of stiffness and, depending on the type employed, their thickness ranges from 0.15m to 2.00m. (5).

## 2.3 Materials

### 2.3.1 Concrete

Concrete is based on the mixture of cement, water, sand and pebble. Mixing these ingredients with water creates adhesion between them, making them a tough paste and therefore a monolithic block. The proportion of these materials is known as trace or dosage.

Concrete is known to withstand high compressive loads and to have low tensile strength. This is due to the transition zone that forms around the coarse aggregate. The transition zone is formed in concrete making because water films are located around this aggregate, this increases the water x cement rate in that area making it more porous, i.e. less resistant.

As regards the strength class of concrete, class C15 is only used for temporary works or concrete which has no structural property (4). For passive reinforcement, concrete C20 is used and for active reinforcement C25 or higher. (1).

Table. 1: Strength classes of structural concretes

RESISTANCE CLASS GROUP I	CHARACTERISTIC RESISTANCE TO COMPRESSION (MPA)	RESISTANCE CLASS GROUP II	CHARACTERISTIC RESISTANCE TO COMPRESSION (MPA)
C20	20	C55	55
C25	25	C60	60
C30	30	C70	70
C35	35	C80	80
C40	40	C90	90
C45	45	C100	100
C50	50		

Source: ABNT NBR 8953 (2015).

### 2.1.1 Steel ropes

Considered as active reinforcement, steel strands are classified according to the number of wires that are manufactured: 3 and 7 wires. Its resistance is classified into two categories: CP-190 and CP-210. (3).

“The numbers 190 and 210 correspond to the minimum tensile strength limit in the unit force kilogram per square millimeter.” (3).

The ropes are supplied greased and plasticized by the industries. Care must be taken that it does not compromise the efficiency of the ropes to the foundations. They must be free of corrosion and even before concreting, the plastic covers must be checked to ensure that there is no tear so that the frame does not come into direct contact with the concrete. coffin - Can be made with various floor levels to increase stiffness.

## III. METHODOGY

For this work, the quantitative method was used. Quantitative research, using mathematical language, is based on studies that can be quantified and it seeks objectivity. (7).

Two construction methods will be addressed: conventional reinforced concrete sill plate and prestressed concrete sill plate. Both were executed in the same work, allowing for present budget data and consolidated economy after adoption of the new typology.

Planning in civil works is critical for any venture to achieve success. (10).

With a view to organizing for greater work efficiency, the service subthemes will be described in chronological order of execution.

### 3.1 Characteristics of the work.

Before describing the processes of execution of this study, it is important to highlight some information that characterize the enterprise in evidence in the present work: through geotechnical tests performed by an engineer specialized in the area, it was found that throughout the construction area presents the same characteristics. ground resistance, being possible the execution of superficial foundations in all the towers of the enterprise; direct cost

of construction will be addressed in both construction methods; The development has 840 housing units, divided into 42 towers of 5 floors; Of 42 sill plates, 2 were made using the conventional reinforced concrete method and 40 on prestressed concrete; The venture is located in the neighborhood of Lily of the Valley, Manaus-AM and was divided into two stages: Phase 01 and Phase 02.



Fig. 1: Location of the project  
 Source: Own authorship, 2019



Fig. 2: Implementation of phase 01  
 Source: Builder's Internal File



Fig. 3: Implementation of phase 02  
 Source: Builder's Internal File.

### 3.1 Project Analysis

In order to bring innovations and viability to the work, an in-depth study of all the construction steps to be performed was made. Until then, for this typology, the conventional reinforced concrete sill plate was used in all the construction company's ventures.

After realizing the possibility of implementing a new construction method for the foundations of the towers, the designer was asked for a new design review, adopting the prestressed sill plate as the new foundation of the blocks. Two designs were sent to the construction company, the first one contains the cable layout, the sill plate thickness and the amount of active reinforcement (CP190 RB 12.7mm strand) and in the second, the amount of shape and passive reinforcement is informed (screen welded Q 196), all according to ABNT NBR 6118 (2014) and NBR 7483 (2008). The software used is AutoCAD 2013 version.

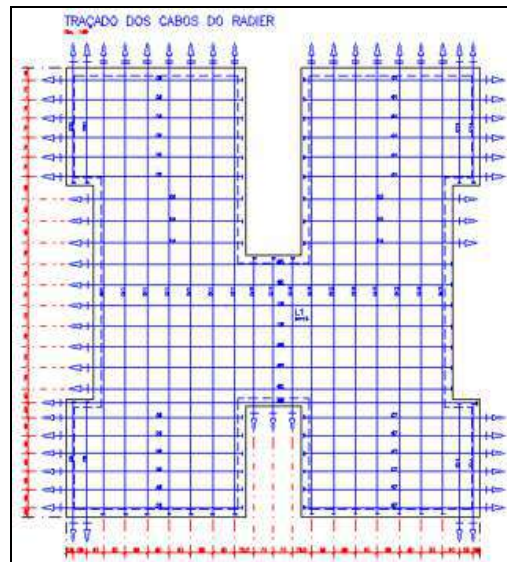


Fig. 4: Cable routing of prestressed sill plate  
 Source: Builder's Internal File

In figure 4, we can see the architectural design that shows the layout of the chordae and in table 2 below is the summary of them, where it is possible to obtain information such as: steel gauge, length and total weight.

Table 2: Cordoalha  
 Summary

PROTENSION SUMMARY						
Non-stick Mono-cables						
Ø	LENGTH	WEIGHT			ANCHORAGE	
		KG/M	KG	KG+4%	A	P
1 Ø 12,70MM	367,93	0,89	327,00	341,00	49,00	49,00
2 Ø 12,70MM	465,36	0,89	414,00	431,00	28,00	28,00

TOTAL WEIGHT = 741,0 KG

Source: Builder's Internal File

### 3.1 Preparation of unit cost composition - CCU

The total cost of a work is based on the budgeted cost for each item in a budget spreadsheet. (8).

Unit cost composition is all input required for a service to be performed. It contains the items of services (labor), materials and equipment.

To compose the reinforced and prestressed concrete sill plate, the quantities sent by the designer were used and the concrete volume was calculated through the product between the sill plate perimeters (calculated in design) by its thickness. The prestressed sill plate's thickness and concrete volume are 0.15m and 34.5m<sup>3</sup>, respectively. In the reinforced concrete sill plate, the thickness is 0.25m and 53.06m<sup>3</sup> of concrete (including 4.0m<sup>3</sup> of edge beam concrete and 5% loss coefficient for both cases).

Table 3: Armed sill plate unit cost breakdown

UNIT COST COMPOSITION - UCC				
SERVICE	UNITY		BASE: OWN	
	Sill Plate		PRICE (R\$)	
Execution of Reinforced Concrete Radier, Esp. = 25cm, with edge beam - MAT. +	UNIT	QUANT.	UNI PRICE	TOTAL
15MM COMPENSATED PLATE FORM - USEFUL. 3X - FOUNDATION	m <sup>2</sup>	30,17	30,88	931,65
AVERAGE SAND	m <sup>3</sup>	4,00	23,00	92,00
BRITA ESP = 5CM BALL	m <sup>3</sup>	11,00	110,00	1.210,00
EXTRA STRONG BLACK PLASTIC CANVAS MED. 4 X 100M 150 MICRAS 35KG (1 ROLL FOR 1.5 RADIER = 267M <sup>2</sup> )	m <sup>2</sup>	267,00	0,40	106,80
RECOZED WIRE No. 18 (1.24 MM)	kg	17,00	5,82	98,94
CA-50 STEEL MEDIUM	kg	36,00	4,16	149,76
WELDING SCREEN Q 196 MED. 2.45 X 6.00M 3.11 KG / M <sup>2</sup> , PRESENTATION PANEL	m <sup>2</sup>	1.058,40	18,03	19.080,00
APCB 70 STEEL ARMOR SPACER	un	450,00	0,78	351,00
FCK 30 MPA CONCRETE SEBUM SLUMP 10 + -2 FOR FOUNDATION	m <sup>3</sup>	53,06	410,00	21.752,73
M.O. RADIER EXECUTION	m <sup>2</sup>	53,06	292,12	15.498,56
CUTTING AND FOLDING STEEL CA-50 - 10.0MM	kg	36,00	0,45	16,20
				<b>R\$ 59.287,64</b>

Source: Own authorship, 2019

In table 3, it is possible to observe the description of each input, the units of measure, the coefficient and with the unit price it is possible to obtain the total construction value of a conventional reinforced concrete sill plate.

Table 4: Composition of prestressed sill plate unit costs

UNIT COST COMPOSITION - UCC				
SERVICE	UNITY		BASE: OWN	
	Sill Plate		PRICE (R\$)	
Protected Radier Execution, Esp = 15, with edge beam, excluding metal shape - Torre	UNIT	QUANT.	UNI PRICE	TOTAL
15MM COMPENSATED PLATE FORM - USEFUL. 3X - FOUNDATION	m <sup>2</sup>	12,93	30,88	399,28
AVERAGE SAND	m <sup>3</sup>	4,00	23,00	92,00
BRITA ESP = 5CM BALL	m <sup>3</sup>	11,00	110,00	1.210,00
EXTRA STRONG BLACK PLASTIC CANVAS MED. 4 X 100M 150 MICRAS 35KG (1 ROLL FOR 1.5 RADIER = 267M <sup>2</sup> )	m <sup>2</sup>	267,00	0,40	106,80
RECOZED WIRE No. 18 (1.24 MM)	kg	17,00	5,82	98,94
CP-190RB STREAM 7 WIRE 12.7MM	kg	937,00	9,75	9.135,75
CA-50 STEEL MEDIUM	kg	483,00	4,16	2.009,28
WELDING SCREEN Q 138 MED. 2.45 X 6.00M 2.20 KG / M <sup>2</sup> , PANEL PRESENTATION	m <sup>2</sup>	264,60	10,82	2.862,97
APCB 70 STEEL ARMOR SPACER	un	450,00	0,78	351,00
FCK 30 MPA CONCRETE SEBUM SLUMP 10 + -2 FOR FOUNDATION	m <sup>3</sup>	34,50	410,00	14.145,00
M.O. SILL PLATE EXECUTION	m <sup>2</sup>	34,50	292,12	10.078,14
MO- STEEL STRIP PROTENSION	kg	937,00	6,50	6.090,50
CUTTING AND FOLDING STEEL CA-50 - 10.0MM	kg	483,00	0,45	217,35
				<b>R\$ 46.797,01</b>

Source: Own authorship, 2019

Table 4 shows the inclusion of the 12.5mm CP-190 RB strand and the equivalent workforce in the composition, the coefficients of the other inputs changed along with the total value of the service.

The unit price of each input was collected from local suppliers. A competition framework was created, which contained at least 3 quotes per input, following the guidance of the Federal Court of Auditors booklet, p.59, TCU, which says: "Market research must contain a minimum of three quotes from different suppliers. If it is not possible to obtain this number of quotes, a detailed justification shall be provided. (Judgments 1,266 / 2011-Plenary, 837/2008-Plenary and 3,219 / 2010-Plenary)."

### 3.1 Execution

Although both methods seen above do not show much difference in their physical characteristics, execution varies according to the type of sill plate. Prior to execution, soil collection was performed to measure moisture content and compaction index as established by standard. The processes below describe how it was actually performed on site.

#### 3.1.1 Prestressed concrete sill plate

In the execution of the prestressed sill plate, the first service to be done is the leveling and compaction of the soil (this is common for any type of sill plate) according to the topographic survey. In the next step are made the hydro sanitary installations and electrical passages. Before allocating the pipes in their proper place, it was necessary to make a layer of sand to accommodate the pipes. The next service is the execution of 7 cm gravel ballast and the placement of plastic tarp over the ballast. This ensures that the frame does not come into direct contact with the ground and ensures its leveling. After the base was completed, the sill plate final height wood forms were made in order to facilitate floor finishing. A layer of Q 196 welded mesh was laid throughout the sill plate area, respecting the cover distance of 3.0 cm. The ropes were allocated, respecting the distances according to the project. It was first checked if there was a tear in the roof so as not to risk the reinforcement coming into direct contact with the concrete. (6). So that the reinforcement does not have contact with the canvas, spacers were placed. Before concreting, check the installation levels, the height of the form and the locking of the form itself. C30 concrete is the one used, and its release has been carefully executed so that nothing goes out of place. The deformation was done the next day. The prestressing is done with hydraulic jack after the curing of concrete that varies from 7 to 9 days, or when it reaches the minimum safety limit equivalent to 21



mpa. All prestressing service is performed by a specialized team, from the placement of the ropes to the cutting of the rope after its tensioning.



Fig. 5: Placement of chords  
Source: Own authorship, 2019

### 3.1.1 Reinforced Concrete Sill plate

For the reinforced concrete sill plate, the first steps (leveling and compacting the shape execution), mentioned above, are the same. Next, 4 layers with approximately 18 Q 198 welded screens per layer are placed over the entire sill plate area, respecting the distance between them and the cover, as informed in the project. After placing the screens, the concreting is done with the same caution and the concrete with the same strength (C30) mentioned above is used. At the time of cure, hydration is done carefully so that water does not damage the hardened concrete. The deforming is done 3 days after concreting.

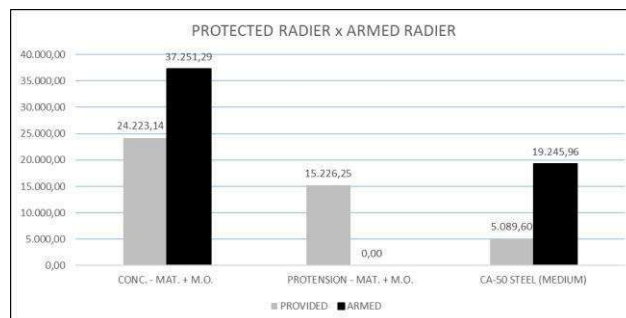


Fig. 6: Execution of the armed sill plate  
Source: Own authorship, 2019

## IV. RESULTS ANALYSIS AND DISCUSSION

After composing the unit costs of reinforced concrete and prestressed sill plate, it was possible to analyze the real cost of construction in both methods. Even though it is necessary to hire another third party to make the prestressing, it pointed to a significant savings of approximately R \$ 12.490,63 per sill plate, which is equivalent to R \$ 499.625,20 in total savings. This is

achieved by reducing the concrete rate by approximately 35% as illustrated in costs in the comparison below.



Graph 1: Comparison of costs between higher weight items of the armed and prestressed sill plate  
Source: Own authorship, 2019

In addition to choosing this type of foundation, prestressed concrete sill plate has a very satisfactory track record in terms of performance. The use of this typology has benefits such as: reduction of cracks, minimizing or even extinguishing the control joints, its use in firmer soils is allowed, increasing durability and improving maintenance. (9)

The same institution mentioned above finds advantages after comparing the prestressed method with the conventional one: it is more impermeable due to its higher strength thus avoiding the cracking effect, the slab is less thick and consequently uses less concrete, the prestressing makes the stiffness foundation increases, thus resisting the loads from the structures.

## V. CONCLUSION

In order to comply with what was proposed in the objectives, the present work addressed two types of foundation and through data and research, proved the innovation and improvement in this system that is widespread in Brazil: the conventional concrete sill plate. Being able to reduce costs, apply material and even increase the efficiency of a system is what engineering has been looking for over the years.

After the researches carried out for this work, it is understood that the foundation is one of the items that present great weight within the budget, because in its composition are inserted the concrete and steel. Therefore, it is one of the steps that needs special care at the moment it is lifted.

The planning performed played a major role in the success not only in bringing innovations to the work, but also in making the current venture economically viable.

Therefore, it is concluded that in the case of superficial foundations, prestressed concrete sill plate is one of the



most viable methods to be performed and should be studied in more depth. It has been shown to be the most economical and most effective method for resisting higher structural loads compared to the conventional method.

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# Legal Frameworks for Environmental Education in Brazil

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**Abstract**— For centuries, the planet has been going through a process of degradation that compromises the future of the generations and ecosystems that make up nature. In this context, environmental education is pointed out by researchers from all over the world as the only possible solution for the awareness of subjects and social transformation. From this outcome, it arises the proposal to include environmental education in formal spaces. This article carries out a systematic analysis of the bibliographies that deal with the introduction of environmental education in educational policies in Brazil, in addition to investigating the main guidelines of environmental education in Brazil. It is a descriptive article on the trajectory of environmental education in Brazil and the world. Brazil has a legal framework and guidance for the effectiveness of environmental education in the various spaces of formal and informal training of the most advanced in the world, necessary to make its regulation, monitoring, and enforcement.

**Keywords**— *Environmental Legislation, School Education, Public Policies and Education.*

## I. INTRODUCTION

The various transformations in ecosystems have caused damage to human health, as well as the threatening the future of current and future generations, a fact that motivated political and civil society actions to promote the care and preservation of the environment.

Environmental Education is known in the academic world as a possible instrument to reduce environmental damage to ecosystems since, as an educational tool, it seeks to raise awareness and guide individuals throughout their actions, raising awareness of their responsibility about the environment and living beings.

Environmental Education can and should take place in formal and informal spaces, depending on the necessities and social contexts. For Travassos (2011), the modern concepts of Environmental Education bring with them a new knowledge practice, taking into account traditional knowledge and social practices, school curricula, and policies directed to formal education.

Among the proposed environmental policies, the National Curriculum Parameters – PCNs (1998) have been constructed to highlight the importance of the approach of Environmental Education in a transversal and

interdisciplinary manner, pursuing transformation and awareness of the subjects (BRAZIL, 1998; 2002a and 2002b).

Being a widely debated theme, object of study and of interest in the present time, it guides debate and investigation to alert society about the environmental problems, as well as possible consequences for current and future generations.

Accordingly, this paper aims to schematize the legal frameworks that introduced Environmental Education in the policy of Brazilian schools, synthesizing the legislation that guides Environmental Education in the educational system in Brazil.

To achieve this goal, the research uses documents published under the technique of historiographical analysis that uses writings, memories, facts, and historical landmarks of humanity (ARRUDA, 2014; REIS, 2011), having as main focus the study of the trajectory of Environmental Education in Brazil.

Therefore, this material is organized into five topics: the first one making a brief introduction to the theme. It focuses on the emergence of discussions on the environment portraying the paths taken to its effectiveness at school, in addition to the legal frameworks for

Environmental Education, presenting the reader with the relevant legislation, and finally, the national policy of environmental education, showing the primary rules governing Environmental Education in various educational contexts.

## II. EMERGENCE OF ENVIRONMENTAL SENSE AND ACTIONS

At the beginning of civilization, it was a common practice to extract from nature the resources necessary for the survival of humankind. From the mastery of cultivation techniques and domestication of various animal species, this increased its dominance over nature (PÁDUA, 2002).

However, the first questions about the environment arose in the 16<sup>th</sup> century, during the period of great navigations. Preceding studies show that the period of expansion and colonization of new lands has been an unfavorable period for the environment, since large areas of closed forests have deforested for the development of villages, in addition to the exploitation of timber and animals as well (PÁDUA, 2002; FRANCO, 2003; CHIAVENATO, 2005; PERLIN, 1992).

The Industrial Revolution in the 18<sup>th</sup> century generated a division between society and nature (POTT; ESTRELA, 2017). The consumerist conception that raised because of the capitalist production line resulted the first cogitations about man's action on nature.

In 1952, the city of London, cradle of the industrial revolution, was affected by smog, atmospheric pollution of industrial origin that killed thousands of people. Genebaldo Freire Dias comments that this tragedy was the starting point for a series of debates on the environmental quality that culminated in the 1956 Clean Air Act. In the United States, the discussion catalyzed the emergence of environmentalism starting in 1960, which was followed by the reform in the science education, being introduced an environmental issue, albeit in a "reductionist" way (KEROUAK, 1998).

This, however, was not the only environmental catastrophe of the decade. The Japanese city of Minamata experienced in 1953 the effects of pollution by mercury caused by industrial dumping in the worst possible way, and thousands of people suffered from small neurological problems until the birth of babies with genetic mutations, such as anencephaly. This illness known as Minamata disease has only been confirmed in the '60s when it was repeated in Niigata (KEROUAK, 1998).

The fatal cases of mercury poisoning in Minamata and Niigata, between 1953 and 1965, were recorded in the subsequent years and provoked the reduction of aquatic flora and fauna in the American Great

Lakes, with the death of birds caused by the unforeseen side effects of Dichloro-diphenyl-trichloroethane, commonly known as DDT. Along with other pesticides and the large-scale contamination of the sea caused by the wreckage of the tanker "Torrey Canyon", spilling an estimated large amount of crude oil off the south-west coast of the United Kingdom in 1967 (PÁDUA, TABANEZ, 1997).

This set of environmental events was responsible for the awakening of a global society; however, the final straw to the degradation of the ecosystem was the occurrence of the World Wars, particularly the World War I (1914/1918), which caused devastating effects. These effects resulted of the emission of heavy metals and harmful substances being present in landmines or chemical agents spread in the environment through attacks on railways, dams and bridges, resulting in soil, water and air contamination. This caused the decimation of many species with perceptible impact on global biodiversity (CAPRILES, 2003).

However, the development and worsening of environmental problems were evidenced and gained strength after the World War II, with the emergence on the world scene of the confrontation of two major superpowers, viz. the United States of America and the Soviet Union, which imposed their models on underdeveloped countries (ALTVATER, 1995; CAPRILES, 2003; GORE, 2006; HOGAN, 2007; LEONARD, 2011; FREITAS, 2014). Yet, the economic stagnation of the third world has increased the disparity between these countries (SOUZA, 1999; MONTMELLER-FILHO, 2000; MARTÍNEZ-ALIER, 2007), raising a concern about the environment. From these aspects, it arose a new look on education, defined as Environmental Education, proposing an approach that could reach all social levels.

This way, the first discussions on Environmental Education emerged from the construction of social strategies that promoted debates on the problems of ecosystems on the planet due to human actions (UNESCO, 1994).

The term Environmental Education in English was coined during the 1965 Education Conference at the University of Keele in England, although the expression about environmental studies were accessible in the vocabulary of teacher in Great Britain (BOTELHO, 1998).

The establishment of a Society for Environment and Education in Leicester, Great Britain, in 1968 was recommended, and consequently Environmental Education was defined as an education program that should aim to train citizens under whose knowledge of the biophysical

environment and associated problems could alert and enable them to be solved (NEVES, 2006, s/w).

The incipient Environmental Education had the purpose of affecting the society of that time on its duty in the conservation and preservation of the planet's natural resources. Therefore, some upheavals related to environmental issues began to emerge in the '70s, mainly in response to the demands of democratic organizations of peoples in search of their rights to freedom, work, education, health, leisure and participation in defining their own future. It occurred during a time when a series of manifestations have taken place in the world, such as the feminine liberation, the May 1968 student events in France, and the toughening of the political conditions in Latin America, with the advent of authoritarian governments (PÁDUA; TABANEZ, 1997, p. 225-263).

Consequently, several studies (BOTELHO, 1998; NEVEZ, 2006; DIAS, 1991; KEROUAK, 1998; PÁDUA and TABANEZ, 1997; FRANCO, 2003; PERLIN, 1992; POTT and ESTRELA, 2017; MENDONÇA, 2004; LEFF, 1999) date the emergence of militant environmental causes in the educational perspective in the '70s. Thenceforth, the concept tended to evolve and improve, creating several theoretical, epistemological lines of approach of the term Environment and Environmental Education.

Currently, Environmental Education has been developed and understood in two manners (REIGOTA, 1994; 2004). Through scientific bias whose understanding is universal and explicit the consensus about a certain knowledge for the scientific community, and alternatively through the social representations that addresses the way the scientific concepts are perceived and internalized by individuals in their daily lives, being reproduced and practiced. The Environmental Education begins to investigate the good and bad events involving the population and other living beings, problems that led to disturbances in public health and consequent death of people and animals. This is because the way natural resources are being used compromises life on the planet. However, it is noticed the emergence of an apprehension and need of building together with the society some tools and strategies to protect the life of species, a proposal presented by the Environmental Education (MENDONÇA, 2004; LEFF, 1999).

According to Dias (1991), wealth countries have started to debate the environmental issues and scrutinize thinkable solutions. After realizing the lack of resources and the repercussion that this theme was achieving in the international media and was causing global concern, the Governments have decided to protest against the phenomenon. However, until that moment there has not

been any policy directed to the conservation and preservation of natural resources to negotiate with the civil society in an attempt to move governments and the world population on the necessity of a more sustainable consumption (DIAS, 1991).

Consequently, the civil organizations afflicted by the environmental issues in the aftermath of the absence of public policies regulating the use of natural resources became attentive to governments whose sole concern was obtaining wealth from natural environment (MARTÍNEZ-ALIER, 2007). They promoted many manifestations and events with the purpose of discussing the environmental crisis to solve or even minimize the impacts generated by human action.

In 1968, scientists created the so called Club of Rome, targeting the research and proposal of solutions to the problems arising from the increasing consumption of natural resources and population growth, factors that were triggering several inequalities to ecosystem and non-renewable resources (DIAS, 1991). With the report "The Limits to Growth", the Club of Rome made public the impacts that development without planning had caused with the withdrawal of natural resources of the environment, triggering many disparities in the ecosystems (DIAS, 1991).

This paper helped to foster debates at the global level on the need to point out a possible limit of economic and social growth for each country, which has not pleased some leaders, especially the economic powers. This led the United Nations Conference to sponsor the Stockholm Human Environment in 1972, which established a global vision and common principles that would serve as an inspiration and guidance to humankind concerning the preservation and improvement of Human Environment (LOUREIRO, 2006). It was highlighted that in the Stockholm Conference Environmental Education is considered as a field of pedagogical action acquiring international relevance and validity.

The Stockholm Conference commenced on June 5, 1972, with the participation of 113 countries. From then on, this date celebrates the World Environment Day. As an unfolding of the Stockholm Conference, the Stockholm Declaration is sanctioned and considered as a model of proposal for the United Nations to overemphasize and environment-oriented program (LAGO, 2006; MEDINA, 1994). The approved final document stated that man has the fundamental right to freedom, equality and the proper condition of life, in an environment that permits living with dignity, well-being and a solemn obligation to protect and improve the environment for future generations



(Stockholm Declaration on the Human Environment, 1972).

Since then, the discussions regarding the nature of environmental education have been accelerated and the agreements led to the Principles of Environmental Education, established at the seminar held in Tammi (Finnish National Commission for UNESCO, 1974).

This seminar considered that Environmental Education consents the achievement of objectives of environmental protection and it is not a branch of science or subject of separate studies, but of a permanent integral education (PADUA; TABANEZ, 1997).

During the General Assembly of the United Nations (1972), the proposal for the creation of the United States Environment Program (UNEP) was debated with the aim of fostering and coordinating environmental protection actions within the United Nations system, under regional and international levels and government entities, creating a voluntary Environment Fund managed by the program. This platform would give global emphasis to environmental issues through environmental movements, working together with the human rights protection, relating population growth, migrations, gun control, and mass destruction. From this conference, it has emerged a new perspective interconnected to environmental glitches, introducing a change that would result in the insertion of environmental education as a pedagogical proposal (DIAS, 1994).

According to the author (1991), the Stockholm Conference played a key role in implementing Environmental Education programs in the global context and presenting references to nations of the world to reduce to reduce negative impacts on the environment.

Two years after the Stockholm Conference, it was inaugurated the Intergovernmental Conference on Environmental Education in Tbilisi, in the former Soviet Socialist Republic of Georgia, in 2005, which is to this day the culmination of the International Environmental Education Program. In this conference, it was defined relevant objectives and strategies at the national and international levels related to the execution of formal Environmental Education, through the publication of the document titled "La Educación Ambiental", which presented many essential remarks for the development of Environmental Education up the present days.

Hereafter, it was postulated that Environmental Education is a crucial element for a global education oriented to solve problems through the active participation of students, whether in formal or non-formal education, for the welfare of the Human community (PADUA TABANEZ, 1997). Understanding the Environmental

Education as an essential issue in all education segments, it fetches subsidies for countries to develop the learning of Environmental Education in formal education since the first series of elementary school.

### III. PRINCIPLES AND LEGAL FRAMEWORK OF ENVIRONMENTAL EDUCATION

According to Reigota (2009), one of the founding legal framework of Environmental Education in Brazil occurred during the 1972 Stockholm Conference, when the development of educational actions for citizens was established as a priority and a tool to improve would-be solutions to environmental issues. It is considered what is conventionally called an Environmental Education, being referred to by the Intergovernmental Conference in Tbilisi in 1977, which advocates the Environmental Education to be an instrument with reach-to-reach people of all ages and social classes, both in formal and non-formal education.

To achieve this goal, the media have fundamental importance in the Environmental Education processes and the responsibility to put resources in the service of this educational mission. Add specialists in environmental issues and those whose actions and decisions can be perceptible in the environment and should acquire, in the course of their training, knowledge and attitudes necessary to fully understand the meaning of Their responsibilities (INTERGOVERNMENTAL CONFERENCE ON ENVIRONMENTAL EDUCATION, 1977), understanding that environmental education has three basic principles, including the acquisition of new knowledge and values, new standards of conduct and the Interdependence.

In Brazil, the initial milestone of Environmental Education is led by the actions of Brazilian researchers that were influenced by the first international conferences. Among those, stands out Joao Vasconcellos Sobrinho who was known in 1972, when he set out a crusade to restore the Pau-Brazil (redwood) as an environmental heritage.

In 1951, in the city of Santa Teresa, Espirito Santo, the Brazilian ecologist Augusto Ruschi set up a six-month course for teachers, whose name condensed its content, i.e. "Process and conservation of nature and its resources", taught at the Museum of Biology Mello Leitao (DOSTOYEVSKY, 1998).

Dostoyevsky (1998) points out that, long before talking about Environmental Education in Brazil, this subject was taught under some initiatives in various parts of the country; these pioneering experiences were mainly related to Ecology (DOSTOYEVSKY, 1998, p. 35).

By the middle of the '70s, contradicting international trends in environmental protection and ecosystems, the Brazilian Government financially

supported the constructions of big projects, such as Angra dos Reis Nuclear Power Plant, Tucuruí Hydroelectric Plant, Trans-Amazonian, and Carajás Project. These constructions suffered a wave of criticism from international organizations once it was contrary to the proposal of environmental preservation. In response, the Brazilian Government argued that the defense of the environment would be a kind of conspiracy of developed nations to prevent the growth of the country (DOSTOYEVSKY, 1998; QUONTAS, 2000).

In 1977, during the Tbilisi International Conference (1977), considered the landmark of environmental education, Brazil had no official representativeness. However, shortly before this event, a group of specialists was summoned to produce the first official document of the Brazilian Government on environmental issues. Under the responsibility of the Special Secretariat of the Environment and the Ministry of the Interior, the document “Environmental education” introduced principles and objectives for the various social sectors (DIAS, 1994), proposing as a specific objective of the process of Environmental education, create a more harmonious, positive and permanent interaction between man and the medium created by him, on the one hand, and what he did not, on the other. For this, it should be considered the ecological environment in its entirety, involving political, economic, technological, social, legislative, cultural, and aesthetic aspects in formal education. To complete, it was informed that the traditional fragmentation of the knowledge taught through school disciplines considered as watertight compartments could not be maintained (DOSTOYEVSKY, 1998, p. 39).

From these conceptual changes, Environmental issues strengthened in Brazil culminating in the decade of ‘80s with the implementation of the National Environment Policy (NEP) established by Law No. 6938/1981, considered a great achievement. (REIGOTA, 2009, p. 85). This policy aims (article 2) “the preservation, improvement and recovery of the environmental quality, in order to ensure socio-economic development, the interests of national security and the protection of human rights.” (LAW NO. 6938/1981).

Starting with the NEP, a more comprehensive and precise concept of the environment was introduced defining it as “the set of conditions, laws, influences and interactions of physical, chemical and biological order, which allows, shelters and administrates life in its various forms” (UBIRACY, 2001, S/N). It defines among its purposes the preservation, the improvement and the recovering, where protecting means the strategies to maintain the natural state of natural resources, hindering

the intervention of human beings. It tends to improve the environmental quality gradually to become excellent through social meditation, and regain emphasis on the proper management of animal and plant species and ecological resources (ABREU, 1997; QUINTAS, 1999).

Advancing in the theme, eight years later, the Federal Constitution of 1988 sanctions the constitutional right of all Brazilian citizens to Environmental Education. The Constitution, in its article 225, subsection VI, grants the state the obligation to “promote environment education in all school levels and public awareness of the need to preserve the environment”. After that, all Federative States determine the inclusion of the Environmental Education among school themes (THOMÉ, 2012; ANTUNES, 2013). In 1992, after discussions and decisions at the United Nations Conference on Environment and Development, the Ministry of Education and Culture (MEC), in a simultaneous celebration, publishes the Brazilian Charter for Environmental Education that recommended to graduate schools the structured introduction of Environmental Education in the curricula. This has established an essential milestone for the implementation of Environmental Education at higher educational level (BELCHIOR, 2011).

The Directives and Basis for National Education – DBNE (Law no. 9394/1996) mentions Environmental Education, demanding in elementary school the natural and social-ecological understanding of the political system, technology, arts and values on which it is based the society, and the curriculum of elementary and high school must necessarily encompass knowledge about the physical and natural world, in addition to the social and political reality of Brazil (BRASIL, 1996).

The DBNE law defined, amongst other determinations of higher education, the stimulus on the knowledge of the current world with exclusivity of national and regional themes. However, the insertion of Environmental Education for the promotion of a fairer society and a policy tool, as tutored by the 1972 Stockholm Conference, did not happen in a practical way (MANZOCHI; TRAJBER, 1996).

The knowledge of the physical and natural world, as well as the social and political reality, has always been a subject addressed in schools in any modality of teaching, and most of the educational institutions meet the requirement present in the legislation because all offer some curricular component that discusses the natural and physical world. However, the socio-environmental glitches present in the current society indicate that this is not enough to generate a socio-environmental consciousness capable of transforming attitudes, conceiving skills,

developing the sense of participation, among others goals on Environmental Education (TRENNEPOHL, 2009).

Environmental Education is an interdisciplinary process that can promote critical and global understandings through a systematic vision. It is a clarifying methodology for the values of alterity, equity, participation with the promotion of citizenship and environmental awareness, as Medina (2001) reinforces, developing attitudes that allow them to adopt a conscious and participatory position in use of natural resources, aiming at improving quality of life and eliminating extreme poverty and rampant consumerism.

#### IV. NATIONAL POLICY ON ENVIRONMENTAL EDUCATION-PNEA

The need for emergency changes in human attitudes led the Environmental Education to be included in the axis of interdisciplinarity as recognized by Law no. 9795, of April 27, 1999, which established the national policy of Environmental Education, as declared in its article eight: Environmental education, respecting the autonomy of school and academic dynamics, should be developed as an integrated and interdisciplinary, continuous and permanent educational practice in all phases, stages, levels and modalities, and should not, as a rule, be implemented as a specific discipline or curricular component (BRASIL, 2012, p. 70).

Thus, it is understood that Environmental Education is a general commitment, and the care for the environment should be approached in all grades and modality of teaching. According to Santos (2000), public policies should ensure the promotion and inclusion of environmental education at all levels of schooling as reported: The reflection on social practices, in a context marked by the permanent degradation of the environment and its ecosystem, involves a necessary articulation with the production of meanings about environmental education. The ecological dimension is increasingly configured as a question that consists of a set of actors from the educational universe, enhancing the engagement of the various knowledge systems, the training of professionals, and the university community in an Interdisciplinary Perspective (JACOBI, 2003, p. 190).

However, Act no. 9795/1999 defines legally Environmental Education as “the process whereby the individual and the collectivity construct social values, knowledge, skills, attitudes, and competencies focused on the conservation of the environment, as well as frequent use of the people, essential to the sound quality of life and its sustainability” (Article 1).

In addition, it instituted the national environment

Policy (article 6) defining its fundamental objectives, for example, the development of an integrated understanding of the environment in its multiple and complex relationships. This also involves ecological, psychological, legal, political, social, economic, scientific, cultural, and ethical aspects, as well as encouraging individual and collective participation, permanent and responsible, in preserving the balance of the environment. This includes the defense of environmental quality as the unified value of the exercise of citizenship (Article 5).

The new legislation (Law no. 9394, of December 20, 1996) recognizes Environmental Education as an essential and permanent component of national education, distinguishing together with its formal character, non-formal character, i.e., non-official environmental education that was already being practiced by educators, people from various areas of activities and even entities, forcing the government to encourage it in all its spheres (Art. 3 and 13).

This way, we conclude that the national policy on Environmental Education was created and implemented to reinforce Environmental Education and join efforts to promote learning. To achieve this right as an interdisciplinary method, the inclusion of the theme in the National Curricular Parameters (PCNs) emerges, which ensures the transversal, indispensable, and indissociable nature of the Brazilian Educational Policy (FURTADO, 2009, P. 346).

With the publication of the National Curriculum guidelines for Environmental Education and the National Curriculum guidelines for primary school, the Brazilian State recognizes the relevance and the compulsory requirements of Environmental Education in all its stages and modalities (BRAZIL, 2012, p. 70). This characterizes advancement and achievement to work the conservation and preservation of natural resources, thus ratifying Environmental Education as a permanent component of the Brazilian education system. It brings in its scope the principles of theoretical knowledge about the environment, the correlation between the natural, economic, and cultural background, in addition to the diversification of ideas, pedagogical conceptions, and the connection between ethics, education, work, and social practices.

Between 2001 and 2010, the National Education Plan (PNE), after being debated by the social sectors involved in education on the advancement of the environmental issue in the educational universe, was sanctioned and became Law no. 10172/2001, whose objectives and goals for a period of ten years includes in elementary and middle education an environmental education, transversal and developed through integrated,

continuous and permanent educational practice was advocated by Law no. 9795/1999.

## V. FINAL CONSIDERATIONS

The introduction and awareness or environmental consciousness were motivated by a set of global facts and events, which stimulated several social, political, and economic groups and environmentalists for ecological issues that bothered future generations.

The path journeyed until the insertion of Environmental Education as an educational policy reached the formal and informal systems, based on the construction of resolutions in the Brazilian legal and educational system, focusing on the relationship between environment, education, and society.

In this context, analyzing the inclusion of Environmental Education in the educational policy of Brazil, it is perceived that social and political advances that seek to improve and protect the environment for present and future generations.

The legal frameworks for environmental education in Brazil gained momentum with the PNMA/1981 that proposed ordering ecological quality in the country, confirming the constitutional right of all citizens to Environmental Education, advocated by the Federal Constitution of 1988, which granted the State the obligation to promote Environmental Education to all teaching modalities.

Environmental Education should be a continuous process, extending beyond school facilities and considering the environment in its multiple dimensions. Among the key measures adopted by the Brazilian Government, aiming at the quality of teaching and addressing cross-disciplinary and interdisciplinary themes, the National Curricular Parameters (PCNs), a set of documents prepared by Ministry of Education with the cooperation of several specialists and institutions and entities of educational studies and research, which integrates the different disciplines through the approach of related topics and the transversality saturating all areas of knowledge present in Environmental Education seeking to fulfill the role of educating for citizenship and environmental awareness.

The creation of the Act no. 9795/1999 establishing the national policy of environmental education was the maximum point of the proposals for the construction of a sustainable society, using a democratic system to raise awareness of each citizen, inviting him to become an environmental educator in the social context in which it is inserted.

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# A Simple Equation for Stable Coastline between Groins and Between T-Head Groins by taking into account diffracted Wave

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**Abstract**— Coastal protection planning using groin requires information on erosion and sedimentation that will occur at the protected coastal segment. An easy and practical yet accurate calculation method is needed, so that the planning cost is not too expensive.

This research developed a method of stable coastline calculation between groin, which includes erosion and sedimentation that occur during the process leading to stable coastline geometry. The governing equation is formulated using the principle of mass conservation where the volume of sedimentation is equal to the volume of erosion, whereas the boundary condition is that stable coastline is oriented perpendicular toward the wave forming it. Therefore, there are two stable coastline orientation, i.e. stable coastline formed by the incoming wave and stable coastline formed by diffracted wave. Using this method, a very simple and easy to use stable coastline equation is obtained.

The equation is formulated for a coastline with groin protector and a coastline with T-Head groin protector. A comparative study was done for the efficiency between the two structures. Stable coastline that was produced is very simple and easy to use. The result of another study stated that for the similar construction volume, T-Head groin provides a better protection.

**Keywords**— stable coastline orientation, diffracted wave.

## I. INTRODUCTION

The coastal segment located between two groins will evolve toward stable coastline geometry, where in this evolution process, erosion and sedimentation occur. The volume of erosion is determined mainly by the distance between groin and also the length of the groin. If the erosion is too large, it can cause damage to the protected coastal construction, then the protection can be stated as a failure. A large distance between groins will result in a large sedimentation at the upstream groin, so that sand bypassing might occur at the end of the groin. Should this happen, the erosion is getting larger. Therefore, the use of groin in the planning of a coastal protection requires a good estimation on the distance between groin and the appropriate length of groin. As a consequence, a model is needed to predict stable coastline geometry with erosion and sedimentation that occur.

The tangent of the stable coastline is perpendicular to the incoming wave ray. In previous researches (Hutahaean (2019a,b)) this characteristic was done on a point as a boundary condition stable coastline. In this research, a development was done, i.e. the boundary condition of the tangent of the stable coastline was done on all points.

The second development is the execution of tangent boundary condition of stable coastline at the shadow zone (Fig 1). In this area, stable coastline is formed by diffracted wave that is perpendicular to the incoming wave ray. This diffracted wave can form sedimentation at the downstream groin. Van Rijn, L.C. (2014) argues that at the downstream groin there is a sedimentation but with different causes.

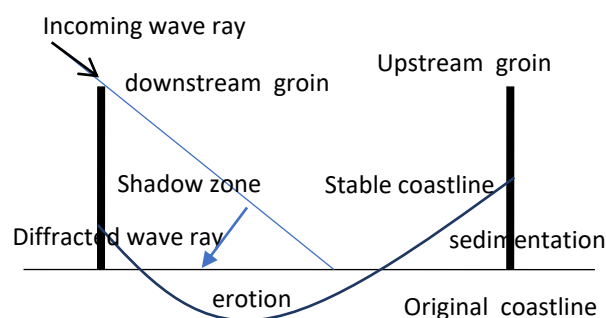


Fig.1. Erosion and sedimentation at the coastal segment located between two groins.

According to Van Rijn, L.C. (2014), as a result of the difference in wave height between the open zone and shadow zone where the wave height in the shadow zone is smaller, there will be a littoral flow toward downstream groin, so that an elliptical littoral flow is formed (Fig 2). This flow carries a littoral drift that is deposited at the downstream groin.

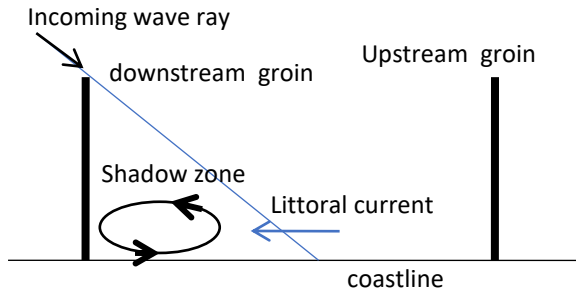


Fig 2. Elliptical littoral current at the downstream groin

## II. STUDY ON THE CHARACTERISTIC OF STABLE COASTLINE

This section will study the characteristic of stable coastline based on longshore sediment transport equation and geometry stable coastline, where the characteristic will become the boundary condition at the formulation of stable coastline equation.

### 2.1. Review on longshore sediment transport formula.

Shoreline change is mainly caused by longshore sediment transport. The equation of longshore sediment transport always uses breaking wave angles as its variable. The followings are the three longshore sediment transport formula.

a. Kamphuis' Longshore sediment transport formula, Kamphuis, J.W. (1991)

$$Q_{ls} = (C_K K_R H_b^2 T^{1.5} m_b^{0.75} D_{50}^{-0.35}) \sin^{0.6}(2\alpha_b) \dots (1)$$

$Q_{ls}$  longshore sediment transport rate,  $b$  = subscript denoting breaking condition; a complete information can be seen at, Kamphuis, J.W. (1991). The concern of this equation is the element  $\sin^{0.6}(2\alpha_b)$ , where  $\alpha_b$  = angle of breaking waves to local shoreline. In this case, if  $\alpha_b = 0$ , the tangent of crestline is parallel or equal to the tangent of the coastline, then  $Q_{ls} = 0$ .

b. Longshore sediment transport of SPM (1984)

$$Q_{ls} = \left( \frac{K_C}{16 \left( \frac{\rho_s}{\rho} - 1 \right) (1-p)} \sqrt{\frac{g}{\gamma}} \frac{H_b^{3/2}}{2.386} \right) \sin(2\alpha_b) \dots (2)$$

Similar to equation (1), the concern is the element  $\sin(2\alpha_b)$  where if  $\alpha_b = 0$  then  $Q_{ls} = 0$ . Complete

information on equation (2) can be seen at Shore Protection Manual (SPM), (1984).

c. Longshore sediment transport formula of Hanson, H., and Kraus, N.C. (1989)

This longshore sediment transport equation from Hanson and Kraus is used at the widely used shoreline change model, i.e. GENESIS. The form of the equation is as follows.

$$Q_{ls} = (H^2 C_g)_b \left( a_1 \sin 2\alpha_b + a_2 \cos \alpha_b \frac{\partial H}{\partial x} \right) \dots (3)$$

In the case of  $\frac{\partial H}{\partial x} = 0$  or is very small, then equation (3) becomes,

$$Q_{ls} = \left( (H^2 C_g)_b a_1 \right) \sin 2\alpha_b \dots (4)$$

In this equation (4)  $\alpha_b = 0$ , then  $Q_{ls} = 0$ . Complete information on equation (3), can be seen at Hanson, H., and Kraus, N.C. (1989).

From the three longshore sediment transport equations, it can be stated that at the stable coastline, the tangent of the coastline is parallel or equal to the tangent of the crestwave that forms the coastline. In an open area where the coast is formed by incoming wave, the tangent of the coastline is parallel with the crestline of the incoming wave, whereas at the shadow zone, stable coastline is parallel with the crestline diffracted wave.

### 2.2. Review on the form of stable coastline.

It has been known that in the nature there is geometrical form of the stable coastline in static equilibrium condition, and there are plenty of researches that have been done on the form of that stable coastline. There are several terminologies for the form of the stable coastline, Silverster, R. (1960) called it zeta bays, half-heart bay Silverster, R., Tsuchiya, Y., and Shibano, Y. (1980), crenulate shaped bays Silverster R, Hsu, J.R.C. (1993), Hsu, J.R.C., and Silverster R., Member et al (1989). The form of the stable coastline, Silverster R, Hsu, J.R.C. (1993), Hsu, J.R.C., and Silverster R., Member et al (1989) studying stable coastline between two headlands are as follows

Stable coastline consists of two parts (Fig.3), i.e. coastline directly facing the incoming wave ( $\overline{BC}$  line) and coastline facing the diffracted wave,  $\overline{AB}$  line. At the segment of the coastline facing the incoming wave, the tangent of the stable coastline is equal to the tangent of the crestline of the incoming wave, whereas at the shadow zone facing the diffracted wave, the tangent of the coastline is parallel with the tangent of the crestline of the diffracted wave.

From the review of the longshore sediment transport equation and the geometry of stable coastline, it can be

concluded that stable coastline has a tangent that is parallel with the crestline forming it.

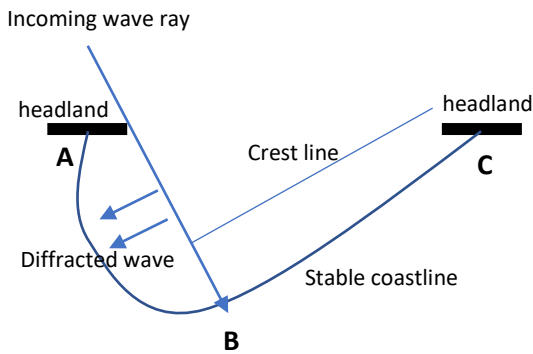


Fig.3. Stable coastline between headlands, Hsu, J.R.C., and Silverster R., Member et.al (1989)

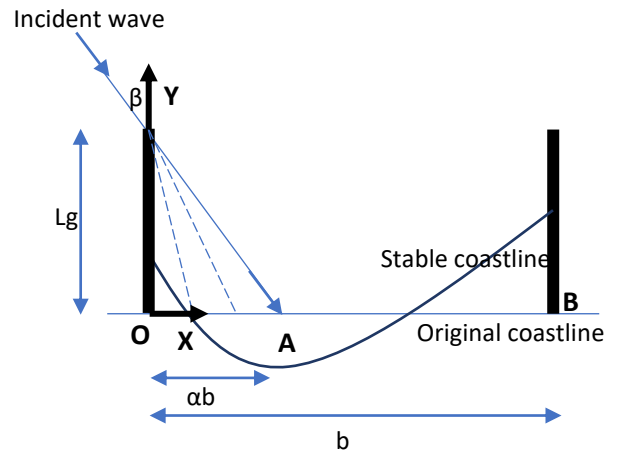


Fig.4. Stable coastline between two groins

For the coastline directly facing the incoming wave, the tangent stable coastline is equal to the tangent of the crestline of the incoming wave, whereas the coastline formed by the diffracted wave will have a tangent that is equal to the tangent of diffracted wave crestline. This condition will be used as boundary condition at the formulation of stable coastline equation.

### III. GOVERNING EQUATION AND BOUNDARY CONDITIONS

#### 3.1. Governing Equation

As is the case in Hutahaean (2019a,b), the stable coastline equation is approximated with quadratic polynomial equation,

$$y(x) = c_0 + c_1x + c_2x^2 \dots\dots(5)$$

$y(x)$  is coastline stable ordinate,  $x$  is an abscissa, where the  $x$  axis coincides with the original coastline (Fig.4).  $c_0$ ,  $c_1$  and  $c_2$  is polynomial coefficient, of which the value should be determined.

With an assumption that there is no sediment that goes in and out of the calculation area, then the volume of sedimentation should be equal to the volume of erosion. By ignoring the porosity of the sand, then the mass conservation equation can be stated as follows.

$$\int_0^b y(x) dx = 0 \dots\dots(6)$$

where  $b$  is the distance between groin (Fig.4). By completing the integration, the governing equation of the stable coastline is obtained, i.e.

$$c_0 + \frac{1}{2}c_1b + \frac{1}{3}c_2b^2 = 0 \dots\dots(7)$$

#### 3.2. Boundary Conditions.

The calculation area consists of two parts, i.e. area directly facing incident wave, i.e. the  $\overline{AB}$  line and shadow zone area directly facing the diffracted wave, i.e. along the  $\overline{OA}$  line where the two areas have different stable coastline characteristic. Therefore, based on the wave, there are two boundary conditions.

##### a. Boundary condition in line $\overline{AB}$

In general, the characteristic of this stable coastline is perpendicular to the incident wave. However, considering that stable coastline is a curve as stated in (5), then the characteristic is not appropriate to be applied only on just one point as in Hutahaean (2019a,b) where the characteristic is represented on a point, i.e.  $\frac{dy}{dx} = \tan\beta$  or  $\frac{dy}{dx} - \tan\beta = 0$ ,  $\beta$  is the incoming wave angle (Fig.4). In this research, the boundary condition of the tangent in the stable coastline is done in all point, i.e. at the part of coast facing the existing incoming wave applies,

$$\int_{x_A}^{x_B} \left( \frac{dy}{dx} - \tan\beta \right) dx = 0 \dots\dots(8)$$

where  $x_A = b - L_g \tan\beta$  and  $x_B = b$ .

##### b. Boundary Condition in line $\overline{OA}$

Boundary condition in this area is equal to the one in area  $\overline{AB}$ , i.e. that stable coastline is perpendicular to the incoming wave; in this area the incoming wave is the diffracted wave that is perpendicular to the original wave i.e.  $(\beta + \frac{\pi}{2})$ , (Fig.3). Whereas the form of boundary condition equation in this area is,

$$\int_0^{x_A} \left( \frac{dy}{dx} - c_d \tan \left( \beta + \frac{\pi}{2} \right) \right) dx = 0 \dots\dots(9)$$

Where,  $c_d$  is a diffraction coefficient. Bearing in mind that the values of diffraction coefficient varies along the  $\overline{OA}$  line then the area is divided into a number of line segments (Fig.4.), hence (9) becomes,



$$\sum_{i=1}^n \int_{x_i}^{x_{i+1}} \left( \frac{dy}{dx} - c_{di} \tan \left( \beta + \frac{\pi}{2} \right) \right) dx = 0 \quad \dots(10)$$

$c_{di}$  is a diffraction coefficient at the center of a segment  $i$ , whereas  $n$  is the number of segment. Therefore, there are three linear simultaneous equations, i.e. Eq.(7),(8), and (10), with three unknowns i.e.  $c_0$ ,  $c_1$  and  $c_2$ . The simultaneous linear equation system can be completed with Gauss elimination system or similar type of method.

Equation (10) can be simplified by using (9), where the average diffraction coefficient is used as the diffraction equation, i.e.

$$c_d = \frac{1}{n} \sum_{i=1}^n c_{di} \quad \dots\dots(11)$$

Where  $c_{di}$  is the diffraction coefficient at segment  $i$ . Using this method will result in polynomial coefficient at (5) i.e.

$$c_2 = \frac{1}{b} \left( \tan(\beta) - c_d \tan \left( \beta + \frac{\pi}{2} \right) \right) \quad \dots\dots(12)$$

$$c_1 = -(1 + \alpha) b c_2 + \tan(\beta) \quad \dots\dots(13)$$

$$c_0 = -\frac{c_1}{2} b - \frac{c_2}{3} b^2 \quad \dots\dots(14)$$

Where,

$$\alpha = \frac{L_g \tan \beta}{b} \quad \dots\dots(15)$$

3.3. T-Head Groin.

The governing equation and boundary conditions for T-head groin are equal to the governing equation and boundary conditions at the groin, only the point A shifted as far as half the length of the head, i.e.  $\frac{t}{2}$  (Fig. 5), where  $x_A = \frac{t}{2} + L_{tr} \tan \beta$ ,  $L_{tr}$  is the length of trunk (Fig.5). The form of the equation coefficient is equal to (12),(13) and (14), where for T-head groin

$$\alpha = \frac{L_{tr} \tan \beta + \frac{t}{2}}{b} \quad \dots\dots(16)$$

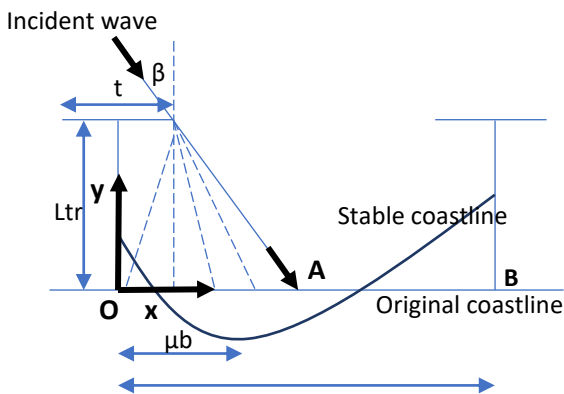


Fig.5. Stable coastline between T-Head groin.

3.4. Diffraction Coefficients

According to Kamphuis, J.W. (1992) diffraction coefficient is, for a point A located at the coastline, where the line  $\overline{BA}$  formed an angle  $\delta$  against the incident wave (Fig.6), then the diffraction coefficient is  $K_d = 0.7 - 0.0077\delta$ , this equation is for a positive value of  $\delta$ , where a positive  $\delta$  is spinning clockwise. Whereas a negative  $\delta$  spins counter clockwise.

$$K_d = 0.7 - 0.0077\delta \quad \text{for } 0^\circ \leq \delta \leq 90^\circ$$

$$K_d = 0.7 - 0.37 \sin \delta \quad \text{for } 0^\circ \leq \delta \leq -40^\circ$$

$$K_d = 0.83 - 0.17 \sin \delta \quad \text{for } -40^\circ \leq \delta \leq -90^\circ$$

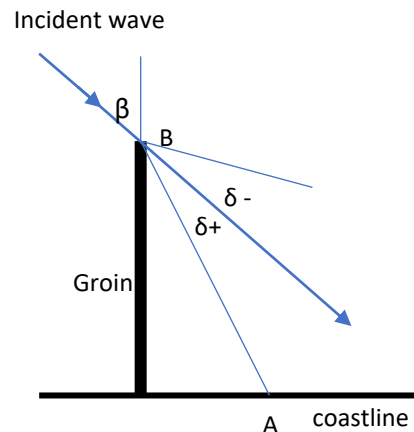


Fig.6. Wave diffraction at a groin

IV. THE RESULT OF THE MODEL

All calculations in this section is done using polynomial coefficients (12), (13) and (14).

4.1. Erosion and Sedimentation at The Coastal Segment B between Groins.

This section studies the erosion and sedimentation at the coastal segment between groins in the process of stable coastline formation. The study was done with several scenarios, i.e. varied wave angel, varied groin length and the distance between groins.

4.1.1. The Study on the Influence of Wave Angel  $\beta$

In this section, the model is done in the distance between groin  $b = 100$  m, the length of groin  $L_g = 40$  m with wave incident angel  $\beta = 15^\circ$  and  $\beta = 30^\circ$ .

Fig.7. shows that the smaller the wave incident angel, the bigger the erosion-sedimentation will occur. Table 1 presents stable coastline condition for several incident wave angel, at a distance between groin  $b = 100$  m, and length of groin  $L_g = 40$  m.

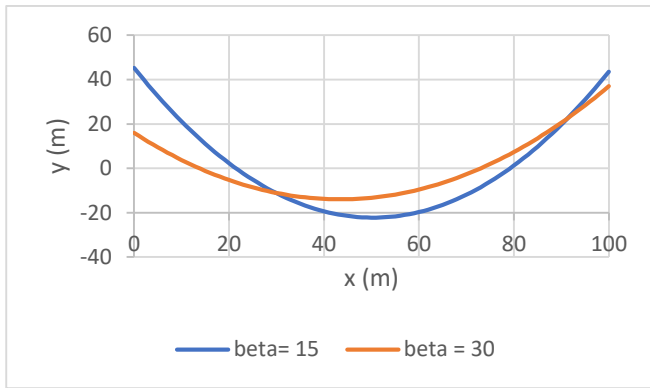


Fig.7. Stable coastline for  $\beta = 15^\circ$  and  $\beta = 30^\circ$ .

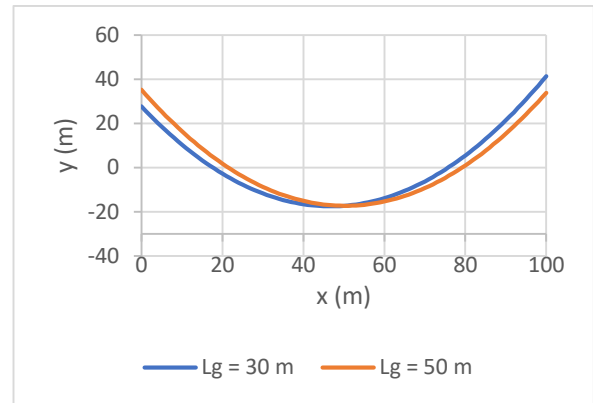


Fig.8. The comparison of stable coastline with different length of groin.

Table (1) shows that the bigger the  $\beta$  the smaller the sedimentation at the downstream groin ( $y_{ds}$ ) and upstream groin ( $y_{us}$ ) as well. Whereas the volume of erosion  $y_{min}$  was initially getting smaller with the increase of  $\beta$  but then it was increasing. Sedimentation at the downstream groin decreases with the increase in wave angel  $\beta$ . Sedimentation at the upstream groin was initially getting smaller with the increase  $\beta$  but then it increases. The position of  $y_{min}$  i.e.  $x_{min}$  is getting closer to the downstream groin with the increase of  $\beta$ . It can be concluded that the dangerous incident wave angel at the coastal segment between groins is a small incident wave angel, where at the coastal water, the angel is getting smaller.

Table 1 Erosion and sedimentation in several values of  $\beta$ .

$\beta$ ( $^\circ$ )	$y_{ds}$ (m)	$y_{min}$ (m)	$y_{us}$ (m)	$x_{min}$ (m)
10	70,5	-32,8	60,43	51,28
15	45,3	-22,21	43,53	50,33
20	31,51	-17,34	37,68	48,51
25	22,46	-14,95	36,24	46,09
30	15,98	-13,94	37,01	43,39

4.1.2. Study on The Influence of The Length of Groin  $L_g$ .

This section will study the influence of the length of groin at the erosion-sedimentation at the coastal segment between groins, with wave angel  $\beta = 20^\circ$  and the distance between groins  $b = 100$  m.

Fig.8 presented erosion and sedimentation that occurred for lengths of groin  $L_g = 30$  m and  $L_g = 50$  m. There is indeed the influence of the length of groin, i.e. the longer the length of groin, the smaller the erosion will be, but with a very small reduction. For a clearer description see Table 2.

The calculation in Table 2 was done with  $\beta = 20^\circ$  and  $b = 100$  m for several values of  $L_g$ , which shows that the longer the length of groin, the sedimentation at the downstream groin ( $y_{ds}$ ) gets bigger, the biggest erosion ( $y_{min}$ ) gets smaller but with a relatively small reduction, with the position ( $x_{min}$ ) that gets closer to upstream groin, whereas the sedimentation at the upstream groin is decreasing. From this phenomenon, a conclusion can be made that the addition of the length of groin is not effective in reducing erosion. It is only needed to prevent sand bypassing at the end of the groin from happening.

Table 2 The influence of the length of groin  $L_g$  on sedimentation and erosion.

$L_g$ (m)	$y_{ds}$ (m)	$y_{min}$ (m)	$y_{us}$ (m)	$x_{min}$ (m)
25	25,84	-17,67	43,35	45,78
30	27,73	-17,52	41,46	46,69
35	29,62	-17,42	39,57	47,6
40	31,51	-17,34	37,68	48,51
45	33,39	-17,3	35,79	49,42
50	35,28	-17,3	33,91	50,33

4.2. Erosion and Sedimentation at the Coastal Segment between T-Head Groins.

This section will study erosion and sedimentation at the coastal segment between T-Head groins at the stable coastline formation. In general, the phenomenon exists in the groin also exists at the T-head groin, i.e. among others at the variation of angel  $\beta$ , the length groin and distance between groins. What will be learned at this T-head groin is the influence of the length of head T and the comparison between groin and T-head groin. The picture of T-head groin can be seen in Fig. 9.

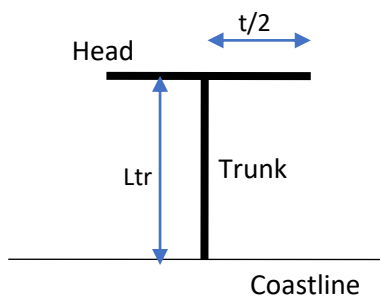


Fig. 9. T-head groin

4.2.1. Study on The Influence of The Length of Head  $\frac{t}{2}$

The model was done at the distance between groin  $b = 100$  m, the length of trunk  $L_{tr} = 25$  m, the length of half the head  $\frac{t}{2}$  varies, with wave incident angel  $= 20^0$ .

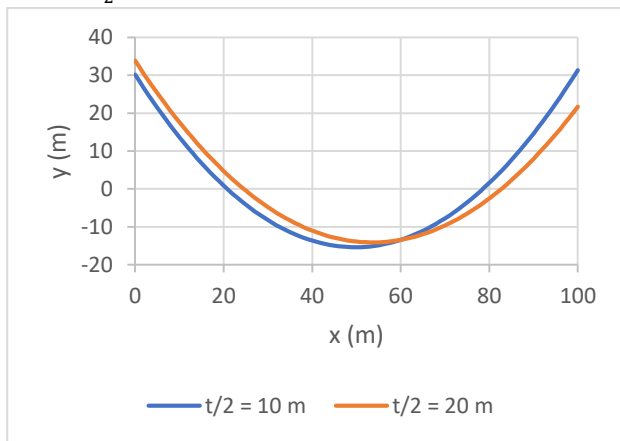


Fig.10. Study on the influence of the length of T-head

As can be seen in Fig.10 that the length of trunk reduces erosion and sedimentation at the upstream groin but increases sedimentation at the downstream groin. The complete result can be seen in Table 3.

Table 3 Erosion and Sedimentation at several lengths of head  $\frac{t}{2}$ .

$\frac{t}{2}$ (m)	$y_{ds}$ (m)	$y_{min}$ (m)	$y_{us}$ (m)	$x_{min}$ (m)
10	30,172	-15,377	31,33	49,686
12	30,911	-15,041	29,236	50,464
14	31,639	-14,746	27,237	51,246
16	32,363	-14,493	25,323	52,034
18	33,092	-14,281	23,49	52,829
20	33,83	-14,109	21,727	53,631

4.2.2. Comparison Between Groin and T-head Groin  
The comparison of construction efficiency was done at the similar construction length, i.e. if the length of groin  $L_g$

and the length of total T-head groin  $L_{total} = L_{tr} + \frac{t}{2}$ , then the comparison was done at  $L_g = L_{total}$ . Fig.11 presents the comparison between erosion and sedimentation between the protection and groin with  $L_g = 40$  m, where the protection with T-head groin,  $L_{tr} = 30$  m,  $\frac{t}{2} = 10$  m. Wave angel  $\beta = 20^0$ , the length of coastal segment  $b = 100$  m. The result of the calculation is presented in Fig.11, where it shows that erosion and sedimentation at T-Head groin is smaller than the erosion and sedimentation at groin.

Furthermore, erosion-sedimentation at groin are compared with erosion-sedimentation at the T-head groin with various length of  $L_g$ , the length trunk is fixed at  $L_{tr} = 30$  m, the length of head  $\frac{t}{2}$  changes where  $L_g = L_{tr} + \frac{t}{2}$ . The result of the calculation is presented in Table 4 which shows that for similar length of construction, T-head groin is more effective than groin.

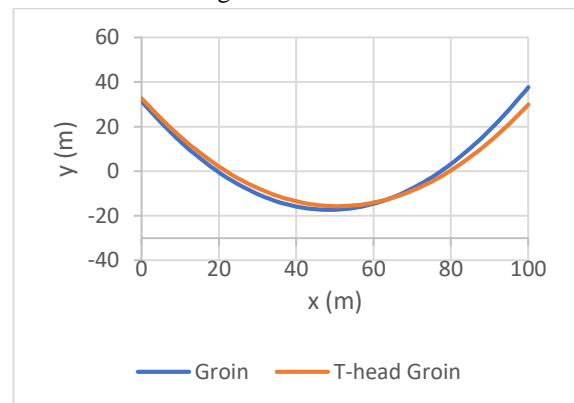


Fig. 11. The comparison of erosion-sedimentation at groin and T-Head Groin

Table 4 Comparison between Groin and T-Head Groin

$L_g$ (m)	Groin			T-head groin		
	$y_{ds}$ (m)	$y_{min}$ (m)	$y_{us}$ (m)	$y_{ds}$ (m)	$y_{min}$ (m)	$y_{us}$ (m)
35	29,62	17,42	39,57	30,45	-16,49	35,4
40	31,51	17,34	37,68	32,82	-15,68	29,87
45	33,39	-17,3	35,79	34,97	-15,1	24,85
50	35,28	-17,3	33,91	37,04	-14,74	20,27

V. CONCLUSION

Stable coastline equation that was obtained in this research is very simple and taking into account diffracted wave. Qualitatively, the model provides a clear description on erosion and sedimentation at coastal segment between

groins, but quantitatively it needs to be studied using physical model data or measurement data.

Study on the comparison between groin and T-head groin obtains that T-head groin provides a better protection than groin.

In this research, sand porosity has not been taken into account where the volume of sand will expand if the sand is inundated with water. The next research that will be done should take into account sand porosity. The inclusion of sand porosity factor can be done in the mass conservation equation.

Another development that can be done is developing numerical model using either finite difference method or finite element method. By using this method, diversity factor can be easily included, such as diffraction coefficient.

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# Maintenance management analysis on electrical equipment of a neonatal ICU in a hospital unit in Manaus, Amazonas

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**Abstract**— This article evaluates the maintenance management of electrical equipment of medical-hospital units in a Neonatal Intensive Care Unit (ICU), with the objective of analyzing the importance and performance of services in the area of medical equipment maintenance, during its implementation in a private hospital in the city of Manaus, Amazonas. In addition it seeks to plan the actions and the systematization, identifying the methodologies that will be applied, to suit the sector. In this context, to demonstrate, especially in the area of maintenance plan management, the importance of an engineering professional in the maintenance management of medical electrical equipments, relating engineering to health.

**Keywords**— *Electrical engineering, clinical engineering, management.*

## I. INTRODUCTION

Electrical engineering uses numerous tools to describe technological processes through the use of energy. It is a science that deals with the studies, applications, research and development of devices or technology process production based on electromagnetism phenomena. Currently, a large number of subareas are also part of electrical engineering, such as control and automation, electronics, telecommunications and similars, seeking to diversify technological knowledge, given this breadth [4].

Thus, the relationship between exact sciences and health sciences is made in an area called clinical engineering, which adopts the techniques of engineering in the management of health equipment, in order to ensure traceability, practicality, quality, efficacy, safety and operation of these equipment, in order to promote patient safety [9].

The maintenance of medical-hospital equipment considers non-interruption of the operation, indicating the availability for immediate use of all Health Care Facility (HCF) appliances, facilities and supplies. HCF's greater responsibilities to its beneficiaries do not tolerate inaccuracies or downtime resulting in serious or even lethal circumstances [21].

When implementing maintenance management in medical equipment, is essential to take into account the importance of the service to be performed and especially the way to manage the execution of this service. It is not enough for a maintenance team to only fix one piece of equipment, it is necessary to understand the level of

importance of the equipment in clinical procedures or in support activities for such procedures [10].

In complex projects should be observed the implementation of equipment control practices, maintenance services, administration from cost prevention and concern with complexity to the equipment. In this context, the importance of the engineering professional in the maintenance management of these equipments is visible, especially regarding the management of the maintenance plans.

Clinical engineering is a branch that operates in health care facilities, enhancing activities based on engineering studies and management for health technologies, emerging as a discipline in the second half of the twentieth century, with Increasing of electronic and mechanical complexity in medical devices, have entered the health environment for preventive, therapeutic, diagnostic and restorative applications [22][14].

In 1989, the Ministério do Bem-Estar e da previdência Social estimated that from 20 to 40% of the equipment in Brazil was inoperative, due to lack of maintenance, and when it was performed, the main responsibility was on the manufacturers and representatives that have monopolized the knowledge about these devices [17].

In addition, the authors cite that other factors also drove the establishment of a niche market for this professional, such as: shortage of trained human resources for the job; lack of equipment documentation; bureaucracy on the importation of parts and equipment testing; lack of cooperation from equipment manufacturers or

representatives regarding the purchase of parts or technical documentation [11].

Somehow, this competence to deal with technical problems also extends to social issues, being necessary in professional practice. In fact, the attitude of thinking and acting needs to receive more attention, especially during vocational training, walking in the direction of forming what can be called a citizen engineer [4]. Therefore the clinical engineer is the specialist who uses the studied engineering methods in the management of health equipment seeking to promote patient safety [9].

The term “maintenance” has its origin in the military vocabulary, whose meaning was “to keep in combat units, the effective and the material at a constant level”. The area of medical-hospital equipment management is also aiming at meeting the various complexities that the hospital environment faces daily, such as technological necessity, legal requirements and the constraints on the economic budget [15].

Collegiate Board Resolution Number 2, of January 25, 2010 advises that health services should develop and implement a management plan for each technology used in the service, including all equipment [6].

Therefore, the objective of the study is to demonstrate the relevance of the engineering professional in the logistics and performance of services in the area of maintenance in advanced medical equipments at a hospital unit, presenting the current structure of the Neonatal ICU, the actions and systematization applied to provide proper operation to the needs of the sector.

## II. MATERIALS AND METHODS

This study has a descriptive character according to the analysis of the maintenance management of electrical equipments in a medical-hospital unit. The scenario of this research was inside of a Neonatal ICU of a large private hospital of the city of Manaus, Amazonas, which was followed by the analysis of the adequacy of the management processes of hospital equipment of the neonatal intensive care unit (NICU), by clinical engineering of that hospital. The data used are the pieces of information from march to august 2019, which was based on the next conditions:

- a) Verification of the updating of the technology park;
- b) The analysis of the introduction of daily patrol;
- c) The execution of the preventive maintenance plan for the medical equipments;
- d) Control analysis of corrective maintenance performed in equipment belonging to the sector, through documentary means;

e) Cost analysis of the effectiveness of maintenance management from the medical equipments.

### 2.1 Equipment Inventory

The inventory presented data about the medical equipments such as: model, serial number, manufacturer, sector location, assets, annual maintenance plan. The methodology was developed to establish improvement criteria, according to the indicators extracted from the elaborated tables, such as: minimum amount of unresolved corrective maintenance, maximum execution of planned preventive maintenance, reduction of the misuse rate and operational failure.

This ICU has 12 beds and a storage room for extra equipment such as a transport incubator and phototherapy equipment from the manufacturer Fanem. In the total of 12 beds there are 62 equipment, each bed has:

- 1) Mechanical fan from manufacturer Maquet;
- 2) Multiparameter monitor from manufacturer Dixtal;
- 3) Neonatal incubator from manufacturer Fanem;
- 4) Infusion pump from manufacturer Lifemed;
- 5) Cardioverter from manufacturer Philips;

The inventory has occurred in two days, generated a document for the registration of each equipment. From these data obtained, plus the information of each equipment, a registration was made in a Microsoft Excel spreadsheet.

### 2.2 Daily Patrol

The daily patrols, lasting approximately one hour, was responsible for the surveys performed in all sectors of the hospital, as a way to prevent problems associated with medical equipment, identifying them during this process. The main purpose of the patrols was to test the mechanical fans, multiparametric monitors, infusion pumps, among others.

During the activity there was also a work of awareness about the use of the equipment, because most of the occurrences founded came from the misuse of the operator. These actions are registered in a specific document (Fig.2), with the activities carried out in that sector, and the responsible technician signs the document, as a guarantee. For each problem founded during the inspection process, the corrective maintenance was performed, identifying it like a service order (SO) reporting the occurrence, the cause of the defect and, the solution.



<b>INTERNAL DOCUMENT: CHEKLIST OF GENERAL PREVENTIVE MAINTENANCE</b>		Code:		
RESPONSIBLE CONTROL AREA: CLINICAL ENGINEERING				
Revision Date: Review: Issue date:				
Unit:	Sector:			
Inspected equipment:				
Model:	Manufacturer:			
Serial Number:	Patrimony:			
Procedure Execution:				
Date:	Start Hour:	Finish Hour:		
General verifications:				
Instructions	OK			Observations
	Yes	No	N.A	
PHYSICAL INTEGRITY AND EXTERNAL PAINTING				
PHYSICAL INTEGRITY OF DISPLAYS				
PHYSICAL INTEGRITY OF (INTERFACE HUMAN MACHINE) IHM				
ON / OFF BUTTON PHYSICAL INTEGRITY				
POWER CABLE CONTINUITY TEST				
INTERNAL CLEANING OF ALL EQUIPMENT				
TIGHTEN OF INTERNAL WIRING CONNECTIONS				
WELDING CHECK ON PCI'S				
CHECK FUNCTIONALITY OF ACCESSORIES				
CLEANING OF ACCESSORIES				
CLEANING ELECTRONIC CONTACTS				
CHECK INDOOR LEAK				
PERFORMING EQUIPMENT SELF-CALIBRATION				
PERFORM EQUIPMENT SELF TEST				
FUNCTION TEST				
OPERATING EQUIPMENT				
_____ Responsible Technician		_____ Responsible Sector		

Fig.3: Preventive Maintenance Checklist

For the type of management, checklists are needed and mandatory, so that there is monitoring and clarity in the evaluation of the activities performed.

2.4 Service Order

The service order records equipment data, reported failure, service to be performed by the technician, the date of entry and exit, and whether parts or components need to be replaced. Equipment that is under warranty, under

contract or in need of maintenance and needs to leave the hospital is also recorded, indicating: the equipment in question, defect presented and dates of departure and return.

A flowchart was used to standardize SO openings and how the employees should proceed with the equipment maintenance (Fig.4).



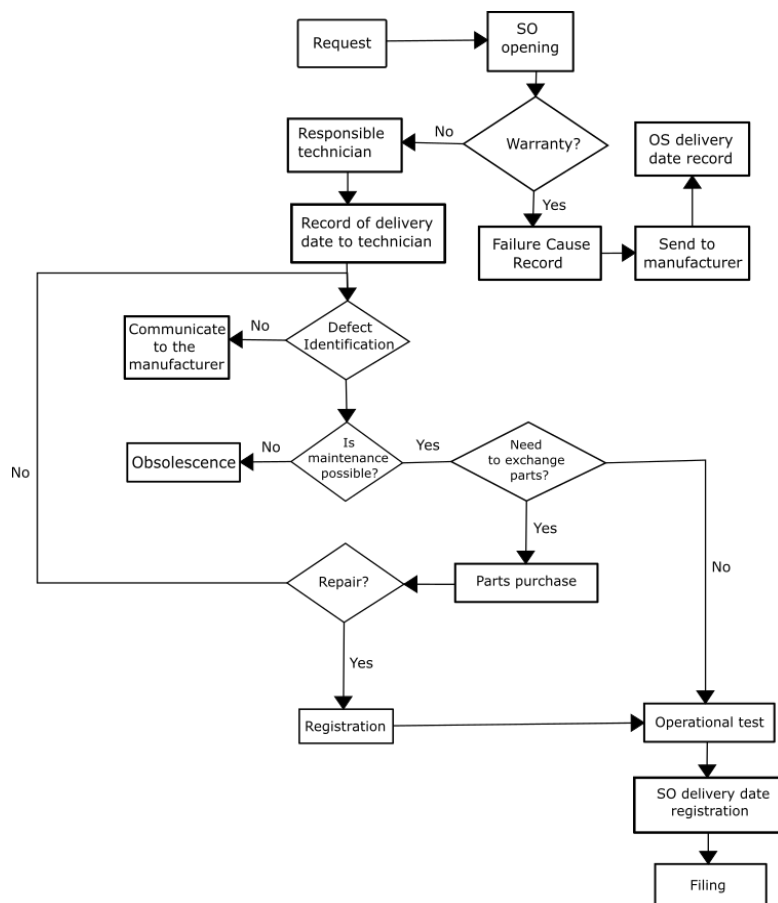


Fig.4: Maintenance flowchart

**III. RESULTS AND DISCUSSION**

It was evident the need to build control practices and equipment maintenance planning in the sector observed, aiming at the standardization of quality and greater safety, leading the hospital to migrate to an effective management process, complying with the regulations of the Brazilian regulatory agencies. All elaborated documentation was based as suggested by the document on hospital medical equipment maintenance and management [10].

Thus, compliance with the maintenance of equipment is expected, as well as schedules, described through the hospital's internal system, with support of a spreadsheet for monitoring, as scheduled. The dates were set in agreement with the nursing staff and medical coordinator of the sector involved, ensuring equipment reliability and optimization, reduced outsourced workforce costs, corrective maintenance and calibration.

Corrective maintenance is simpler to be understood, being applied by the simple act of fixing what is broken, inoperative, unproductive. Meanwhile, preventive maintenance has the purpose of avoid the failure occurrence [23][19].

3.1 Equipment Maintenance History

All events associated with equipment life, from installation to obsolescence disposal, were documented in an organized way and this observation fed the system, forming a history, where reports are generated of each equipment in the sector, describing which services were performed, when performed, and who performed them.

These data were tabulated via Excel, where all events occurred was recorded in the form of SO: corrective, preventive maintenance, replacement of parts, updates, and others, must be filled the largest number of fields with the identification of the register in order to provide speed in equipment demand, including: sector, equipment, assets, and serial number.

Clinical engineering performance monitoring was established through data obtained from OS (corrective and preventive maintenance, patrols and equipment installation), managed through the generated spreadsheets (Fig.5).

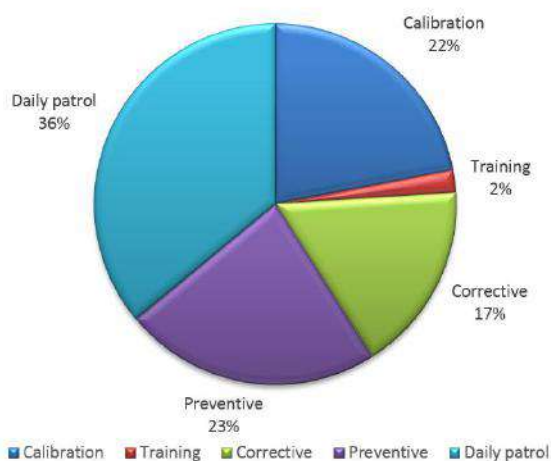


Fig.5: Documented service orders

All maintenance histories are available quickly and affordably, enabling improved management of the operating procedures in terms of accessibility, control and functionality. Therefore, the work order is a propitious tool to manage and control maintenance interventions, because it contains information related to the equipment indicating the description of causes and occurrences in order to help the employee to feed the management indicators. This document is usually adapted to the health facility [5].

340 service orders (SO) were opened and 346 closed, among them: 78 calibrations, 58 corrective, 78 preventive maintenance, 126 daily patrols, 6 training (Fig.6). For the relationship between the corrective maintenance closed by the corrective maintenance open, indicating using eq.1.

$$\frac{\text{Service Orders Closed}}{\text{Service Orders Opened}} \times 100 \quad (1)$$

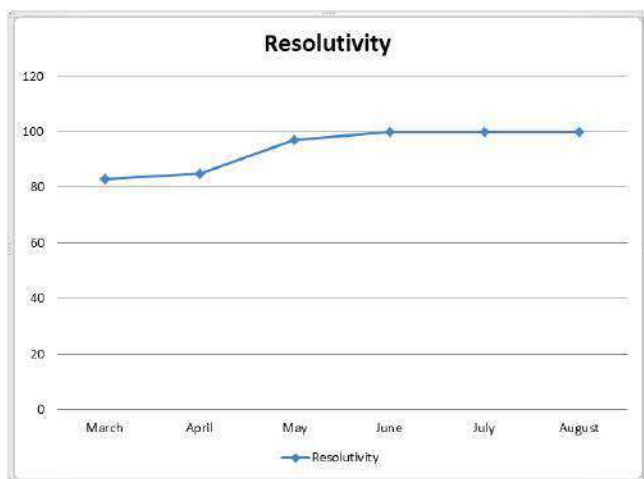


Fig.6: Resolutivity of clinical engineering

This result generated positive responses, causing the resolution in these months to reach and remain above 90%, where it was achieved in the third month of activity, thus leaving no internal issues of this period and previous periods. During the implementation of the maintenance

management of equipment of medical-hospital units, employees began to perform the first service and equipment evaluation, and a goal for corrective maintenance was set (Fig.5), aiming to minimize these demands.

For the effective accomplishment of this process, we have the indicators, parameters of a process that aim to measure quality and quantity in health institutions. These are used to assist in the management and investigation of facts related to hospital medical equipment, to extract the data to make the decision based on critical analysis and action plans, clearing problems, maximize gains and minimize costs of a strategic nature for excellent management [3][13].

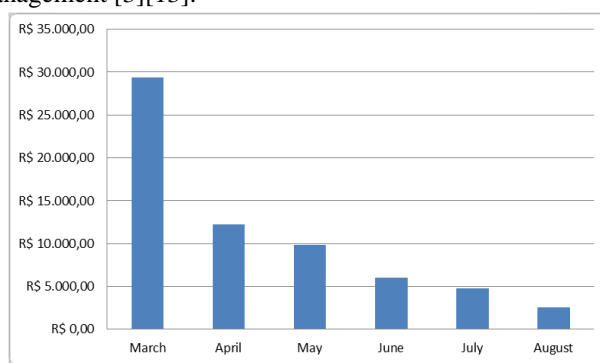


Fig.5: Total cost of corrective maintenance in 6 months of implementation of the management process.

#### IV. CONCLUSION

A methodology was developed to establish improvements according to the analysis of indicators extracted from the elaborated tables, such as: keeping the minimum of corrective maintenance, performing the maximum of preventive maintenance and predicted calibrations, reducing the misuse and operational failure rate and perform the planned training.

Thus, it is concluded that the activities related to management contribute to ensure the best use of medical equipment, having as its main objective the quality of services provided to the institution.

However, we continue to develop actions that serve as parameters for further studies and future adjustments, such as the implementation of management software not only in the Neonatal ICU, but also in all hospital sectors for better quality management, better care, facilitating the control and demonstrating the indicators.

Therefore, it is evident that the hospital management with quality of services provided to the patient, will be better provide the absorption of the data with this work done by the Clinical Engineering in the Neonatal ICU, achieving continuous improvement of the technology park

quality, in order to reach satisfactory proportions, for patient safety and the institution's strategic interest.

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# Environmental Crimes in the Environmental Preservation Area (EPA) Adolpho Ducke in the city of Manaus- AM

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**Abstract** — *The Adolpho Ducke Forest Reserve (RFAD) is an Environmental Protection Area (EPA) located in Manaus-AM covering neighborhoods in the northern area belonging to the peripheral region of the city. This research seeks to show through quantitative data the infractions that occurred in the years 2016 to 2019. Data from the notices of infringements made available by the transparency portal on the IPAAM website were used, describing the crimes that occurred in maps acquired by the IBGE website. Among the years evaluated, 2016 was highlighted with the highest occurrence of environmental crime. It was verified the fragility in the preservation compliance of this area of protection, evidencing the need for a more rigid inspection and control by environmental agencies.*

**Keywords** — *Infractions, Forest Reserve, Environmental Violation.*

## I. INTRODUCTION

The studies in recent years have devoted themselves to the problems caused by the population, both economic and environmental, knowing that they live according to the social conditions of the environment, in a direct link between food production and infrastructure [16]. This search for appropriate social conditions has caused great consequences. The unbridled uses of non-renewable environmental resources lead to biodiversity reduction and increase carbon dioxide levels[25].

Since the 1960s, the Amazon has been in transition from phases, by different uses of land – hunting, deforestation, harvesting and planting –characterized by rural exodus[27]. These authors also claim that the Amazon rainforest is the most biodiverse and extensive rainforest in the world, besides containing most of the planet's freshwater, about 1/6.

Due to the major discussions on environmental protection, the Federal Constitution of 1988, in article 225, ensures that everyone has the right to a balanced environment, commonly used, and it is up to the government to preserve it and defend it for the generations present and future. In addition, in § 1 paragraph III informs that to ensure the effectiveness of this right, the government must "define, in all units of the

Federation, territorial spaces and their components to be specially protected..."[4].

The National Environment Policy in Law 6,938/81 in Article 2 aims to promote the preservation, improvement and recovery of environmental quality, aiming at socioeconomic development and protection of the dignity of human life. Thus, thinking about the protection of fauna and flora, the federal government created the Conservation Units (UC) where they were divided into two groups of Integral Protection and Sustainable Use, where the protection of up to 10% area for each Brazilian biome [3] is established.

In order to achieve the protection objective effectively, the National System of Conservation of Nature (SNUC), promulgated by Law No. 9.985 of July 18, 2000, was created through the three spheres of government (federal, state and municipal), and in its Article 4 item iii communicates the importance of the creation of UC aiming at the contribution of the preservation and restoration of ecosystem diversity in a balanced way[7].

In Manaus, the National Institute of Amazonian Research (INPA) oversees and supports the maintenance of seven forest reserve units in the capital, with an average area of 32,000 ha, and some of these areas have a



physical structure for research development [21]. One of the research areas used by INPA is the Environmental Protection Area Reserve Adolpho Ducke created through municipal decree 1502, of March 27, 2012[24].

Forest fragments are environmental resources essential to the quality of urban life, although these spaces suffer constant threats by environmental degradation and urban growth[23].

Starting from this prerogative, the present study aims to analyze the records of environmental crimes carried out by IPAAM in the period from 2016 to 2019 around the Adolpho Ducke Forest Reserve in Manaus - AM, in order to verify the main causes of crimes and compare the advance on the preservation area.

## II. MATERIALS AND METHODS

### 2.1. Type of study

The approaches adopted in the research were the descriptive and exploratory methods. Studies identify that descriptive research is an exposition of facts and phenomena of reality and relate exploratory research with knowledge of the problem exposed, in order to make it more explicit[14]. This work is classified as qualitative and quantitative, because it uses the understanding and interpretation of data with attention to its meaning [28].

### 2.2. Area of study

The Adolpho Ducke Forest Reserve (RFAD) was established from Decree No. 1502 of March 27, 2012 aimed at safeguarding biological diversity, protecting existing ecosystems, ensuring the sustainable use of natural resources and quality of the lives of the population.

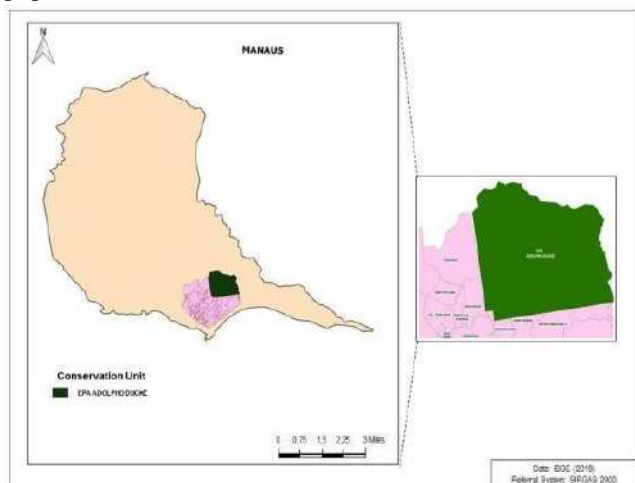


Fig.1: Location map of the Adolpho Ducke Forest Reserve.

According to the National Institute of Amazonian Research, the reserve is located in the Cidade de Deus

neighborhood, north of the capital, in which it is considered one of the peripheral regions of Manaus (Fig.1).

RFAD has about 18,204.8 ha and covers 10,000 ha of humid rainforest, playing the role of bringing the community closer to its surroundings with environmental issues so that they act as collaborators for the protection of biodiversity, promoting the socio-environmental sustainability [2].

DATA from INPA report that the reserve covers areas of the neighborhoods Lagoa Azul, Nova Cidade, Cidade de Deus, Jorge Teixeira, Distrito Industrial II and a part of AM 010 Manaus – Itacoatiara[22]. The unofficial neighborhoods closest to the Ducke reservation are: Communities aliança com Deus, Raio de sol (invasion since 2000); Cidade nova (created in 1996) e Residential viver melhor 1 (2010)[20]. SNUC classifies THE APAs as spaces for planning and environmental management in large areas and that have ecosystems of great importance, coordinating one or more environmental attributes. It is necessary to guide the sustainable use of natural resources, elaborated through participatory processes of society, which result in a better quality of life of local communities.

### 2.3. Data processing

The data in shapefile format, for the development of the location map, were acquired through the IBGE website. As for the files related to the notices of infringements, they were obtained through the Transparency Portal that is on the IPAAM website, such information was arranged in a spreadsheet and organized by municipalities. For data processing, ArcMap 10.5 and Microsoft Excel 2010 software were used.

The geographic coordinate system used for the production of maps was the Universal Transversa de Mercator – UTM and as a reference system the Datum SIRGAS 2000. For the demonstration of the location map of the reserve (Fig.1) in relation to the municipality of Manaus it was necessary to insert different coloring for the main highlighted layers. As for the creation of the points, in order to demonstrate the places of occurrence of the infringements, the New Shapefile tool was used, later the data was entered through the Add Data tool and edited through the editor tool, respectively applying the use of the create feature tool.

Microsoft Excel was used to filter the years and recurring locations of environmental crimes that were in the vicinity of RFAD.

### III. RESULTS AND DISCUSSION

Environmental impacts are classified as the increased human need to gain more space in the environment, devastating in the short, medium and long term. When industrial growth and human activities fail to come to terms with economic progress and the preservation of the environment, they cause environmental violations [11].

A total of 8 environmentally harmful violations around RFAD were filed with IPAAM between 2016 and 2019. Fig.2 shows the types of environmental violations that occurred in neighborhoods that are in the vicinity of the APA.

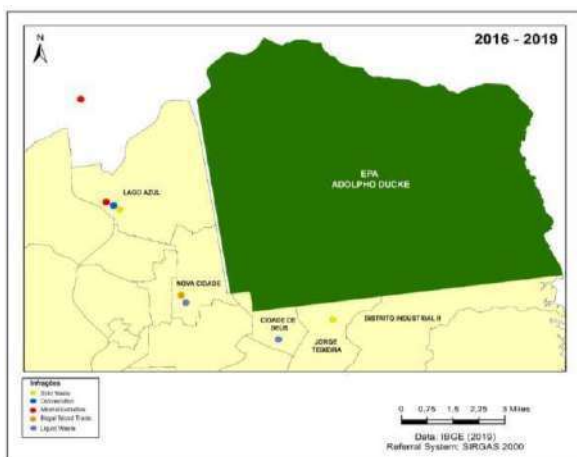


Fig.2: Map of the location of infringements between 2016 and 2019.

Through the spatialization maps of environmental violations, it was observed that 5 different crimes against the environment were recorded, including deforestation, inadequate disposal of liquid waste, inadequate disposal of solid waste, illegal timber marketing and illegal mineral extraction.

It is observed that in the years 2016 and 2018 the crime of illegal mineral extraction was recurrent in the vicinity of the Lagoa Azul Community and on the AM-10 Highway, which connects Manaus to the municipality of Itacoatiara. The extraction of ore in the city of Manaus is due to the technical and socioeconomic feasibility of this resource being applied in activities such as civil construction[12].

It is noteworthy that in the information provided by the agency contained that the users did not have an environmental license, however it is included in the Environmental Licensing Manual of the year 2010[18] of IPAAM that for the performance of this activity it is indispensable that there be the Environmental License, as determined in Law No. 6.938 of 31/08/81[6], State Law No. 3.219/07[1] and CONAMA Resolution 237/97[5].

Also in 2016 there were records of deforestation and dumping of solid waste in place without the authorization of the supervisory body in the Lago Azul Community. One of the environmental problems faced by entities is the fight against the crime of plant suppression without proper environmental licensing, since the removal of vegetation directly influences the loss of the local ecosystem, reduces fauna and flora and with the undue management of the soil, contributes to its erosion [15].

Fig.3 exemplifies the percentage of each environmental crime committed in 2016 to 2019 with the aim of showing the most relevant infractions

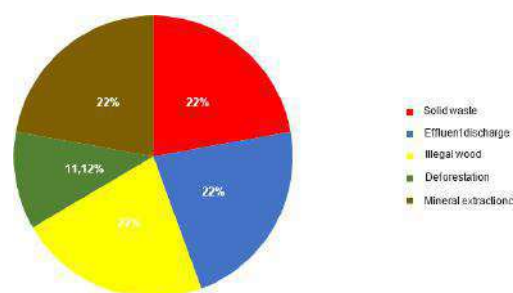


Fig.3: Separate offences by type 2016 to 2019.

According to data obtained, illegal timber offences, effluent dumping, mineral extraction and solid waste have the same amount in the years evaluated, about 22%. Regarding deforestation, it presented the lowest result, being only 11.12%.

It is common knowledge that one of the urban problems is the dumping of solid waste in inappropriate places. Urban Solid Waste (RSU), they are all materials discarded by human activities. Before the acceleration of urbanization, much of the garbage produced was organic matter, being buried in the backyard of the residences[17]. Due to generational change and technology advancement, some materials have become more complex in their decomposition in nature, with the need to raise awareness of their destination.

The sense of 2008 realized by the Brazilian Institute of Geography and Statistics presented data stating that 99.96% of Brazilian municipalities have solid waste management services, on the other hand, their final disposition is 50.75% in leakers, 22.54% in controlled landfills; 27.68% in landfills[3].

In a study conducted in the neighborhood Jorge Teixeira it was possible to identify that this site has garbage accumulation points in some of its main access routes and points out that the residents of the region have a certain knowledge about the aggravating

factors from improper disposal[26]. The authors reinforce that it is necessary to strengthen environmental education practices for these problems to reduce. In view of these data, it is evidenced that inadequate disposal of solid waste is considered a serious problem for the health of the population and brings harm to the environment.

As for deforestation crime, the Legal Amazon in the last 12 months has had about 2,000 km<sup>2</sup> deforested,, these data come from the System for detecting Deforestation in the Legal Amazon in Real Time - DETER , a tool used by INPE[8]. In Manaus the gradual urban expansion is one of the main factors in the decrease in vegetation cover in the North and East zones of the capital. It should be epigraphed that the APA is located along the extensions of the two regions[10].

Fig.4 shows the number of occurrences separated by type of violations committed in the years 2016 to 2019 in neighborhoods adjacent to RFAD.

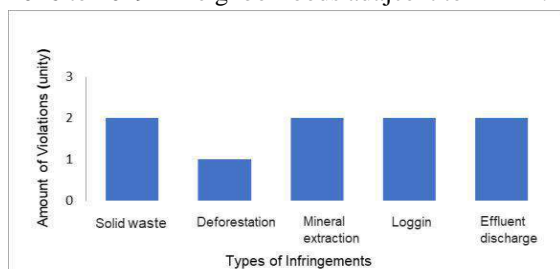


Fig.4: Number of offences identified in the years 2016 to 2019.

Although deforestation violations appear as one of the environmental crimes with low evidence, The recurrent crimes in a UC cated in southern Amazonas deforestation corresponds to 38% of the crimes environmental authorities [13].

It can be observed that Fig. 5 shows a difference in violations detected between the years evaluated. The year 2016 stands out with the highest number of recorded infractions and the years 2018 and 2019 with a smaller number of occurrences.

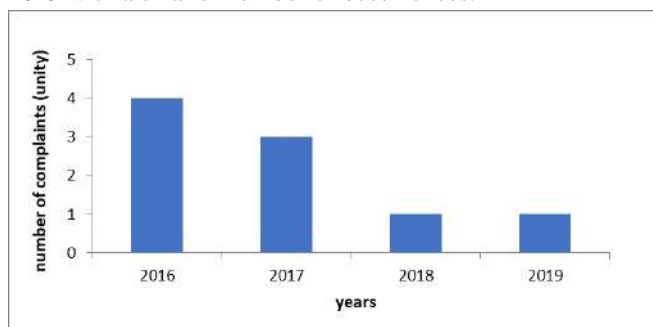


Fig.5: Number of complaints in 4 years.

According to the Specialized Defender's Office in the Environment and Agrarian Issues (one of the departments of dpe – AM), most of the filed reports not knowing, at that time, the practice of environmental crime. It also clarifies that there is a need to strengthen environmental education[9].

We can observe that, in Figure 2, in 2019 only the crime of eviction of domestic effluent without due treatment was evidenced. However, on the official IPAAM website, it informs that in February of that same year, it had disarticulated an invasion called Itaporanga, located in the vicinity of RFAD[19]. In which a devastation was identified on land with demarcated lots and found the removal of wood and the hunting of wild animals. The agency began the year by complying with a series of monitoring of areas with the aid of drones in an attempt to improve environmental surveillance.

The years in which there was a low incidence did not mean that they were exempt from occurrences since the data collected were only complaints recorded in the department responsible for supervising the site. There are communities emerging near the reserve that have not yet been monitored and have no record of violations due to lack of government inspection.

#### IV. CONCLUSION

The environmental protection areas were created with the objective of total preservation of its location and still occurrences were detected around the RFAD unit. Among the period analyzed, the year 2016 was where the most occurrences recorded by ipaam. Offences such as dumping solid waste and mineral extraction were recurrent in the years studied, showing the difficulty in containing population occupation and fulfilling the function of safeguarding the APA.

The article highlights the lack of supervision and control of environmental agencies responsible for these areas, emphasizing the need for preventive actions focused on the population that lives around the reserve, seeking through awareness and education establish joint care between community andstate.

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# Safety Performance in Construction Industry in Dharmapuri Town

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**Abstract**—Although safety management is known to be vital to construction projects, very few studies have solicited views from construction practitioners about their perceptions of which safety management practices (SMPs) are important to construction projects and related to project performance. The suggestion is to improve the safety performance on the construction sites. The government should follow up the safety performance by visiting the construction sites and the insurance company should be more active in visiting the construction sites. The current study focus on site data's collection from the contractors, consultant, and owners by using questionnaire to evaluate the safety performance in the construction sites. In total, there were 40 questionnaires which were distributed to respondents with a response rate of 100%. The results show that there was still a lack of commitment from the government, the insurance company, the labour ministry, the owners, consultants, and also the contractors to improving safety performance on the construction sites.

**Keywords**— construction, safety, SMP.

## I. INTRODUCTION

In the developed as well as developing part of the world, construction industry is considered to be one of the most significant industries in terms of its impact on health and safety of the working population. Construction industry is both economically and socially important.

The major causes of accidents are related to the unique nature of the industry, human behaviour, difficult work site conditions, and poor safety management, which result in unsafe work methods, equipment and procedures. Emphasis in both developing and developed countries needs to be placed on training and the utilization of comprehensive safety programs.

## II. LITERATURE REVIEW

**Yousif Salam Saeed et al. (2017)** [1]. In his study he suggested that the organizations should be more take care about H&S of their construction teams to minimize construction risks to an acceptable value. Companies should prepare employees before starting construction work and provide them with relevant information to identify risks to avert risks on their Health & Safety. Contractors should encourage workers to follow Health & Safety instructions. Moreover, organizations through worker supervisors can reduce Health & Safety risks by providing worker supervisors for each team/ group of workers engaged in different places within the same projects, especially in large projects. The worker supervisors should have sufficient experience and

knowledge to encourage the workers to carry out their works safely.

**Kashiwagi (2004)**[3] in his research in the USA proposed that quality performance and safety issues are not a construction or engineering issue, but a business issue of supply and demand. This \$4 million research programme at Arizona University provides evidence that the owner (and not the construction industry) has more impact on the level of construction performance. It concludes that the relationship between the owner's approach to construction and the level of performance (quality and safety, on time, and on budget) is driven by the ability of the owner to efficiently demand performance. If the owner out sources construction properly, by passing the risk of performance to the contractor, the contractor is more likely to send highly trained personnel who can perform on the project (and who are safe). The construction industry's performance has shown that when the owner identifies minimum standards, contractors have supplied the minimum level of performance. This research shows that when the owner properly identifies and demands performance through correct outsourcing, the level of performance of construction is extremely high.

**McDonald & Hrymak (2002)**[2] stated that it is too easy to comply with legal requirements through having a paper system, which does not effectively operate in practice. This report argues that safety management systems should be audited to assess the effectiveness of

safety management systems; the duties of the safety officer should be strengthened, while operational management of health & safety should be measured and held accountable. They showed the strongest relationship with safety compliance. They recommend that all sites should have a safety representative and their role and functions should be reinforced as part of the safety management system.

**Brabazon et al, (2000)**[4] in his paper mentioned that incidents of life threatening respiratory diseases in the construction industry for the period between 1996 and 1999 are estimated to be about 200 to 300 per annum. When compared to the total number of fatal injuries due to accidents in construction industry over the same time period and allied to the probable under reporting of occupational ill health, the number of fatalities in the construction industry due to ill health probably exceeds those due to injury.

**Langford et al. (2000)**[5] in their studies found that when employees believe that the management cares about their personal safety, they are more willing to cooperate to improve safety performance.

### III. OBJECTIVES AND METHODOLOGY

#### OBJECTIVES

- 1) To realize the real safety problems that occurs in construction industry
- 2) To assess any factors that predicts good safety performance.
- 3) To assess any patterns or trends in safety management in Constructionists.
- 4) To make recommendations to the construction on industry based on the Results.

#### METHODOLOGY

- 1) Collection of Literatures
- 2) Site Visits.
- 3) Questioner preparation and distribution to clients, Contractors, Owners and Engineers.
- 4) Based on Score, Data is analysed through Microsoft Excel
- 5) Recommendations and Conclusions.

### IV. QUESTIONER SURVEY

#### SCAFFOLDING

The observational items that were measured under this category were

- 1) Scaffolding on sound footing
- 2) Base-plate & sole boards
- 3) Platforms properly supported
- 4) Scaffold tied properly

- 5) Ladder access provided

#### HOUSEKEEPING

The observational items that were measured under this category were:

- 1) Scaffold base free of rubbish
- 2) Lifts free of rubbish
- 3) Materials stored neatly & safely
- 4) Access routes & stairways rubbish free

#### PERSONAL PROTECTION EQUIPMENT

The observational items that were measured under this category y were:

- 1) Workers wearing safety footwear
- 2) Workers wearing safety helmets
- 3) Workers wearing Ear Protection.
- 4) Workers fall arrest equipment worn where appropriate

### V. RESULTS & DISCUSSION

#### RESPONSE AMONG THE OFFICIALS

There are five most popular and efficient construction companies are participated in the questionnaire. All these companies are located in and around the Dharmapuri town. They are SWASTIK Construction PVT, ARTIC Engineers PVT, OM SAKTHI Constructions, BALAJI GREEN Buildings, VETRI Constructions. Participated in the questionnaire are four types of the respondents such as Owners, contractors, consultants, and engineers 40 questionnaires have been distributed and the response rate is 30 % of the Contractors, and 22% of consultants, and 10% of the Owner, and 38% of Engineers, response rate among respondents. All the Type of the respondents executed many projects at the last three years.

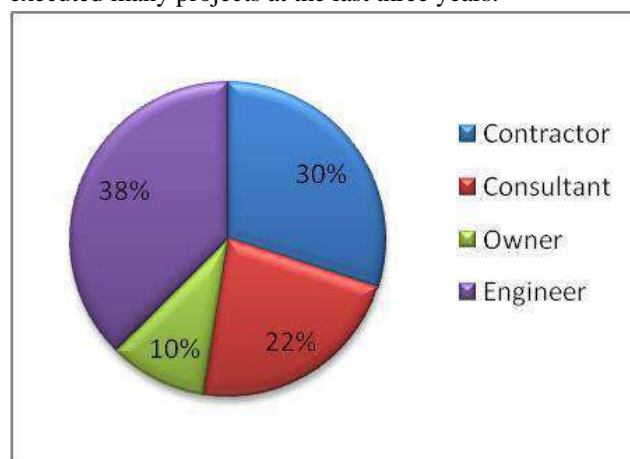


Fig.1

#### Scaffolding Braced properly

Out of 40(100%) respondents, 5(12.5%) respondents mention that Scaffolding braced properly are in excellent condition, 16(40%) respondents mention that Scaffolding

braced properly are in good condition, 9(22.5%) respondents mention that Scaffolding braced properly are in fair condition, 7(17.5%) respondents mention that Scaffolding braced properly are in Poor condition, and 3(7.5%) respondents are mentioned no.

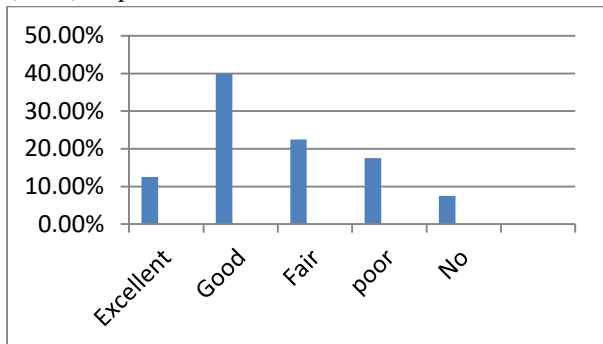


Fig.2

**Scaffold lifts Free of Rubbish**

Out of 40(100%) respondents, 6(15%) of respondents mentioned that Scaffold lifts are free of rubbish are Excellent, 14 (35%) of respondents mentioned that Scaffold lifts are free of rubbish are good, 8(20%) of respondents mentioned that Scaffold lifts are free of rubbish are fair, 8(20%) of respondents mentioned that Scaffold lifts are free of rubbish are Poor, 1(2.5%) of respondents mentioned that scaffold lifts are free of rubbish are worst, 3(7.5%) of respondents mentioned no.

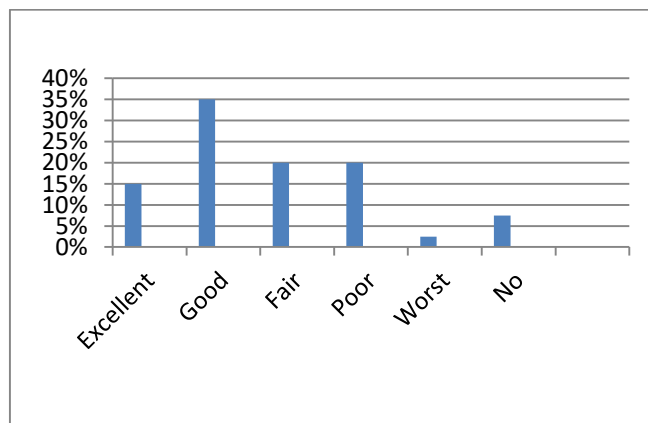


Fig.3

**Eye Protection**

Out of 40(100%) respondents, 6(15%) of respondents mentioned that All are wearing eye protection is Excellent, 4(10%) of respondents mentioned that All are wearing eye protection is good, 11(27.5%) of respondents mentioned that All are wearing eye protection is fair, 8(20%) of respondents mentioned that All are wearing eye protection is Poor, 3(7.5%) of respondents mentioned that All are wearing eye protection is Worst, 8(20%) of respondents mentioned no.

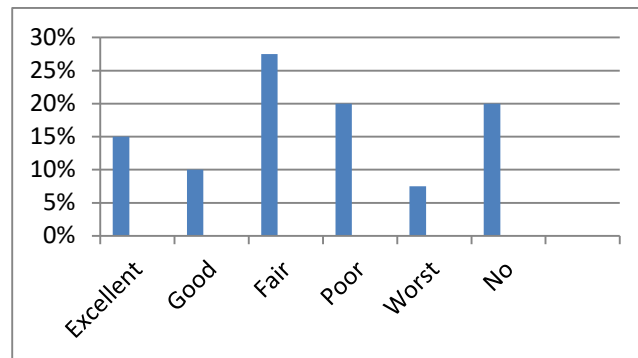


Fig.4

**VI. CONCLUSIONS AND RECOMMENDATIONS**

**CONCLUSIONS**  
From this Thesis it is noted that there was no detailed record for the size and number of accidents, as the data available only showed the real injuries. Management carelessness, lack of safety officer and safety culture were the main reasons contributed to the increase of rate of accidents in the construction sites.

Several recommendations are suggested here on the role of each party involved in construction projects, including the insurance companies, the owners, the Consultants and the contractors.

**THE INSURANCE COMPANIES**

The insurance companies should visit construction sites to monitor the safety.

**THE OWNERS**

The owners should control and mentor the contractors and consultants by giving safety training to workers, promoting safety culture in the construction site and by making sure that the consultants inspect the safety of the tools used in the construction sites.

**THE CONTRACTORS**

The contractors should train the workers, promote the safety culture for workers and educate them on how to avoid the risk and use the equipment properly in the construction site.

The contractors should prepare the regular safety meeting during the work in the construction site.

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# Home automation as a tool to Management household Electricity Consumption

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**Abstract**— This article presents a feasibility study to use home automation as a tool to manage and reduce household electricity cost. It is a result obtained after checking different academic's research articles about domotics and the perception that there is a gap when it is related with home automation systems that perform the management of energy resources. To many academic's researches talk about the comfort provided by home automation, but a few about managing and optimizing the use of energy resources. At the end, some points and suggestions for future research are raised to complement this article.

**Keywords** — *Domotic, Home automation, Energetic efficiency, Temperature sensor, refrigerator.*

## I. INTRODUCTION

Besides being associated with the productive potential and representing the society's hold, the electricity consumption is an important indicator of economic evolution. Therefore, in order to increase a nation's growth, well-being and wealth, it is essential a correct and appropriate consumption planning [1].

However, the constant electricity consumption increase has been indicated as one of the main responsible for environmental problems, such as greenhouse gas emissions and natural resources degradation [2].

According Brazilian Energy Research Company, Brazil's energy consumption increased by 1.2% in 2017, ranking among the 10 largest electricity consumers in the world, reaching 467 TWh. Consuming 29% of all electricity produced, the residential sector is the second largest consumer in Brazil, behind only the industrial sector. In a scenario where electricity production and consumption are environmentally impactful, current consumption patterns must be improved through more efficient and conscious use of this resource [3]

On the other hand, man always looking for ways to do his daily tasks quickly, efficiently and with minimal effort. Wheel's invention in the early days of our existence in order to reduce the effort to move things around and hydraulic mill for flour production in the tenth century are examples of our constant search to facilitate the day-by-day activities [4].

With technological advancement, repetitive and tiring tasks, which were executed by man on industries, stated to be performed by machines. In order to improve the quality of life and comfort, automation has also started to be introduced on people's daily tasks. In this scenario, home

automation has become increasingly true in modern society. For the first time, it became possible to interact with automated environments even from a distance, due of internet and devices technologies progress [5].

However, most of the academic work focuses on the convenience, comfort, and safety afforded by home automation without indicate the energy consumption management that can be done through it. Cost saving and rational use of resources are the main reasons for home automation growth on Brazil during the last years. Based on it, makes sense invest in home automation not only for comfort, safety and convenience, but mainly to reduce electricity costs [6]

## II. THEORICAL REFERENCE

Domotic term was coined to refer home automation, and originated from the word "domus", which in Latin means "home" with robotics. By definition, automation is a system or method whereby it is possible to realize and control housing resources, making use of the multidisciplinary combination of many specialties such as electricity, mechanics, psychology, telecommunications, computing and medicine which reflects on quality life of residents and users, generating comfort, safety, leisure, communication and energy saving, with sustainability and effective use of resources [7].

Although the earliest automation records have arisen in antiquity (such as the waterwheel, for example), it was during the industrial revolution and with the electricity trade that automation gained prominence and over the years began to employ home automation concepts. However, the automation used in industries is much more complex than that used in homes, being necessary develop

specific and simpler technologies for residential environments [8].

The earliest home automation records date back to the late of 1970s in United States, where the first Power Line Carrier (PLC) modules came in and home's power line were used to send and received PLC. Although simple, these solutions were used to remotely turn on some equipment types or lights, but with no communication between them [9].

In 1975 a technology called the X-10 emerged on market. With this technology and from the first time, lighting devices and equipment could establish communication with each other. In the 1980s, PC automation software based on this technology was launched. Then in the 1990s the use of X-10 technology became quite popular because for the first-time people could have access to a technology previously used only by industries [8].

Today there are several home automation systems, but none of them have a communication standard defined. Only recently has the KONNEX protocol emerged in order to become the standard protocol adopted in home automation [10].

To have an adequate experience based on wishes, needs and conditions, there are several elements involved in home automation process, from simple sensors to complex automation centers. However, all projects must have some basic elements such as Sensors, Actuators, Bus Interfaces and controllers [11].

Besides converting physical quantities into electrical signals, sensors are devices that detect stimuli by measuring, monitoring, and converting these stimuli into a value that can be manipulated by computer systems. The sensors are responsible for collecting and forwarding information to controllers about event and subsequently send the appropriate commands to actuators [11].

Actuators are devices that receive commands from the controllers to activate equipment, converting electrical, hydraulic or pneumatic energy into mechanical energy. They are drive modules, connected between electrical network and equipment [12].

The physical environment responsible for data transfer is called Bus. Basically, there are 03 ways to transport information [13].

Powerline – The use of this technology to data transfer has minimal impact regard to physical changes since the housing power grid is reused by home automation system;

Cable – May be more wasteful and require a greater investment especially in existing housing. However, the use of cable ensures greater stability and immunity to external interference, as well as providing high data

transfer speeds; Wireless – Similar to powerline, has minimal impact with physical changes on housing to be installed, but it is subject to external interference and variation in data transfer speed.

Interfaces are devices or mechanisms that allow user to view information and interact with system. Interface examples are internet browsers, remote controls, panels, switches, etc.

Microcontrollers have a processor, memory, input and output peripherals, timers, serial communication devices and other devices, all within a single chip. They are the natural result of technological advancement and complexity digital circuits increased, on the other hand they are simple, inexpensive and compact, used and widespread in worldwide [14].

Home automation systems can be divided into centralized and distributed. On centralized system it is used a single central unit that controls the entire system, from information gathering to system supervision. In the distributed system, there are several devices with information processing capabilities that talk to each other [15].

Between 1995 and 2011, household energy consumption increased 77% from 63,000 GWh to 112,000 GWh, an average rate of 4.2% per year. This growth is directly related with income Brazilian improvement and consequent household electronics growth, has well as increased access to the electricity grid in rural areas [15].

Energy planning in Brazil has always sought to expand supply looking at consumption growth. However, the power generation expansion capacity has shown signs of decline in recently years, as new generation plants require high investments in addition to generating social and environmental impacts, either in the flooding of large areas or in the displacement of local communities [16].

According statistical yearbook of electricity [3] households' electrical consumption is almost 29% of all energy generated in the country. In addition, consumption has been growing year after year driven by the improved purchasing power of the Brazilian population, which reinforces the need to adopt means that can help manage and optimize the way of electricity is used.

	2013	2014	2015	2016	2017	Δ% (2017/2016)	Part. % (2017)*	
<b>Brasil</b>	<b>463.142</b>	<b>474.823</b>	<b>465.708</b>	<b>461.780</b>	<b>467.191</b>	<b>1,2</b>	<b>100</b>	<b>Brasil</b>
Residencial	124.908	132.302	131.190	132.672	134.308	1,1	28,8	Residencial
Industrial	184.685	179.106	169.289	155.214	167.308	1,3	35,8	Industrial
Comercial	83.704	89.840	90.768	87.673	88.292	0,5	18,9	Comercial
Rural	23.455	25.571	25.899	27.366	28.136	3,2	6,0	Rural
Poder público	14.653	15.355	15.196	15.096	15.052	-0,3	3,2	Public Sector
Iluminação pública	13.512	14.043	15.333	15.035	15.443	2,7	3,3	Public lighting
Serviço público	14.647	15.242	14.730	14.969	15.196	1,5	3,3	Public service
Próprio	3.379	3.205	3.394	3.355	3.277	-2,3	0,7	Own use

Fig. 1: Electrical energy consumption by sector in Brazil

As Fig2, most of the electricity consumption is concentrated in air conditioning, refrigerator, lamps and TV, where the four groups account for 88% of all consumption in a residence in the northern region.

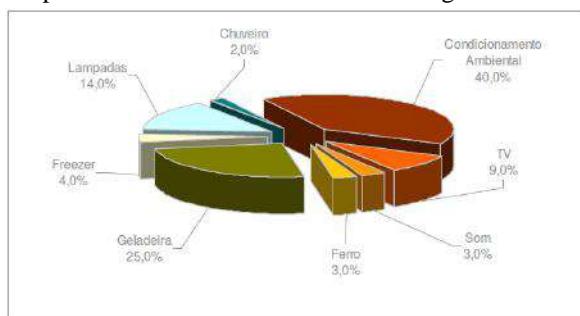


Fig. 2: Residence electricity consumption, north region.

Appliances are responsible for most of the monthly electricity consumption in a home. Making equipment energy efficient will lead to a decrease in electricity consumption in the residential sector.

Currently there are two strategies for achieving energy efficiency: The first one through changing consumer habits by programs and policies that encourage rational energy use and the second through new technologies [17].

Air conditioning is responsible for the most share of energy consumed. Therefore, it is essential that temperature control is effectively performed, since a one-degree increase in temperature provides savings of around 7% in electric power [18].

The refrigerator is the second largest responsible for household consumption, and just as the air conditioner must have an effective temperature control, ensuring that not freeze food outside the designated compartment for this activity, which characterizes waste of energy.

By to the popularization of LED's lamp, values have been dropping which makes the use of this technology increasingly accessible to the entire population. For this reason, we will not address the use of lighting technique in this article.

The objective of this article is to analyze the process of home automation as a tool to manage the power consumption in electronics with greater impact on the bill such as refrigerator and air conditioning.

### III. MATERIALS AND METHODS

To do this article was used in the research the qualitative method. This type of research involves qualitative and quantitative methods, in order to obtain an understanding and broader subject studied explanation. According to [19] the qualitative method aims to interpretatively analyze the data and information obtained in natural setting and in a non-quantifiable manner in order

to understand the attitudes, motivations and group's behaviors. As [20], this method deals with the phenomena's explanation and allows to analyze the concrete data, deducing the constant, abstract and general elements.

According to [21] the quantitative method uses different statistical techniques to quantify opinions and information for a specific study and comes to understand and emphasize logical reasoning and information that can be measured about human experiences.

This study deals with a literature review, focusing on research about what has already been published in home automation area and energy saving in refrigerators.

Electricity consumption in households has been rising over the years, doing constant electricity bills increases. However, the solution to consumption growth lies not only in generation growth, even though necessary and strategic.

According Brazilian Association of Energy Conservation and Services Companies, about R\$ 12.6 billion is the negative balance of electricity waste in Brazil. Almost of this total, around R\$ 5.51 billion, is residential consumer type [22].

Waste losses of "460,000 GWh are estimated in four years (sufficient to meet the country's demand in one year) [23]. In this scenario, home appliances are the largest consumers of energy and are responsible for the increase in the electricity bill. Even though it is impossible to stop using them, it is important to act strongly in reducing their consumption.

According to [24] energy efficiency is the act of rationally and efficiently using energy to achieve a result and is the relationship between the amount of energy employed in this activity and that available for this performance.

It is observed that the consumption of electricity in the homes is more accentuated in appliances for refrigeration, indispensable in the daily's life population. It is true that over the years and with technological advancement, these objects have become more efficient, consuming less electricity, but still they have a great economic impact on household income and home automation can help to manage, control and reduce consumption.

The refrigerators are turned on 24 hours a day, often freezing products more than necessary and wasting electricity. This is directly related with the mechanical control made by a factory preset thermostat and allows only the measurement and thermal control functions, being inaccurate and having a high response time.

According to [25], temperature sensors are commonly used by computers and other electronic devices to prevent overheating. Furthermore, electronic thermometers are



thermostats that keep the temperature constant through voltage control, turning device on or off whenever necessary.

Whether to ensure food quality stored in a refrigerator or the temperature of a boiler in a chemical process, temperature control is related with lots of measure in our daily lives. [26]

One way to improve the energy efficiency of refrigerators is using an electronic thermostat. In addition to accurately measuring and controlling the temperature, the electronic thermostat allows to program and time actions such as minimum, maximum temperature and compressor trigger intervals.

Using a refrigerator with the following manufacturer information (consumption 36.6kWh; compressor EMU40CLP 1/8 hp). (1) summarizes that:

$$1CV = 735,5W \rightarrow \frac{1}{8}CV = x$$

$$x = \frac{735,5W}{8} \rightarrow x = 91,93W$$

Based on calculation, the compressor uses approximately 100W of power. Also, according refrigerator and compressor consumption information, it is possible to calculate the compressor cycle time in 10 minutes. In other words, compressor runs for 5 minutes and shuts off for another 5 minutes.

Table 1 – Compressor cycle time use

Compressor cycle time calculation			
Variable	Compressor cycle time ON	Compressor cycle time OFF	Total
Minutes	5	5	10
Hours	12	12	24
Month/ Hours	360	360	720
Month consumption (Wh)	3600	0	3600

Analyzing above information, the power electricity is consumed only when the compressor is on, during 50% of the time. The rest of the time the compressor is off and therefore without consuming electricity. In one month, the compressor runs for 360 hours. By applying (2):

$$\text{Consumption} = \text{time(h)} \times \text{power (W)}$$

$$\text{Consumption} = 360h \times 100W$$

$$\text{Consumption} = 36,6KWh$$

The monthly consumption is the same as reported by the refrigerator manufacturer on label.

Using the national average household electricity consumption in 2017, which was 134.368Wh (Figure 1), the consumption of 36.6kWh is equivalent to almost 27% of the monthly consumption in a household, which confirms the data collected on Figure 2.

According to [24] Using an electronic thermostat can improve the operating cycle time of the compressor, reducing the compressor cycle time on interval and increasing the compressor cycle time off, impacting the electricity cost because the actuation and reaction time on electronic thermostat is much smaller as well as more accurate and efficient.

Also, an electronic thermostat can last longer than the refrigerator’s life, which, according to the BBC, ranges from 10 to 16 years. A mechanical thermostat has an estimated service life of between 3 and 5 years.

In addition to energy savings, the use of an electronic thermostat can extend the life of the refrigerator since reducing the compressor’s cycle time on, working less and therefore last longer. Therefore, the cost of the electronic thermostat can be deducted from maintenance that will not be performed in the refrigerator during its useful life.

For this study we used a small refrigerator used in a low-energy home. In larger homes or commercial establishments with various equipment such as freezers and refrigerators, the savings can be quite significant. In addition, AI (artificial intelligence) can be used to monitor refrigerator operation, indicating non-standard spikes and warning the user when something is wrong (such as a forgotten open door or insulation problems) because during this kind of occurrence, a drive peak out of the normally will happen. When the compressor is started out of normal use, the system warns the user by message, alarm or any other chosen way. Also, using AI can even make decisions such as turning off the refrigerator to avoid unnecessary expenses.

#### IV. CONCLUSION

This study made possible to better analyze the use of home automation as a tool to manage and reduce the electric energy expenses in the refrigerators. As any technology, there are advantages and disadvantages but has proven effective and the results are very encouraging, although implementation costs are still high.

Despite the clear advantages and benefits of the electronic thermostat, industries are unlikely to adopt it in their products due to the cost being slightly higher comparing with mechanical thermostats. In addition, the use of the electronic thermostat would extend the life of the compressor and other components, which would result

in fewer new equipment being sold, thereby reducing the profits of large companies through planned obsolescence.

Analyzing the management of electricity consumption in homes was important because makes room for further studies to be done in other electronics such as air conditioners and lamps, being a suggestion for future articles and research.

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# Critical Software Processes Tailoring and Very Small Entities (VSE): A Literature Review

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**Abstract** — Aligned with the worldwide trend of developing using small teams, most of the critical software has been developed by small organizations, which demand a particular attention to establishment of process approaches suitable for them. Although there are many software standards, the majority of them do not specifically aim the needs of organizations such as Very Small Entities (VSEs). Standard processes are usually tailored based only on the software criticality, and so researches have been conducted about the effects of project characteristics on software processes and how to use them for processes tailoring. For systematically determining software processes, they need to be defined according to projects' characteristics and objectives. This work provides a review on project evaluation, process profiles, identification of factors which impact software processes, tools for classifying VSE software projects subject to processes tailoring. Results show the review organized in topics that surround the research objective, presenting the critical software and VSE scenario. Critical software and VSE standards comparison indicated that these processes present similarities, representing opportunities to use them complementarily. Accordingly, the projects' criteria selection is a means to support the understanding of the influence factors for critical software projects in VSE context and, furthermore, to develop a notion on adequate tailoring. A systematic approach can be helpful in the VSE context. Suggestions for future research are proposed based on the results.

**Keywords**— Software, evaluation, process, tailoring, VSE.

## I. INTRODUCTION

At present the objective of obtaining quality software products has led to the need of carrying out good software processes selection, for which a systematic method is an important aspect. This work explores the fundamental elements of the process selection, tailoring criteria and project evaluation.

Software development can be difficult and resource-consuming (Wieggers, et al., 2013). Therefore, managing its development activities in an organization is usually accomplished by introducing techniques, tools, best practices and process models (Naur, et al., 1969). According to SEI (2010), organizations should direct their efforts to three critical dimensions of the software development process: people; procedures and methods; tools and equipment.

For the three critical dimensions, standardization is a significant instrument for increasing quality and communication among stakeholders during conception, planning and implementation of projects, while it also helps to reduce risks and costs associated, making business more profitable as less time is spent on non-productive work (Yilmaz, et al., 2016).

Because product quality improvement is typically achieved by improving their processes, standards have been published by committees, international technical entities or regulatory agencies to influence software development through guidelines for processes and products considering their associated risks (Munch, et al., 2012). Software processes have the potential to be highly complex (Clarke, et al., 2016) and may be subdivided into tasks and activities. A **process** is a set of related activities performed for a particular purpose or outcome (like develop and maintain software products); a **task** is an action with inputs and outputs, which may be a requirement (must), recommendation (should) or permission (may); and an **activity** is a set of tasks (ISO, 2015).

Projects tailor software standard processes to develop their own defined processes, which account for the unique characteristics of the project. This tailored process is referred to in the Capability Maturity Model (CMM) as the project's defined software process, comprising a coherent, integrated set of distinct software engineering and management processes (SEI, 2010).

Standard processes typically cannot be used without customization, a tailoring (Ginsberg, et al., 1995), and

although the need to tailor software processes to specific project requirements is widely accepted, the way of doing it is frequently unclear (Kalus, et al., 2013). The European Cooperation for Space Standardisation (ECSS) (2017a) and National Aeronautics and Space Administration (NASA) (2017) recommend tailoring their standard processes based on the software criticality level (ECSS, 2017b), and it is under responsibility of each organization to eventually select other criteria to indicate the risk that the project is prepared to take and the extent to which the processes are made applicable. Research (Kalus, et al., 2013) has been conducted on the effects of project factors for the resulting software process and how to use this knowledge to choose the ones to be considered for processes tailoring.

Process tailoring needs to be performed in a thoughtful and disciplined manner. Interpreting the standard terminology (i.e. documents, processes, activities, tasks, roles and artifacts) in such way that each organization understands is not a trivial task. Tailoring the selected processes to the project specificities requires criteria for evaluating the relevance of the activities to the overall project needs. The subset of applicable processes selected through project classification can vary, depending mainly on factors such as type, size, complexity and phase of the project being addressed.

Since the set of all possible software is very large, a set of processes suitable for use by all potential organizations and projects would be either excessively general or complex, and also difficult to apply. Consequently, different initiatives have taken place considering the software environments.

The objective of this research work is to perform a literature review on approaches for process selection applicable to critical software projects in Very Small Entities (VSE). The literature review aims to compare the VSE practices to the more consolidated critical software literature, and to explore the systems complexity environment where both intersect, by reviewing concepts related to identification of specific criteria that influence software projects and their implications on processes considering the typical resources limitations of VSE.

## II. METHOD

Research method comprises bibliographic research with qualitative analysis for background and studies review. Background review comprises two topics: VSE and software criticality. And, complementarily, studies review can be grouped also in two topics: critical software processes tailoring and software process in VSE. The research outline is shown in Fig. 1.

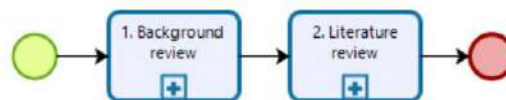


Fig. 1: Research outline

### 2.1 Background review

The *Background review* provides the foundation to situate the context to which this work has been addressed, comprising two topics: VSE and software criticality.

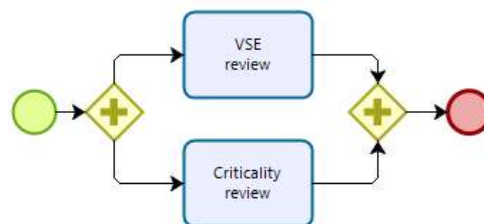


Fig. 2: Background review

In this work, the VSE contents come from ISO/IEC 29110; and, for software criticality, from ECSS material, which is based on ISO 9000 family of documents (which addresses various aspects of quality management), as well as on *ISO/IEC/IEEE 12207 - Systems and software engineering – Software life cycle processes* (an international standard for software lifecycle processes) and *ISO/IEC 15504 - Information technology – Process assessment*, also termed *Software Process Improvement and Capability dEtermination (SPICE)* (derived from ISO/IEC 12207 and from maturity models like CMM). The main sources of standards material are:

- ECSS-E-ST-40C. Space Engineering - Software.
- ECSS-Q-ST-80C-Rev.1. Space product assurance - Software product assurance.
- ECSS-Q-HB-80-02-Part1A. Space product assurance – Software process assessment and improvement – Part 1: Framework.
- ECSS-Q-HB-80-02-Part2A. Space product assurance – Software process assessment and improvement – Part 2: Assessor Instrument.
- ISO/IEC. (2011a). ISO/IEC 29110-4-1 - Software engineering — Lifecycle profiles for Very Small Entities (VSEs) — Part 4-1: Profile specifications: Generic profile group.
- ISO/IEC. (2011). ISO/IEC TR 29110-5-1-2. Software Engineering - Lifecycle Profiles for Very Small Entities (VSEs) - Part 5-1-2: Management and engineering guide: Generic Profile Group: Basic Profile.



2.2 Studies review

The studies review comprises identification and a synthesis of the papers with greater intersection with the topics of interest. According to Pai et al. (2004), the core five steps of a systematic review process are: (i) review question formulation; (ii) a comprehensive search; (iii) studies evaluation; (iv) results synthesis; and (v) results analysis. Fig. 2 presents the systematic review process.

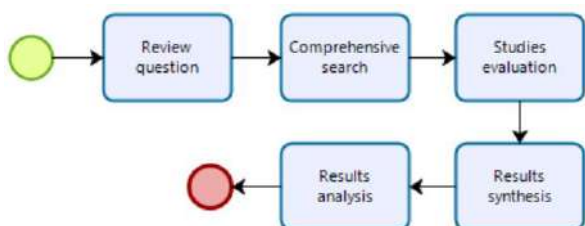


Fig.2: Studies review

Because systematic reviews are time-consuming, when a decision to conduct a review is made, the first step was to formulate a clear, focused question and prepare a protocol. The PICO (Population/Problem, Intervention, Control/ Comparison and Outcome) framework is often used to identify the four critical parts of a well-built research question. The protocol should specify the population (or the topic of interest), the intervention (or exposure) being evaluated, the comparison intervention (if applicable), and the outcome. (Higgins JPT, 2011) A focused question will help in conducting more specific searches of databases, and also in creating unambiguous criteria for selecting studies. TABLE 1 shows the PICO framework for this review.

Table 1: PICO framework

	Description	Keywords
Population/ Problem	Software processes tailoring	Process, tailoring
Intervention	Critical software processes in VSE	critical, small entities
Control/ Comparison	ECSS system + ISO/IEC 29110	ECSS, 29110
Outcome	Identification of initiatives on processes tailoring for critical software in VSE	-

Based on TABLE 1 contents, the research question was: “What initiatives have been proposed for critical software processes tailoring in very small organizations?”

The search was performed on the selected databases: “Science Direct”, at [www.sciencedirect.com](http://www.sciencedirect.com) and “IEE

Xplore”, at <https://ieeexplore.ieee.org/Xplore>, conducting searches using multiple, alternative terms combined with the Boolean operators “AND” and “OR” for the keywords from the PICO set. Using “OR” for each keyword explodes the search and make it highly sensitive (likely to yield thousands of results), while using AND dramatically narrows the search.

The search strings, defined using combinations of the keywords and extended by adding the term “software”, were used in the title, abstract and keywords fields, focusing on exploring works in the field of software process published since January/2000, including journals and conference proceedings.

III. RESULTS AND DISCUSSION

3.1 Background review

The first topic presents the VSE fundamentals and related practices. The second topic presents concepts about software criticality based on the perspective presented by ISO and improved by ECSS.

3.1.1 Very Small Entities (VSE)

The term “very small entity” (VSE) has been defined by ISO/IEC JTC1/SC7 Working Group 24 and subsequently adopted for use in the ISO/IEC 29110 process lifecycle standard as being “an enterprise, organization, department or project having up to 25 people” (ISO/IEC, 2011b). They have important significance in contributing with valuable products and services as they represent a large majority of enterprises worldwide (Moll, 2013). Because of their size, VSEs differ from larger organizations, with most of the management processes performed more informally and less documented (O’Connor, et al., 2010).

Even though most of the space software has been developed by small groups (Lahoz, et al., 2015), most of the software development Standards do not specifically aim the needs of small enterprises (O’Connor, et al., 2010), a scenario that demands particular attention with establishment of process approaches suitable for small organizations.

For many small software companies, it is a major challenge implementing controls and structures to properly manage their software processes (Larrucea, et al., 2016), and the lack of formalism in their processes may have negative consequences, such as missing important activities and tasks, or having limited ways to demonstrate their quality and be recognized in their domain, consequently they may be put aside from projects (Rodríguez-Dapena, et al., 2017).

ISO/IEC 29110 series of International Standards and Technical Reports objectives to assist and encourage very small software organizations in assessing and improving their software processes (O'Connor, et al., 2011a). Their approach (O'Connor, et al., 2011b) relies on the concept of ISO standardized profiles (SP) making use of pre-existing international standards, such as the software life cycle standard ISO/IEC/IEEE 12207 and the documentation standard ISO/IEC/IEEE 15289. Relevant elements from those standards have been selected to compose subsets of applicable processes, referred to as VSE profiles, targeted to specific project types. The profiles are gathered in profile groups according to the classification of software projects, proposing a progressive approach that addresses most VSEs not involved in critical software development.

ISO/IEC (ISO/IEC, 2016) International Standards and Technical Reports were developed according to the characteristics and needs of VSEs. Beyond size, other factors may affect a profile preparation or selection, such as: Business Models (commercial, contracting, in-house development, etc.); Situational factors (such as criticality, uncertainty environment, etc.); and Risk Levels (Laporte, et al., 2008). Producing one profile for each combination of these factors would result in an unmanageable set of profiles. Consequently, VSE's profiles are grouped in such a way to be applicable to more than one category.

A profile group is composed by elements related by composition of processes (i.e. activities, tasks), by capability level, or both (O'Connor, et al., 2010). The Generic profile group, chosen as reference for this work, comprises a collection of four profiles (Entry, Basic, Intermediate, Advanced), proposing a progressive approach to satisfying most of VSEs as it does not imply any specific domain (ISO/IEC, 2011a).

The four profiles from the Generic profile group are:

- **Entry Profile:** targets VSEs working on small projects (e.g. at most six person-months effort) and for start-up VSEs that do not have significant experience with large software development projects, and so do not attract contract jobs from larger software firms.
- **Basic Profile:** describes external or internal projects of a single application by a single team with no special risk or situational factors. To use this Profile, the VSE needs to fulfil basic entry conditions, e.g. documented project statement, feasibility analysis performed, training personnel and infrastructure available.
- **Intermediate Profile:** describes the management of more than one project in parallel with more than one work team, comprising processes to

identify opportunities, evaluate all agreements or requests from customers for fit with organisational goals and resources, obtain and provide necessary resources to perform, monitor and evaluate all projects.

- **Advanced Profile:** targeted at VSEs wanting to sustain and grow as an independent competitive system and/or software development business. For that it contains processes to move software in an orderly, planned manner into the operational status such that the system is functional in the operational environment, appropriately handle replaced or retired elements, and to attend critical needs (e.g. per an agreement, per organisational policy, or for environmental, safety, and security aspects).

### 3.1.2 Criticality

IEEE (2002) describes software “whose failure could have an impact on safety, or could cause large financial or social loss” as critical. According to (ECSS, 2017b), if a software error has the potential to cause human lives loss or other major or catastrophic consequences, the software is designated as Safety Critical Software (SCS).

Critical software can be found in several diverse standard regulated environments, such as: Aerospace, Aeronautics, Medical, Railway and Nuclear. Software developments in these different areas must consider specific factors such as type of software product, role of software in the system, size of the system and level of risk. Software is found from top system functions down to firmware, including safety and mission critical functions, presenting different types of risks according to the variety of possible consequences of a failure in their different environments. (Marques, 2016)

Critical software main reference of processes is ISO/IEC 15504 (superseded by ISO 330xx series), also known as SPICE (Software Process Improvement and Capability dEtermination), which is based on the Process Reference Model (PRM) from ISO/IEC 12207. ECSS definitions are considered for the development of the present research, because the contents of the model defined in ECSS-Q-HB-80-02, called SPICE for Space (S4S), extend SPICE by adding processes and indicators related to specific RAMS (Reliability, Availability, Maintainability and Safety) requirements (*Fig. 3*) from ECSS standards, to ensure that software is developed to perform properly and safely, meeting the project's quality objectives.



Fig.3: S4S contents

ECSS standards present the criticality definition based on the severity of failures consequences (ECSS, 2009), as described in TABLE 2, where, for each software product type described in the right column, a correspondent criticality category is assigned in the left column, based on the highest criticality of the functions implemented by the software and the existing system compensating provisions. According to this classification, software of criticality category A, B or C is defined as critical; consequently category D denotes non-critical software (ECSS, 2017a).

Table 2: Software criticality categories definition

Criticality category	Definition
<b>A</b>	Software involved in category I functions AND: no compensating provisions exist
	Software included in compensating provisions for category I functions
<b>B</b>	Software involved in category I functions AND: at least one of the following compensating provisions is available: - A hardware implementation - A software implementation; this software shall be classified as criticality A - An operational procedure
	Software involved in category II functions AND: no compensating provisions exist
	Software included in compensating provisions for category II functions
<b>C</b>	Software involved in category II functions AND: at least one of the following compensating provisions is available: - A hardware implementation - A software implementation; this software shall be classified as criticality B - An operational procedure
	Software involved in category III functions AND: no compensating provisions exist
	Software included in compensating provisions for category III functions
	Software involved in category III functions AND: at least one of the following
<b>D</b>	Software involved in category III functions AND: at least one of the following

	compensating provisions is available: - A hardware implementation - A software implementation; this software shall be classified as criticality C - An operational procedure
	Software involved in category IV functions AND: no compensating provisions exist

Source: Adapted from (ECSS, 2017a)

The software criticality category (A, B, C, D) is assigned based on safety and dependability aspects, considering the severity of the eventual failure of the most critical function it implements (ECSS, 2017b) as shown in TABLE 3.

Table 3: Function criticality description

Severity	Function criticality	Criteria
<b>Catastrophic (Level 1)</b>	I	A function that if not or incorrectly performed, or whose anomalous behavior, can cause one or more feared events resulting in catastrophic consequences
<b>Critical (Level 2)</b>	II	A function that if not or incorrectly performed, or whose anomalous behavior, can cause one or more feared events resulting in critical consequences
<b>Major (Level 3)</b>	III	A function that if not or incorrectly performed, or whose anomalous behavior, can cause one or more feared events resulting in major consequences
<b>Minor or Negligible (Level 4)</b>	IV	A function that if not or incorrectly performed, or whose anomalous behavior, can cause one or more feared events resulting in minor or negligible consequences

Source: adapted from (ECSS, 2017b)

### 3.2 Studies review

The number of publications identified by using the presented criteria is shown in TABLE 4.

Table 1: Search results – Reference date: 07/Nov/2019

Search string	Science Direct	IEEE Xplore
software AND process AND small entities	267	137
software AND ECSS OR 29110	13	68
software AND small entities AND tailoring AND process	54	10
software AND critical AND small entities	138	36
<b>Total</b>	<b>472</b>	<b>251</b>

As TABLE 4 shows, the initial search run on Science Direct returned 472 papers and on IEEE Xplore returned 251 papers in total. After a review of titles, duplicate and irrelevant papers were removed and the abstracts review resulted in the selection of 30 publications for further analysis.

After reading completely the selected publications, the data extracted was summarized in this section, divided into two main topics: Critical Software Process Tailoring and Software Processes in Small Entities.

The first topic presents the critical software processes tailoring fundamentals and current limitations analyzed through an historical perspective and according to topics of interest for this research. The second topic presents methodologies and best practices related to software processes in small entities.

### 3.2.1 Critical Software Processes Tailoring

As software development organizations' needs may vary according to multiple factors, any process model to be implemented should be capable of dealing with their differences. Although comprehensive top-down prescriptive models such as CMMI and ISO/IEC 15504 (SPICE) have been used (Gorschek, et al., 2006), literature reports that these so-called heavy models and their evaluation methods are considered expensive by small organizations (Cater-Steel, 2004) (Laryd, et al., 2000) (Johnson, et al., 1997) (Kelly, et al., 1999) (Villalón, et al., 2002) (Schoeffel, et al., 2015), which is related to these models not being extensively deployed and their influence in software industry remains more at a theoretical level (Laporte, et al., 2015).

SPICE initially had several limitations. Routa et al. (2007) reviewed the evolution of the Standard and the parallel achievements of the SPICE Project and the standardization effort in advancing the state of the art in process assessment and improvement. Their work presents the significant advances in understanding of the nature of

process capability and its evaluation that have been made possible through SPICE, although it does not present the processes.

Because software malfunctions due to poorly written requirements may cause financial loss, Vérias et al. (2015) proposed a benchmark, with 3 checklists to assess the quality of space software specifications, providing a simple and effective way to identify weaknesses and maturity degree of requirements documents. The checklists were applied to telecommand and telemetry software in the Requirements Definition phase.

In (Bujok, et al., 2016) standards from different domains are mapped revealing the presence of common requirements and the potential for the identification of a "Common Core" to be used as a unified framework, addressing the need to comply with multiple international standards regulations in safety critical domains.

Studies have proposed criteria other than criticality for tailoring development processes, mainly related to the variables used for software effort estimation (Kalus, et al., 2013), also demonstrating the correlation between software quality metrics and aspects such as team skill (Wang, et al., 2006).

Kalus & Kuhrmann (2013) present a Systematic Literature Review about criteria for software process tailoring, comprising the dependencies between different criteria and their influence in the software process, concluding that the consequences of the criteria usage remain abstract and are to be interpreted on a project-per-project basis. Their set of 49 project factors that influence software processes tailoring is organized and presented, comprising the names and brief descriptions of project factors categorized in: team - characteristics of the people involved in the project; internal environment - organizational aspects of the project's entity; external environment - context where the project takes place; objectiveness - product related features.

Pedreira, et al. (2007) conducted a study about the current practice in software process tailoring, concluding that existing approaches for process tailoring are defined in specific environments, and that a general framework should be developed. The idea of a generic systematic framework is corroborated by (Xu, et al., 2008), that present an investigation about software projects challenges based on interviews, concluding that tailoring affects the software process and environment, and that excessive tailoring can undermine process repeatability and consistency.

Estimation techniques may be applied for the definition of project processes. The main methods for estimation are based either on algorithmic estimation models or on expert



estimation techniques, commonly used for appraising software development effort (Jørgensen, et al., 2007). Expert estimation is considered a light process, involving a small number of documentation, as expert estimation relies on expertise to subjectively assess the involved factors, using experts "intuition" alone or combined with historical data and/or checklists, when available, to make estimates (Jørgensen, 2004).

Software estimation approaches lack studies supporting them in detail, though the usual checklist consists of the typical activities (e.g., requirements management, design, prototype, testing, documentation etc.) in a software project (Usman, et al., 2018).

Jørgensen & Molokken (2003) proposed a preliminary checklist, to be customized to include only relevant issues, structured on a project management framework considering scopes comprehending since the typical estimation activity until different project phases. In the VSE critical software context, it may not be feasible to use long checklists covering aspects beyond the typical estimation.

### 3.2.2 Software Processes in Small Entities

Given the limitations in terms of people and money that small organizations have due to their size, they face many challenges in running process assessments (Basri, 2011). Considering this, the assessment method proposed by Pino et al. (2010) sets out the elements needed to assist with diagnosing the process step-by-step in small organizations developing non-critical software while seeking to make the assessment application economically feasible in terms of resources and time.

VSE usually consider that SPI frameworks: are either too expensive to deploy or do not take organizations' specific needs into consideration. Pettersson et al. (2008) presents a light weight assessment and improvement planning (iFLAP) that enables practitioners to base improvement efforts on the issues that are the most critical for the specific organization. Their packaged improvement framework, containing both assessment and improvement planning capabilities, was applied to non-critical software case studies, without presenting the software processes involved.

Evidence has shown that the majority of very small organizations are not adopting existing standards and best practice models because they perceive them as developed by and orientated towards large organizations, therefore pointing out the relevance of the number of people involved in a software project (O'Connor, et al., 2009).

Zarour, et al. (2015) analyzed the reasons behind small organizations failures in Software Process Improvement

(SPI). They investigated, through a literature review, the pieces of knowledge and their frequencies that form the best practices for the successful design and implementation of lightweight software process models. They do not present the software processes, but classify a set of 38 best practices into five main categories, covering all aspects of the assessment, namely: assessment method, supportive tool, procedure, documentation, and users.

Yousefal-Tarawneh et al. (2011) proposed the use of XP as software development model and CMMI as SPI model because, SPI traditional models were developed to help large and very large organizations. They present their development process improvement framework, which does not consider Safety Critical Software aspects, comprising the method's stages for developing suitable software by using CMMI-DEV V1.2.

Sanchez-Gordon et al. (2017) reviewed relevant standards, such as ISO/IEC 29110, ISO 10018, OMG Essence and ISO 33014, to develop a framework to integrate human factors in software processes. Their proposed approach integrates international standards in a comprehensive, yet practical, framework addressing the human factors of small companies developing non-critical software. And Laporte & O'Connor (2017) presented an overview of eight implementations process improvement standards and guides for non-critical software in VSE, with a four-stage roadmap to support process improvement activities using ISO/IEC 29110.

Laporte, O'Connor, & Paucar (2015) present seven case studies involving pilot usage of ISO/IEC 29110, comprising a project classification into three categories (small, medium and large), based on characteristics such as duration, team size, number of engineering specialties and engineering fees. This study demonstrated that it is possible to plan and execute non-critical software projects in small settings using proven practices to significantly reduce the number of discrepancies.

Rodríguez-Dapena & Lohier (2017) proposed a step-wise approach to participate in space projects in a feasible way, adding processes from ECSS-Q-HB-80 (S4S) and capability from ISO/IEC 15504 to one of the profiles presented in ISO/IEC 29110. This approach considers different subsets of processes and levels of process capability, but it is only applicable for software criticalities levels D (non-critical) and C (low criticality).

## IV. CONCLUSION

The purpose of this review was to outlook the trends in critical software development studies in VSE within the past twenty years, identifying which practices have been applied to adapt standards and models to software projects.

Many studies have been proposed to describe process tailoring for software development. The reviewed publications make evident that the tailoring criteria must regard the project specificities to define what processes need to be performed. Furthermore, the methods to select criteria and processes are varied and the development organization is in charge of defining how to implement.

From the research reviewed, it is clear that standard processes are very immersed and widely practiced throughout in development organizations. Along with this, it is also clear that the field of processes tailoring is varied and continues to be studied and analyzed in order to most benefit the product quality. Critical software process tailoring in VSE is still an open issue, though, as the results show scarce research for critical software processes considering the VSE context. This topic is very important as at its center is a concern with helping VSE become better and demonstrate the quality of their processes and products, consequently suggesting the potential of VSE processes within critical software projects scope.

Critical software and VSE standards comparison indicated that these processes present similarities, representing opportunities to use them complementarily. Accordingly, the projects' criteria selection is a means to support the understanding of the influence factors for critical software projects in VSE context and, furthermore, to develop a notion on adequate tailoring.

A systematic approach for process tailoring can be helpful in the VSE context, where team-based expert estimation is usual, there is lack of documentation and new team members might not be aware of all activities and factors that should be accounted for during estimation. Frequently process tailoring is informally performed in VSE and the lack of a documented approach is also likely to result in the loss of useful experience from previous projects.

Further studies are necessary on the use of adequate profiles, comprising simplified and flexible sets of processes according to each software project evaluation, providing evidence on their feasibility with evaluation of their completeness, applicability and usability for critical software in VSE.

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# Environmental Management Practices in Rural Properties

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**Abstract**— This study aimed to promote a theoretical discussion about environmental management in the universal context applied to rural areas in small farms and as specific objectives indicate the most common practices related to Rural Environmental Management and show the most flawed practices with the environment in rural properties. For this purpose a bibliographic survey on sustainability was used, followed by environmental management as a complex context for to articulate studies on rural environmental management, in other words, an application of the principles of sustainability in rural use. At last studies by other authors were used to indicate which are the most common practices, which are the wrong forms and are being applied.

**Keywords**— *Environmental Management; Rural properties; Sustainable practices.*

## I. INTRODUCTION

Over the last decades the environmental problems resulting from the growth focused on the economic factor, taking several looks at the sustainable issues, have increased. Ecological thinking became active in organizational matters. Therefore, nowadays the needs are in the assessment not only of development, but of the type of development that one wishes to implement by considering that “development and environment” are no longer antagonistic but complementary; the existence of one is dependent on the good direction of the other (LAYRARGUES, 1997).

In doing so, urban and rural organizations began to pursue a sustainable commitment due to several factors. The sustainable movement has become one of the “[...] most important of our time and judging by the vitality of the institutional factors present [...] around the world, it can be inferred that it will continue to spread for many years decades” (BARBIERI et al, 2010, p. 153).

In turn, the world has seen the continued growth of consumer needs and the competitive market environment in which new ideologies have been opened up; rural properties began to look for new production techniques to increase grain production, enhance agriculture and generate greater income for producers (MOREIRA, 2009). However, all these changes led to higher consumption and environmental degradation. Equally the current production pattern, which accounts for

much of the increasing commitment to expand the countryside, is generally intensive in higher energy, raw material and natural resource expenditures, resulting in a large environmental loss. (LUSTOSA, 1999).

In doing so, the idea of sustainability and the debated sustainable development was presented as a concept to be popularly disseminated in 1992 at the United Nations Conference on the Environment in Rio de Janeiro - RIO 92 - (CMMAD, 1991) and resumed in 2012 at the Rio conference. +20, also in the same city where the concept of sustainability and its importance worldwide was emphasized. This concept came to consider sustainable everything that works with current resources consciously without compromising future needs. Therefore, the idea of sustainability was the assumption that one could talk about Environmental Management not only in the urban scope, but mainly and in the aspects of rural production and growth.

In doing so, the Rural Environmental Management has become a tool to emphasize sustainable rural development by presenting proposals for Environmental Management Systems (EMS) aimed at new greener and more environmentally conscious views. In doing so, this study aimed to theoretically discuss the environmental management in the general context applied to the rural environment in small farms, consisting of specific objectives of: indicate the most common practices related to Rural Environmental Management and report the

main problems in relation to more environmentally sound practices on farms.

This way, a study was conducted that sought to review the concepts of sustainability and environmental management followed by studies focused on Rural Environmental Management and environmental practices applied correctly or mistakenly in rural areas.

## II. THEORETICAL FRAMEWORK

### 2.1 Sustainability and Environmental Management

The sustainable movement has generated one of the largest social and environmental foundations over the past decades

(BARBIERI et al, 2010), because in 1987 the report Our Common Future obtained the first and official definition of sustainable development spread in Rio 92: "Sustainable development is one that meets the needs of the present without compromising the ability of future generations to meet their needs." (CMMAD, 1991, p. 46).

This way, sustainability was based on its three main axes: social, environmental and economic. In doing so, the idea of sustainability was directly related to the idea of development, efficient use of resources and commitment to current actions in relation to future damage.

The Sustainable development has become relevant for generations who, in assessing the standard of living of their populations, were concerned with the directions of the planet. According to Carvalho and Barbieri (2012), Agenda 21, the founding document of the movement for sustainable development, explains that exorbitant levels of production and consumption patterns constitute the main causes of environmental degradation and that the production of food, which occurs mostly in rural areas wouldn't be able to supply all the demand.

Therefore, the word development spent to indicate "the process of promoting the qualitative improvement of the living conditions of the population of a specific country, region or place" (BARBIERI, 2007, p. 2). It also refers to the idea of productive transformation providing efficiency; most often linked to economic growth in which the latter had already occupied much of the classic organizational interests of yore.

Several organizations focused on sustainable development began to observe this new form of development, citing as examples the company Natura and Unilever, elected by Exame magazine (2011) among the 20 most sustainable in the country.

Besides sustainable vision of large corporations and brands, the foundation of development needed to be strengthened, because it would be difficult to talk about

environmental management without having to approach mainly natural environments like the rural properties.

The great expansion of agriculture and commerce, the industrial revolution, generated in the management of both companies and its properties, the need to better evaluate its requirements, considering the great agricultural mechanization in rural areas, as indicated by Oliveira and Senna (2012), the environment. environment and sources of resources needed more attention, resulting in several future concerns. (DUARTE, 1999).

It was then necessary to reflect not only about to produce, but how and how much to produce, observing a more sustainable means of development that supports the needs of the present without future damage.

This is because according to Hawken and McDonough (1993) individuals do not know what causes various problems as animal extinction, or what happens to 20% of carbon dioxide in the atmosphere every year. However, it is already aware that nature's reactions are directly related to human actions.

In doing so, the sustainable development theme proposed by Agenda 21 has been repeatedly criticized for also supporting economic development, as the latter has been considered one of the main causes of the great environmental and social problems of this planet. (BARBIERI et al, 2010).

For Barbieri et al (2010) economic growth and especially rural extension as smallholdings or large estates are the focus of entrepreneurs in need of ascent, which explains major global problems such as food shortages and serious environmental problems. This is because sustainability is directly related to Environmental Management, which is directly related to rural property and other organizations.

Although farms are part of a more natural context and that connect directly to the idea of a clean environment, it is not always so. Irregular growth and especially the use of machinery, pesticides have undermined the idea of a healthy and sustainable environment.

Therefore, to discuss about sustainability in rural properties, it is necessary to reflect on Environmental Management conscious and focused not only on productivity, but on the quality of its production (BARBIERI et al, 2010).

This way, Environmental management has emerged for producers as a strong competitive tool that by enabling reflections on concerns, has generated changes in the way of thinking about the environment and controlling human actions about it.

Then came the Environmental Management System (EMS) that comprises a set of actions aimed at planning, organization, control and minimization of environmental impacts caused by production processes. (BARBIEIR, 2007).

Environmental Management Systems are a form of control of farms, but cannot be applied without the knowledge and planning of producers.

## 2.2 Environmental Management of Rural Properties

Sustainable management aims to bring traditionalism closer to operations aimed at profit and efficiency, with a reflection about environmental impacts (KLEINDORFER, SINGHAL, VAN WASSENHOVE, 2005).

This way, Rodrigues (2016) considers as Sustainable Agriculture the management of agricultural ecosystems aimed at maintaining and increasing productivity, quality of the environment be it water, air, soil as well as the diversity of fauna and flora, and the quality of life of people, all over the countryside.

It is understood that it is not enough that property is sustainable, it must produce profits and be efficient in its processes, for this, it is possible to rely on the use of attractiveness in which innovation is one of the main tools.

According to Oliveira and Senna (2012) man has always taken advantage of the natural environment for his survival, removing everything he needed from the environment, developing agricultural mechanization activities in rural areas without proper management and especially without environmental and sustainable balance. Consequently, he needed to create methods of Environmental Management aiming to recover what was degraded and the maintenance of what still resists.

In doing so, rural environmental management is concerned with the sustainability of the rural natural environment, agricultural activity being one of the oldest forms of human interference about natural environment. Barbieri (2007) considers that human interference in rural areas represents a great environmental impact caused by the removal of natural vegetation, loss of biodiversity of flora and fauna, climate change, soil compaction and its loss of resources by monoculture, water pollution, increased pesticides and pesticides etc.

Besides that, most of the agricultural population develops through family support activities, resulting in the need to start means of environmental preservation concurrently with productive activities. This is because the monoculture model used was responsible for the loss of biodiversity and biomes causing a decrease in species of

animals and plants and other problems generated by unsustainable practice. (BARBIERI, 2007).

Irregular use of chemical inputs and fertilizers is one of the main means for environmental degradation, besides that, the irregular disposal of residues or waste from the agricultural and animal production itself. (BERNARDI et al, 2011). In addition, Rodrigues (1998, cited Rodrigues et al, 2016) says that it is indispensable to evaluate the impacts generated by agricultural activities and to create public measures aimed at the sustainable development of rural environments.

The authors point out that in order to verify the quality of environmental management it is necessary to carry out rural activities that promote the integration of local producers for effective management of sustainable techniques. For this to happen, the first objective is environmental education; it is the basis for producers who previously only cared about profit, also cared about maintaining existing resources. (SENNA, OLIVEIRA, 2012). After that it is possible for properties to apply the Environmental Impact Assessment (Avaliação de Impacto Ambiental - AIA); a formal document aimed at assessing which processes may cause the most damage to properties.

According to Rodrigues (1998, apud Rodrigues et al, 2016), AIAs are necessary to define the forms of management that minimize the effects of risky and polluting activities allowing the maintenance of the natural environment. Thus, the Rural Environmental Management aims to plan the process to prevent or minimize impacts, ensuring a more conscious use of natural resources, as stated by Dal Forno (2017), the planning is to know the origin of the wood that will be used to light the fire that will be used to make the dulce de leche and how will be the management of the forest in which this firewood comes.

This whole chain analysis is an Environmental Management of the whole process; however, it is necessary time, knowledge and commitment from those involved, highlighting what Senna and Oliveira (2012) explained about environmental education.

## 2.3 Small Property and the Environment

The concept of property, with its sense of real law, has changed over time, usually linked to political events (VAZ, apud COSTA, RESENDE, 2011, p.46) and the current economic regime. Similarly, the pursuit of economic activity is also linked to the fulfillment of social function and respect for the environment (CF, art. 170, III and VI).

This state is growing so slowly, as a condition of survival of the species, that the elaboration of a Global

Constitution that develops the environmental theme and other basic themes for societies is being studied (ESPECIALISTS, 2014).

Small rural properties are those with one to four fiscal modules (CAIRES; AGUIAR, 2015). Some studies point out that in spite of approval of the Brazilian Forest Code, Federal Law No. 12,651 / 2012, there are still extensive degraded areas that need to be recovered by means of new legislation.

One of the methods created by the federal government to ensure compliance with the legislation is the Rural Environmental Registry (Cadastro Ambiental Rural - CAR). The CAR is an electronic registration instituted by Law No. 12,651 / 12, mandatory for all rural properties. It aims to form a database for control, monitoring and combating deforestation of forests and other forms of native vegetation in Brazil.

The achievement of economic, social, and environmental benefits by smallholders must derive from the management of rural vegetation that respects the mechanisms that sustain the ecosystem. This is called sustainable management, which aims to ensure harmony between the environment and rural properties (BRASIL, 2012).

### III. METHODOLOGICAL STRATEGY

The method used for this paper was bibliographic research which uses several bibliographic sources to support the research.

For Vergara (2003), bibliographic research is a structured study, enhanced with theoretical material published in books, magazines, newspapers, electronic networks or material accessible and available to the general public.

Bibliographic research consists of reading materials to constitute the theoretical framework of the research, using books, monographic research, dissertations, theses etc. These theoretical sources are verified according to the research theme and thus the elaboration of the monograph work will be done (RAUPP and BEUREN, 2006). Through this method it was possible to elaborate the paper, aiming to understand the activities, functioning, strengths and weaknesses, opportunities and difficulties.

### IV. RESULTS AND DISCUSSIONS

Considering that Environmental Management refers to the management of economic activities rationally using natural resources as a focus on sustainability (BARBIERI, 2007), rural environmental management practices are the

activities that properties do to apply environmental management in daily lives.

It has been listed four empirical studies that present rural properties and its relationship with Environmental Management as the basis for its daily monitoring verifying which practices are most applied and which are failures during the sustainable process of the property's activities.

The first study is Oliveira and Senna (2012) who presented thirteen producers who were interviewed for the analysis of their Environmental Management practices, finding that most, although concerned about sustainability did not use specific sustainable management control techniques.

Among the listed producers all indicated the use of fertilizers, fertilizers and pesticides for pest control and product growth, they did not indicate using natural methods for pest control. On the other hand, half of the respondents grow organic produce and plant fruit trees, but less than half correctly separate, reuse or dispose of waste. (OLIVEIRA, SENNA, 2012). It is possible to notice that the environmental education and the incentive to the researched group directly interferes in the perception about the environmental management.

This is because when analyzing the second study brought, it is based on the survey by Kessler et al (2013) who interviewed a third of producers from Santa Maria / RS. He aimed in his research to identify which sustainable practices were applied by farmers, realizing a better consideration of farmers towards sustainable practices.

More than 60% of respondents indicated that their greatest preservation measures are related to riparian forest, correct return of pesticide packaging and proper management for water and soil preservation. The third study discussed was related to Oliboni and Sossae (2018) which aimed to verify the sustainable practices of rural properties in the municipality of Chapecó / SC.

It was possible to observe in the research the relation of education with the agroecological or non-agroecological profile of the marketers who sell their products in the fair of the producer in that city. It was found that among all respondents there was a good percentage of preserved riparian forest, indicated as one of the good environmental management practices applied by rural producers. (OLIBONI, SOSSAE, 2018).

An important point observed by the study was that agroecological and non-agroecological producers used artesian well water for consumption, however, only those first treated the water. This shows that there is a greater



concern about health and environmental risks from the first group.

Finally, the majority of agroecological producers indicated that they use green fertilizers, that is, those that own natural production, compared to non-agroecological ones, less than half use natural fertilizers, being the biggest problem the use of heavy pesticides. This way, it can be considered that the most present positive environmental management practices were:

- a) proper management of water care;
- b) The preservation of riparian forest;
- c) Proper disposal of pesticide packaging;

Considering the main negative practices, it is presented:

- a) the use of pesticides, fertilizers, fertilizers and industrial pesticides;
- b) incorrect disposal of solid waste;

Finally, one of the most important aspects highlighted was environmental education, considering that the higher education groups had a better understanding of environmental management practices compared to those with lower education levels.

## V. CONCLUSION

This study which aimed to discuss theoretically about Environmental Management, showed that concern with the environment emerged decades ago and is related to the idea of sustainability. In doing so, environmental management is important on farms, allows greater strategic control over activities and ensures greater safety for the environment.

It was possible to analyze, in relation to the Environmental Management practices, that the most effective ones have been the preservation of riparian forest, the correct management for water care and the correct disposal of collected packaging, such as those of pesticides, however, in Regarding negative practices, we can mention the use of pesticides, pesticides, etc., as well as the incorrect disposal of other solid waste.

It is possible to verify that the environmental concern is in the discourse of the majority of the interviewees in the surveyed studies, however, the practical application of the Environmental Management still crawls so that it can have a strong effect in the preservation of the environment, beyond that, the environmental education is an important ally to compose a larger group of adherents to environmental assumptions.

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# Golden ratio, Concentric Circumferences and Planetary Distances

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**Abstract**— In this work we will show some important relations that includes the study of the golden ratio between two concentric circles, showing that there is a linear combination between the radii of the circumferences. We derive a constant  $K$  which corresponds to the perfect number representing the largest root of the golden ratio which is a function of the radii of two concentric circles  $C_1$  and  $C_2$ , respectively. This relation makes it possible to find the values of the radii  $r_1$  of  $C_1$  and  $r_2$  of  $C_2$  or vice versa. We will apply the results obtained in a problem related to the Uranium and Neptune planets where we will use the known astronomical distances of said planets with respect to the sun to calculate the minimum and maximum distance comparing the percentage of the relative error with the known astronomical values in the scientific literature. Plot the graphs comparing the planetary distances in relation to the distances of Kepler and Titus as well as the margin of error.

**Keywords**— Golden Ratio; Concentric Circumferences; Planetary Distances.

## I. INTRODUCTION

The Golden Ratio is known as the numerical pattern that governs the balance of bodies along with the harmony of forms and motions in nature. From the mathematical understanding of this proportion it is possible to verify it in several phenomena of nature [1], [2].

Due to this characteristic, it is known that in several areas of knowledge, studies seek to unravel the mysteries that relate the golden ratio, also known as Fibonacci sequence [3], with the behavior of the most varied natural phenomena. Such studies generally have as purpose to analyze and to lead the equations characteristic of different phenomena, to an irrational number, which is denominated "gold number", represented by the letter  $\Phi = (1 + \sqrt{5}) / 2 = 1.618034 \dots$  [4], [5]. Therefore, given that nature presents itself obeying a certain harmony [6], and that the existence of golden proportion is intrinsic in nature in different forms or design [7].

Due to the importance and study directed in this area, the present article tries to show that there is a relation of the golden proportion with the planetary distances, starting from the development of equations originating from two concentric circles that are positioned from this proportion. Many texts focus on the golden ratio in the solar system and in the universe. There is the presence of this proportion in the diameters of the Earth and the Moon and

they determine a triangle whose dimensions are related to the number Phi (root from the equation that represents a golden segment) and relations of that number with the distances of the planets with respect to the sun and that exponentially correlate with Phi. This number is also related to the rings of Saturn in close and dimensioned values at the golden ratio of the planet's diameter [7].

Due to this study, the present article seeks to show that it is possible to obtain planetary distances with small margins of errors by considering an equation relating the planetary rays to the sun, starting with the priore, to consider two concentric circles intersected by points whose distances are in a golden ratio. Based on this equation, they determine the smallest and largest distances of the planets Uranus and Neptune with small margins of error. We extend the equation to determine the distances of the other planets and compare them with the astronomical distances of Kepler and Titus-Bode and the error margins to detect to what extent they approach the known astronomical values [8].

Another fact that has been a reason for great admiration are the celestial bodies that fascinated the human mind since the earliest times [9], [10]. Due to scientific advances on the solar system, mathematical formalism on the movements of planets and stars as well as knowledge of their structures from astronomical observations and

mathematical calculations [11] has led man to an understanding beyond knowing about the gravitational forces, nature of orbits, velocities and periods of revolutions relative to the sun.

Development on the solar system carried out in history by renowned scientists like Kepler, Nicolaus Copernicus, Galileo and Newton, led mankind in understanding the planetary system, with the sun in focus and the planets orbiting, elliptically, in planes and governed by gravitational forces. Another well-known scientist who sought to determine the planetary distances was Titus-Bode who was able, by a very simple law, to determine planetary distances without, however, resorting to any equation such as Kepler's laws or the law of universal gravitation [12].

Titus-Bode who was director of the Berlin Observatory, which ended up defining the final sequence, which today is known as Titus-Bode Law. This law is based on a geometric progression of reason 2, from the second term: 0, 1, 2, 4, 8, 16 and 32. Titus-Bode multiplied each of these terms by 3: Obtained: 0, 3, 6, 12, 24, 48 and 96 and added 4 units each, yielding: 4, 7, 10, 16, 28, 52 and 100 and finally dividing by 10, obtained the following result, 0.4, 0.7, 1.0, 1.6, 2.8, 5.2 and 10.0 This sequence of numbers gave the distances of the planets to the sun [13]

**II. THE PERFECTNUMBER OF NATURE: THE DIVINEPROPORTION**

There is a number in nature that has been the subject of great research since antiquity and has always aroused the curiosity and fascination of mathematicians and scholars. This number that will be the target of this article corresponds to the number that we denominate of  $\Phi = (1 + \sqrt{5}) / 2 = 1.618034 \dots$  also denominated gold number. In human proportion, in works of classical architecture, Renaissance paintings and sculptures, and in nature there is a relation between the proportions of these elements and the number  $\Phi$ , and for this and another reason it is considered as a magic number that organizes the universe into a same proportion known as the divine proportion. [14].

**2.1 Definition of golden ratio**

Called "golden proportion" by Euclid (360-295 BC) and "divine proportion" by Kepler, it was found that in the works of Leonardo da Vinci (1452-1519) such a proportion was adopted in important works. Thus, the golden ratio represents the most harmonious form of dividing into two parts of a segment so that from this division we derive the following quadratic equation.

$$k^2 - k - 1 = 0. \tag{1}$$

Mathematically, the golden ratio can be described as follows: Let a segment of line AB be divided by a point C between A and B, the golden ratio occurs when the relationship between the sequences is satisfied,

$$AB/AC = AC/CB \tag{2}$$

Geometrically, this relationship can be visualized as shown in Figure 1.



Fig.1: Golden ratio of a line segment AB divided by a point C.

Solving the proportion (1), we have to

$$(AC)^2 = AB \cdot CB \tag{3}$$

Establishing a metric relation where the follow-up AB has a length of 1u.m. (1 unit of measure) (ie AB = 1), we obtain that  $[(AC)]^2 = CB$ , so since the total length of segment AB is 1u.m., then the sum of AC segments with CB must be equal to that unit. Therefore, one can write:

$$AC + CB = 1.(4)$$

Or, by replacing the term CB with (AC) 2, we have:

$$(AC)^2 + AC = 1.(5)$$

Since this last expression corresponds to a quadratic equation, it is observed that by calculating its roots, we will have for the value of the segment AC, given by:

$$AC = \frac{1+\sqrt{5}}{2} \tag{6}$$

That is,

$$AC' = \frac{1+\sqrt{5}}{2} = \Phi = 1,6180339 \dots = \frac{AC}{CB} \tag{7}$$

The number  $\Phi = 1.618033988749894848204568834365638 \dots = AC / CB$  represents the irrational number, known as "gold number" in honor of Phidias (490-430a.C.), A phenomenal Greek sculptor who has always used the golden ratio in his construction.

**III. GOLDEN RATIO FOR TWO CONCENTRIC CIRCLES  $C_1$  e  $C_2$**

In this section we will use the golden ratio considering that point A (0,0) represents the center of two circles  $C_1$  and  $C_2$  with B  $(x_0, y_0) \in C_1$  and C  $(x, y) \in C_2$ , so that the points considered to be collinear. Let us consider that the segments  $\overline{AB}$ ,  $\overline{BC}$  and  $\overline{AC}$  obeys a golden ratio. In this case, we must,

$$|\overline{AB}|^2 = |\overline{AC}| \cdot |\overline{CB}| \tag{8}$$

Since B  $(x_0, y_0)$  belongs to the circumference  $C_1$ , we must

$$r_1^2 = x_0^2 + y_0^2$$



From where we obtain that,

$$|\overline{AB}| = \sqrt{x_0^2 + y_0^2} = r_1 \tag{9}$$

Similarly, since point C (x, y) belongs to the circumference C<sub>2</sub>, it follows that

$$r_2^2 = x^2 + y^2 \rightarrow$$

$$|\overline{AC}| = \sqrt{x^2 + y^2} = r_2 \tag{10}$$

We also have that the difference between the coordinates between the points C (x, y) and B(x<sub>0</sub>, y<sub>0</sub>) can be represented by the following vector,

$$\overline{CB} = (x, y) - (x_0, y_0) = (x - x_0)i + (y - y_0)j \tag{11}$$

Making the module, we get,

$$|\overline{CB}| = \sqrt{x^2 - 2xx_0 + x_0^2 + y^2 - 2yy_0 + y_0^2} = \sqrt{r_2^2 + r_1^2 - 2(xx_0 + yy_0)} \tag{12}$$

Where do we consider

$$r_2^2 = x^2 + y^2 \text{ e } r_1^2 = x_0^2 + y_0^2 \tag{13}$$

Since the points A, B and C are collinear, it is worth the relation,

$$\begin{vmatrix} x & y & 1 \\ x_0 & y_0 & 1 \\ 0 & 0 & 1 \end{vmatrix} = 0 \leftrightarrow y = x \cdot \frac{y_0}{x_0} \tag{14}$$

Taking (13) into (12), we obtain,

$$|\overline{CB}| = \sqrt{r_2^2 + r_1^2 - 2 \cdot (xx_0 + \frac{y_0^2}{x_0}x)} = \sqrt{r_2^2 + r_1^2 - \frac{2x(x_0^2 + y_0^2)}{x_0}} \tag{15}$$

$$|\overline{CB}| = \sqrt{r_2^2 + r_1^2 - \frac{2r_1^2}{x_0}x} \tag{16}$$

Taking (12), (10) and (9) into (8), we obtain:

$$r_1^2 = r_2 \cdot \sqrt{r_2^2 + r_1^2 - \frac{2r_1^2}{x_0}x} \tag{17}$$

Rising to the square (17), it comes that,

$$r_1^4 = r_2^2 \left( r_2^2 + r_1^2 - \frac{2r_1^2}{x_0}x \right) = r_2^4 + r_2^2 r_1^2 - \frac{2r_1^2 r_2^2}{x_0} \cdot x \rightarrow 2r_1^2 r_2^2 \cdot \frac{x}{x_0} = r_2^4 - r_1^4 + r_2^2 r_1^2 \rightarrow x = x_0 \left( \frac{r_2^4 - r_1^4 + r_2^2 r_1^2}{2r_1^2 r_2^2} \right) \tag{18}$$

Denoting,

$$K = \frac{r_2^4 - r_1^4 + r_2^2 r_1^2}{2r_1^2 r_2^2} \tag{19}$$

Taking (19) in (18), we obtain the point x,

$$x = Kx_0 \tag{20}$$

Using this expression in (14), we obtain,

$$y = x \cdot \frac{y_0}{x_0} \rightarrow y = K \cdot x_0 \cdot \frac{y_0}{x_0} \rightarrow y = K \cdot y_0 \tag{21}$$

In this case, point C is represented by:

$$C = (x, y) = (Kx_0, Ky_0) = K \cdot (x_0, y_0) \rightarrow$$

$$C(x, y) = K \cdot B(x_0, y_0) \tag{22}$$

What shows that there is a linear combination between the points of C<sub>1</sub> and C<sub>2</sub>

### 3.1 Values assigned to K.

Let points A, B and C be

$$A(0,0)B(x_0, y_0)C(Kx_0, Ky_0)$$

As it was verified the segments AB, BC and AC obey a golden ratio. Thus, we will determine the values of K.

Soon,

$$\begin{aligned} \overline{AB}^2 &= |\overline{AC}| |\overline{BC}| \rightarrow x_0^2 + y_0^2 \\ &= \sqrt{K^2 x_0^2 + K^2 y_0^2} \cdot \sqrt{(K-1)^2 x_0^2 + (K-1)^2 y_0^2} \rightarrow \\ x_0^2 + y_0^2 &= |K| \sqrt{x_0^2 + y_0^2} \cdot |K-1| \sqrt{x_0^2 + y_0^2} \rightarrow \\ x_0^2 + y_0^2 &= |K| |K-1| |x_0^2 + y_0^2| \rightarrow \\ |K| |K-1| &= \frac{x_0^2 + y_0^2}{x_0^2 + y_0^2} = 1 \leftrightarrow |K| |K-1| = 1 \rightarrow \\ K(K-1) - 1 &= 0 \rightarrow K^2 - K - 1 = 0 \end{aligned} \tag{23}$$

The expression (23) represents the relation that leads to the condition predicted by the golden ratio. Therefore,

$$K' = \frac{1+\sqrt{5}}{2} = a \tag{24}$$

$$K'' = \frac{1-\sqrt{5}}{2} = b \tag{25}$$

Since the golden ratio as the division of two distances, thus positive, does not make sense to discuss the second solution given by (25). In this case, let us consider K = (1 + √5) / 2 = a as the solution. Thus taking the relation given by (24) in (19), it follows that,

$$a = \frac{r_2^4 - r_1^4 + r_2^2 r_1^2}{2r_1^2 r_2^2} \tag{26}$$

The expression given by (26) may be useful for calculating concentric circumferential radii to C<sub>1</sub>. This is what we will discuss in the next section. Another fact to be considered in this question is that the equation given by (26) has an important application when considering that the planets have circumferential orbits. In this case, it is possible to obtain the values of the planetary distances. Another fact to consider is that the equation given by (26) assumes a proportionality between the given radii. This proportionality factor is the root of the golden ratio. Thus, it becomes possible to obtain distances from the planets in a much easier way.

## IV. THE ROOTS OF GOLDEN PROPORTION AND PLANETARY DISTANCES.

Taking the relation given by (26). This is,

$$a = \frac{r_2^4 - r_1^4 + r_2^2 r_1^2}{2r_1^2 r_2^2}$$

Explaining r<sub>2</sub> as a function of r<sub>1</sub>, we obtain that,  $\left(\frac{r_2}{r_1}\right)^2 - \left(\frac{r_1}{r_2}\right)^2 = 2a - 1$  (27)

Denoted,

$$\delta = \frac{r_2}{r_1} \tag{28}$$

Taking (27) into (26), we obtain that,

$$\delta^2 - \delta^{-2} = 2a - 1 \tag{29}$$

Or,

$$\delta^4 - (2a - 1)\delta^2 - 1 = 0 \tag{30}$$

Substituting (30) the first root of the golden ratio,

a = 1.618034, we obtain that,

$$\delta^4 - 2,2361\delta^2 - 1 = 0. \tag{31}$$

Extracting the root of this biquadrated equation,

where only real solutions are considered, we obtain that,

$$\delta = \frac{r_2}{r_1} = 1,618034. \tag{32}$$

Or,

$$r_2 = 1,618034r_1. \tag{33}$$

Substituting (26) for the second root of the golden ratio, a

= -0.618034, we obtain that,

$$\delta^4 + 2,2361\delta^2 - 1 = 0. \tag{34}$$

Soon

$$r_2 = 0,618034r_1. \tag{35}$$

The equation given by (33) will be useful to obtain the planetary distances. In this case, let us take as reference the average mercury distance to the sun.

#### 4.1 Applications to the Uranus and Neptune planets

##### 4.1.1 Calculation of the minimum distance of Neptune.

Using the equation given by (33) and  $r_1 =$

18,2766AU (Table 3)

as the least distance from Neptune to the sun, we must,

$$r_2 = 1,618034r_1 = 1,618034.18,2766 = 29,572161$$

Soon,

$$r_2 = 29,572161$$

Looking still at table 3, we have  $r_2 = 29,5711$  AU

The relative error for this value will be,

$$Error = \frac{Exactly - Valor Approx.}{Exactly}$$

So,

$$Error = \frac{29,5711 - 29,5722}{29,5711} = 0,00003719$$

What is equivalent to a 0,004%

##### 4.1.2 Calculation of the maximum distance of Neptune

Using the equation given by (33) and being the value of

the orbit of Neptune and considering that it supposes  $r_1$  is

the maximum distance of the planet Uranus with  $r_1 =$

20,0874AU (Table 3).

$$r_2 = 1,618034r_1 = 1,618034.20,0874 =$$

$$r_2 = 32,5020$$

Looking at the table above, we must  $r_2 = 30,3163$

The relative error for this value will be,

$$Error = \frac{Exactly - Valor Approx.}{Exactly}$$

So,

$$Error = \frac{30,3163 - 32,5020}{30,3163} =$$

This is equivalent to an error of 3.911%.

Proceeding this way, we can obtain the following

Table for the values of the rays given by expression (33)

(Table 3). This table expresses the values of the minimum,

average and maximum distances according to Kepler's 3rd

law and then expresses the values of the distances using

the equation 33 from the golden ratio.

Table.1: Comparison of the maximum, average and maximum distances in relation to the golden ratio.

Planets	Minimum distance (UA)	Average Distance (UA)	Maximum Distance (UA)	Minimum distance eq (33)	Average Distance eq (33)	Maximum Distance eq (33)
Mercury	0.3075	0.3871	0.4667	0.3075 <sup>1</sup>	0.3871 <sup>1</sup>	0.4667 <sup>1</sup>
Venus	0.7184	0.7233	0.7282	0.4975	0.6263	0.7551
Earth	0.9833	1.0000	1.0176	1.1624	1.1703	1.1782
Mart	1.3814	1.5237	1.6660	1.5910	1.6180	1.6465
Ceres <sup>1</sup>	2.5468	2.7663	2.9858	2.5351	2.4654	2.6956
Jupiter	4.9510	5.2028	5.4546	4.1208	4.4760	4.8311
Saturn	9.0075	9.5388	10.0701	8.0109	8.4183	8.8257
Uranus	18.2766	19.1820	20.0874	14.5744	15.4341	16.2938
Neptune	29.7993	30.0578	30.3163	29.5722	31.0371	32.5020
Pluto	29.5711	39.4387	49.3063	48.2163	48.6345	49.0528

The figures (Figure 2, Figure 3 and Figure 4) represent the graphs extracted from origin and the data of table 3 in order to evaluate and compare the planetary distances between Kepler distances and the results obtained from equation 33.

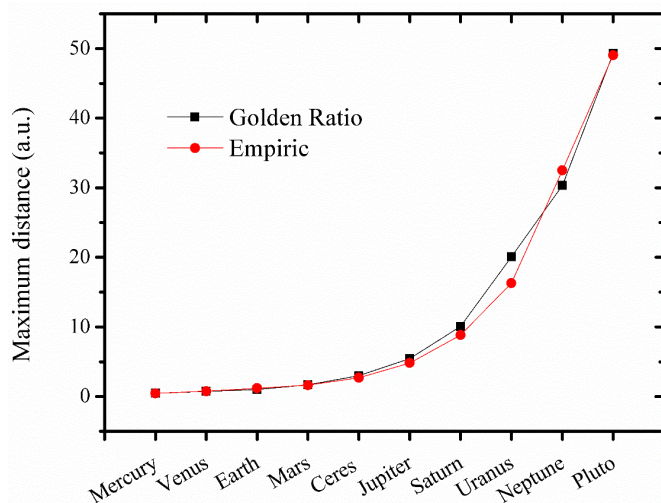


Fig.2: Comparison of Kepler's 1st Kepler's minimum planetary distances with the minimum distances given by Equation-33

Source: Authors' Collection.

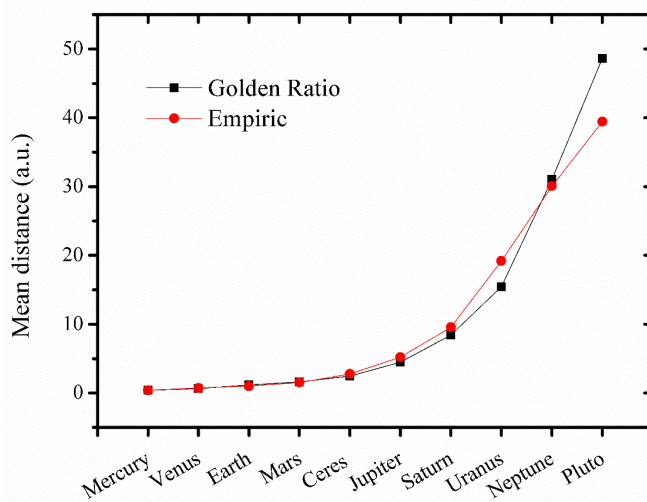


Fig.3: Comparison of planetary distances Average of Kepler's 1st law with the mean distances given by Equation 33.

Source: Authors' Collection.

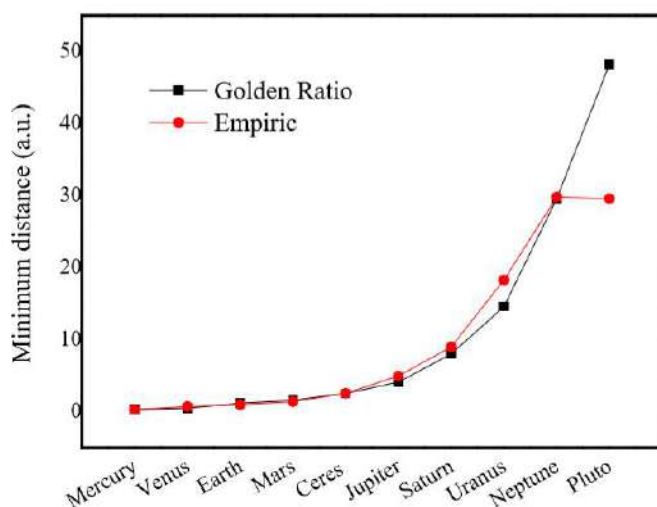


Fig.4: Comparison of Kepler's 1st maximal planetary distances with the maximum distances given by Equation-33.

Source: Authors' Collection.

V. COMPARISONS OF PLANETARY DISTANCES, ACCORDING TO KEPLER, TITUS BODES AND THE GOLDEN RATIO

Table 2: Calculation of planetary distances by Kepler, Titus Bodes and the golden ratio.

Planetas	AverageDistance Kepler (UA)	Average Distance by Titus Bodes (UA)	AverageDistance(Eq.33) (UA)
Mercury	0.39	0.4	0.39
Venus	0.72	0.7	0.63
Earth	1.00	1.00	1.17
Mart	1.52	1.6	1.69
Ceres	2.77	2.8	2.46
Jupiter	5.20	5.20	4.48
Saturn	9.53	10.0	8.42
Uranus	19.18	19.6	15.43
Neptune	30.06	38.8	31.04
Pluto	39.44	77.2	48.63

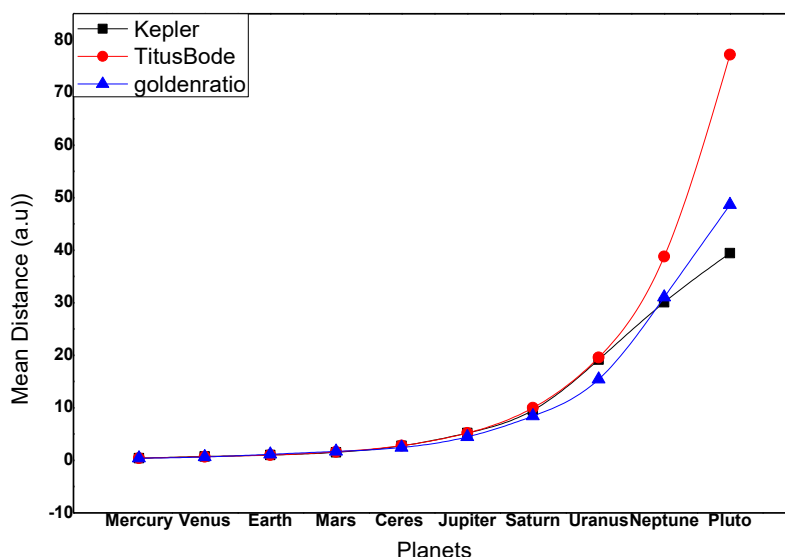


Fig.5: Comparison between planetary distances according to Kepler, Titus Bodes and the golden ratio.

Source: Authors' Collection.

Table 3: Relative error margins of the planetary distances in relation to Titus Bodes, equations (33).

Planets	Average Distance by Titus Bodes (%)	Average Distance per Golden Proportion 1 Eq (33) (%)
Mercury	2.56	0.0
Venus	2.78	12.5
Earth	0.00	17.0
Mart	5.26	11.18
Ceres	1.08	11.19
Jupiter	0.00	13.85
Saturn	4.82	11.65
Uranus	2.08	19.55
Neptune	29.08	3.26
Pluto	95.75	23.30



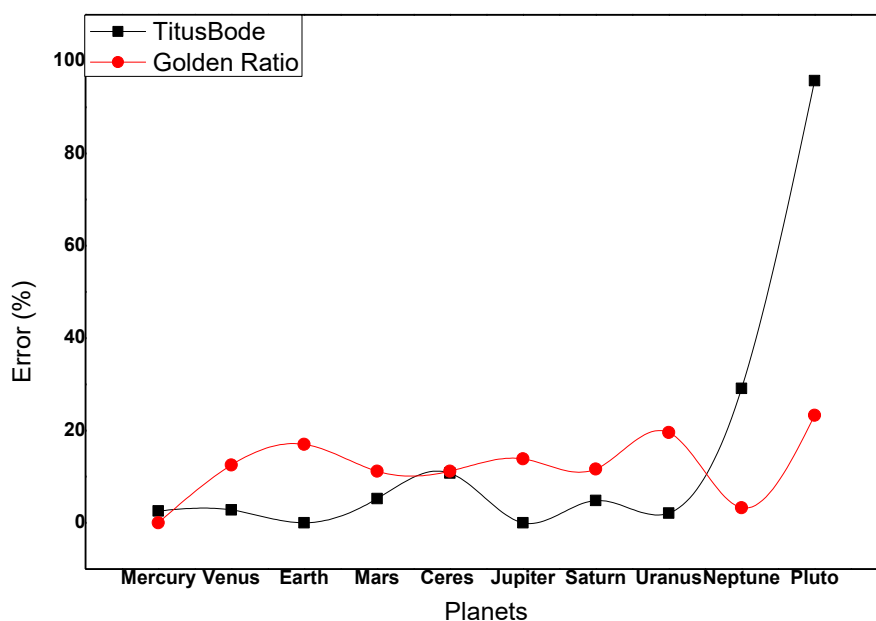


Fig.6: Values of relative errors (%) of the distances of the planets by the law of Titus Bodes and Equations (32) from a golden ratio.

Source: Authors' Collection.

## VI. CONCLUSION

As was verified for the planets, uranus and neptune that assume positions with segments that have a certain astronomical relation and that obeys a certain approximation with a golden proportion. The golden ratio has a certain rigor with Kepler's empirical laws and the law of Titus Bodes, presenting in some points a better description than that of Titus Bodes. It can be seen that the equation given by (32) very well describes the astronomical distances when comparing the error margins, as was observed for the uranus and neptune planets. This shows that there is a consistency about the relevance of the golden ratio to these and other planets.

Another fact to consider in this article is that simple idea from geometric theories such as concentric circles was able to show impressive results of astronomical values, as positions of planets near and far in relation to the sun.

For a better description and application of equation (32), graphs were plotted for comparison with Kepler and Titus Bode distances, taking into account comparisons of relative errors. Therefore, with this study, it can be considered that the golden ratio can be used to evaluate the positions of the planets in relation to the sun taking into account the margins of errors to show to what extent the theory has reliability.

Another fact to consider is that simple ideas from geometric theories such as concentric circles, were able to

show impressive results of astronomical values, as positions of planets near and far in relation to the Sun.

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# Effect of difference of Photoperiod in culture chlorella sp. with the continuous photobioreactor system

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**Abstract**— Research on the effects of differences in cultures of *Chlorella sp* photoperiod. with a continuous photobioreactor system. This research was conducted in April 2019 at the laboratory of Fish Hatchery and Breeding University of Riau. The purpose of this study was to find out the right photoperiod in *Chlorella sp*. culture by using a blue LED light with a continuous photobioreactor system to population density and specific growth rates. The method used is the experimental method by using a completely randomized design with four treatments and 3 repetitions. The treatment used is P1 (24 hours bright - 0 hours without lighting), P2 (20 hours bright - 04 hours without lighting), P3 (16 hours bright - 08 hours without lighting), P3 (12 hours bright - 12 hours without lighting). The results of the study found that lighting 16 hours bright - 08 hours without lighting give the best results with a cell density of  $336.67 \times 10^4$  cells / ml and the specific growth rate of 0.341 / day d with peak growth occurring on day 8.

**Keywords**— photoperiod, photobioreaktor, *Chlorella sp*.

## I. BACKGROUND

Natural feed is live food for fish larvae and seeds includes phytoplankton, zooplankton and benthos. Feed use in larval rearing dominant influence on fish growth because feed functions as an energy supplier to spur growth and maintain life (Melianawati, 2005). Small fish (larvae) need more feed with nutrient content especially higher protein content than large fish (Djarajah, 1995). Many high protein content found in natural food in the form of phytoplankton type *Chlorella sp*. This species is widely consumed by the larvae of fish like milkfish, tilapia and others. Although the availability of natural food can be replaced with artificial feed, high protein requirements for fish larvae cannot be fulfilled by artificial feed.

Optimizing the capabilities of microalgae can be obtained by designing a photobioreactor. Photobioreactors are places where conversion takes place involving certain organisms to be the desired result (Jordening and Winter, 2005). Besides being more efficient in using the place, culture with photobioreactor systems is also easy to do and control, smaller contamination and higher productivity because of the high agitation process (Nadya, 2017).

Photobioreactors are divided into two types, namely closed photobioreactor and open photobioreactor. Conditions on closed photobioreactor are easier to control and the possibility of contamination of microalgae is smaller compared to open photobioreactors. One type of closed photobioreactor is Tubular photobioreactors which have the highest photosynthetic efficiency compared to other closed photobioreactor types (Hadiyanto et al., 2012).

Giving light greatly affects the photosynthesis process of plants one of them is microalgae. Microalgae are photosynthetic organisms, microalgae absorb light in the form of photons. The energy of the photon will be used by chlorophyll to break hydrogen bonds in water which will later be with CO<sub>2</sub> in photosynthesis it will be used to produce O<sub>2</sub>. *Chlorella sp*. able to photosynthesize using artificial light sources. One light source that can be used is an LED light (light emitting diode), blue LED wavelengths range from 450 - 500 nm (Syafriyudin et al., 2015), while the light that can be absorbed in photosynthesis is light with a wavelength of 3800nm to 700nm. But you need to know how long the radiation or photoperiod is right to produce optimal microalgae culture, Based on these considerations it is necessary to do research on how long the best photoperiod in *Chlorella sp*. culture by using blue

LED (light emitting diode) lights on a continuous bioreactor system.

## II. RESEARCH METHOD

This research was conducted in April 2019 in the Laboratory of Fish Spawning and Breeding, Faculty of Fisheries and Marine Sciences, University of Riau. The first step before starting the research is preparing tools and materials to be used. The material used in this study is *Chlorella* sp. which comes from the Laboratory of Microalgae, Faculty of Fisheries and Marine, University of Riau as material to be observed, fertilizer as a source of nutrients and nutrients for microalgae, and water. The tool used in this study is 4-liter glass containers totaling 12 pieces as a photobioreactor tool, LED lights are used as light sources, water pump used to drain *Chlorella* sp. so that the agitation process occurs, The rack is used as a photobioreactor, pH meter, DO meter and thermometer used to measure acidity, oxygen and temperature levels of cultured water, tissues and napkins as a glass cleaner and other equipment. The method used in this study is experimental method. The design used is a Completely Randomized Design (CRD) one factor with 4 treatments and 3 replications. In this study used LED (Light Emitting Diode) lamps with wavelengths ranging from 450 - 500 nm (Syafriyudin et al., 2015). With the intensity of light used is 1000 lux, According to previous research (Utami et al., 2012) the treatments used in this study are as follows.

P1: 24T-0G (for 24 hours lighting is given 24 hours and 0 hours without lighting)

P2: 20T-04G (for 24 hours lighting is done 20 hours and 04 hours without lighting)

P3: 16T-08G (for 24 hours lighting is done 16 hours and 08 hours without lighting)

P4: 12T-12G (for 24 hours lighting is done 12 hours and 12 hours without lighting)

After the container is cleaned then the container is filled with 3.5 liters of clean water and given 400 ml of liquid fertilizer (dahril solution) in each container as a

source of nutrients, circulation with a pump is given to stir the fertilizer to be evenly distributed, then add 100 ml of *Chlorella* sp. in each container (Djarajah, 1995), the calculation of cell numbers is first done using the haemocytometer which was observed under a microscope with the help of a hand counter. *Chlorella* sp. which is then further illuminated by LED lights according to each treatment. The process of adding *Chlorella* sp and fertilizer can be seen in Figure 1.

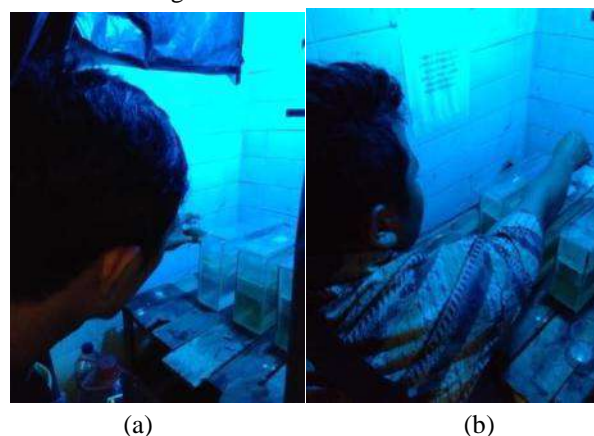


Fig.1. a. Addition of *Chlorella* sp. b. Addition of fertilizer

The parameters measured in this study are cell density / ml and specific growth rate (SGR), and parameters Water quality measured is temperature, dissolved oxygen, and pH.

## III. RESULTS AND DISCUSSION

### Cell Density / ml

Early in the culture, it was known that stock *Chlorella* sp. amounting to 700,000 / ml. Growth of *Chlorella* sp. can be seen from the increasing density of *Chlorella* sp. From the results of observations of *Chlorella* sp. in this study showed a growth pattern that is divided into several phases. Data density of cells / ml of culture observation *Chlorella* sp. during the research takes place can be seen in Figure 2 below.

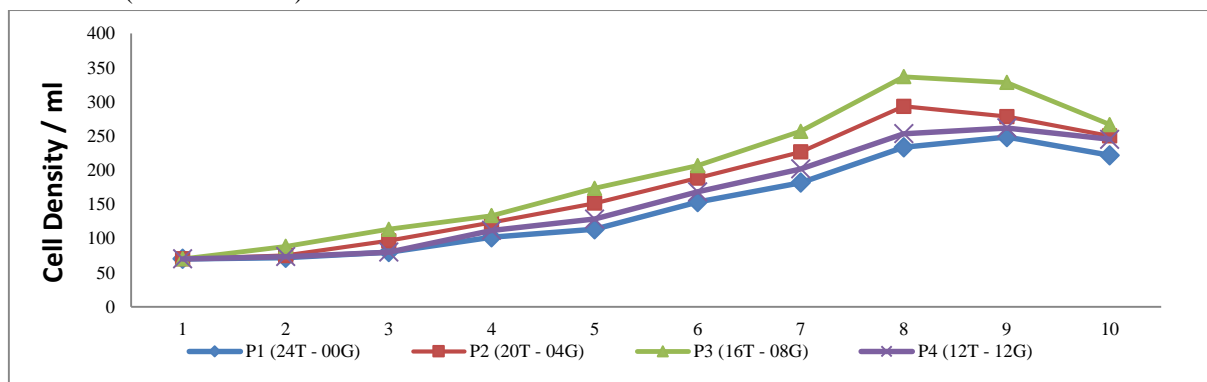


Fig.2. Average Cell Density / ml Graph



Note : Value of cell / ml density in  $10^4$

P1: 24 hour bright photoperiod treatment - 0 hours without lighting

P2: 20 hour bright photoperiod treatment - 4 hours without lighting

P3: 16 hour bright photoperiod treatment - 08 hours without lighting

P4: 12 hour bright photoperiod treatment - 16 hours without lighting

Based on Figure 2 it can be seen that in general, the population growth pattern of *Chlorella* sp. following the pattern of plankton growth in general, that is adaptation phase, exponential phase, the phase of the peak and decline phases of growth. In the adaptation phase, at P1, P4, it occurs on day 1 to day 2 while in the P2 and P3 treatment there is no adaptation process.

The results showed that the highest peak *Chlorella* sp. cell density in each treatment of different light periodicity occurred on different days. In figure 2 shows the highest cell density occurs on days 8 and 9, in treatment (16T-08G) and (20T: 04 G) population peak occurred on day 8 with cell density  $336.67 \times 10^4$  cells / ml and  $293.33 \times 10^4$  cells / ml. In the treatment (12T-12G) and (24T: 0 G) the population peak occurred on day 9 with cell density  $261.67 \times 10^4$  cells / ml, and  $248.33 \times 10^4$  cells / ml. The longer the radiation is given the higher the number of cells at the peak of the population until the irradiation time is 16 hours and when the duration of exposure increases, the number of cells eventually decreases, (Raymont 1963 in Andriyono 2001) stated that in photosynthesis there were 2 reactions namely light reaction and a dark reaction. In the light, cells will divide asexually, so that the child cells are smaller in size than the parent. While in the darkened state, cell development occurs to reach normal size.

The treatment (12T-12G) is the lowest treatment, too short lighting time affects the utilization of nutrients such as nitrate and phosphate, but microalgae need dark

conditions for their cell productivity (Meseck, et al., 2005). Giving light (16T - 8G) gives the best influence on the growth of *Chlorella* sp. because it can provide the highest cell / ml density. The statement above is supported by Ohi, et al. (2006) and Danesi, et al. (2004), that is Biomass production can decrease due to less optimal radiation or less duration of radiation while biomass can increase if the duration of optimal irradiation.

In the process of photosynthesis, light plays a very important role in both light intensity and long irradiation. Novianti (2015), states that the duration of irradiation can affect the synthesis of organic matter in photosynthesis because only with sufficient energy the process can proceed smoothly. Inthe (2012), states that, the reactions that occur in the process of photosynthesis are divided into 2 namely light reactions and dark reactions. Light reaction is very dependent on the availability of light. Light reactions are steps to convert light energy into chemical energy. Light absorbed by chlorophyll moves electron transport and hydrogen from water to the receiver (receptor) called NADP + which functions as an electron carrier in cellular respiration. Dark reactions are reactions to the formation of sugar from  $\text{CO}_2$  that occurs in the stroma. Unlike the light reaction, dark reactions or light-independent reactions can occur during day and night, however during the day the dark reaction rate is certainly lower than the light reaction rate (Inthe, 2012). In dark reactions, cyclic series reactions occur which form sugars from the basic ingredients of  $\text{CO}_2$  and energy (ATP and NADPH), which energy is used in the dark reaction is obtained from the light reaction (Novianti, 2015). Dark reaction aims to convert compounds containing carbon atoms into sugar molecules.

#### Specific Growth Rate (SGR)

Based on data obtained from observations of *Chlorella* sp. Culture. during the study, the specific growth rate can be seen in Figure 3 below by having different results in each treatment.

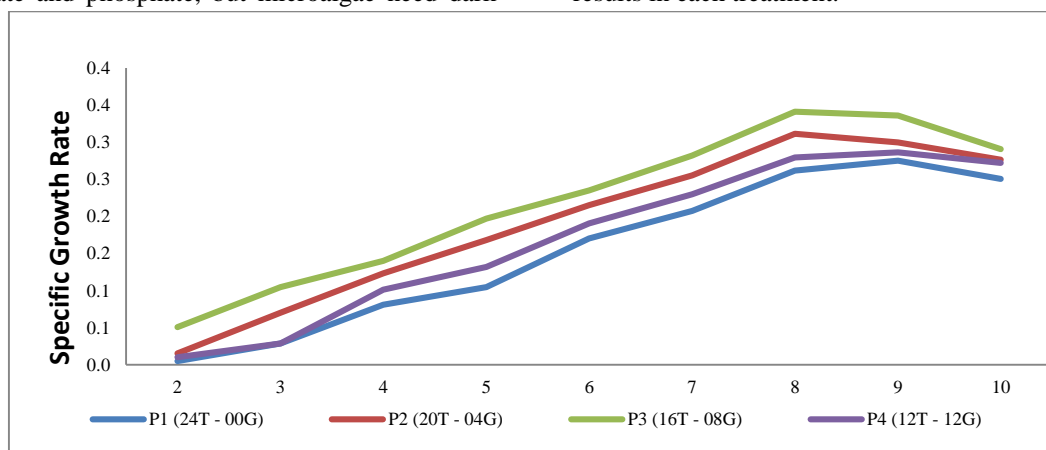


Fig.3. Graph of Specific Growth Rate

Specific growth rate is a parameter that describes the rate of growth of cells *Chlorella* sp. per unit time. Based on the results of observations on specific growth rates can also be known also the ideal time of harvesting cells *Chlorella* sp. The ideal harvest time is when the specific growth rate reaches the maximum value, because at that time the *Chlorella* sp. cell biomass reaches optimum concentration. According to Vonshak (1997), the optimum biomass concentration will correlate with the highest productivity.

Based on figure 3 the highest growth was obtained at treatment 16:08 (hours of light: dark) that is equal to 0.341 / day, then in the treatment (20G: 04 T) of 0.311 / day, then in the treatment (24G: 0T) of 0.286 / day, and in treatment (12G: 12T) of 0.275 / day. Suminto and Hirayama (1996), in their study stated that the greater SGR value means that the process of algae cell division is faster, so that cell growth per unit time will be greater than the increase in time itself. Although the maximum specific growth rate occurred at the same time, the growth rate in the treatment of 16T - 08G showed a higher value than the other treatments. This difference exists presumably due to the presence of different lighting times resulting in different cell growth rates. According to Fogg (1975) light is the energy source needed in photosynthesis, the amount of energy received depends on the quality, quantity and period of irradiation.

According to Lavens and Sorgeloos (1996) states that light irradiation must be appropriate in culturing phytoplankton, if light is too bright it will inhibit the process of photosynthesis. Long exposure very decisive in the process of synthesis organic material on photosynthesis because only enough energy the process can run smoothly. Long exposure can affect the biochemical composition were cultured besides the culture media, temperature, pH, light intensity, and stage time of harvest (Novianti, 2015).

#### WATER QUALITY

Water quality is an important factor for the growth of *Chlorella* sp. The results of measurements of water quality parameters during the study are presented in Table 1.

Table 1. Water Quality Measurement Results During Research

NO	Parameter	Value
1.	Temperature	29-33,°C
2.	pH	7-8,4
3	DO	7,3-8,5ppm

Growth of *Chlorella* sp. which is good besides being influenced by the nutritional content also influenced by environmental conditions in the media of maintenance.

Environmental factors that support the growth of *Chlorella* sp. is temperature, pH and dissolved oxygen. In this study, the range of water quality is still in good condition for the growth of *Chlorella* sp. The temperature at the time of the study reached a range of 29-32 °C. Isnansetyo and Kurniatuty (1995) state that the optimal culture of *Chlorella* sp. laboratory scale is 20-40 °C, according to Fachrullah (2011), changes in temperature affect the processes of chemistry, biology and physics, an increase in temperature can reduce the solubility of the material and can cause an increase in the speed of metabolism and microalgae respiration in the waters. The value of the degree of acidity (pH) of the media in this study is also still in a fairly good range for the growth of *Chlorella* sp., pH range obtained between 7 - 8.9. pH it is still in the optimal range for the growth of *Chlorella* sp. Ciferri (1983) in Winarti (2003) states that *Chlorella* sp. can grow well at pH 6-9. Measurement of dissolved oxygen during the study ranged from 8 ppm - 8.5 ppm and can still be tolerated by *Chlorella* sp. Oxygen Level (O<sub>2</sub>) is one of the factors that influence the growth of microalgae. Photosynthesis that works well will produce enough oxygen for the growth of microalgae Widyawatik (2018).

#### IV. CONCLUSIONS AND RECOMMENDATIONS

From the results of this study it can be concluded that giving 16-hour bright photoperiod treatment and 8 hours without lighting using blue LED lights affect cell density / ml and specific growth rate (SGR) in *Chlorella* sp. culture with a continuous photobioreactor system with cell / ml density obtained is  $336.67 \times 10^4$  cells / ml, with a specific growth rate (SGR) of 0.341 / day. It is recommended to culture *Chlorella* sp. with blue LED lights using a continuous photobioreactor system you should use a bright 16 hour photoperiod and 8 hours without lighting.

#### THANK-YOU NOTE

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# An Integrated Approach for Systems Engineering and Project Management Applied to the Implantation of a Satellite Test Laboratory Infrastructure

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**Abstract**— *The objective of this article is to describe a management model applied to the development of an executive project and implantation of a large infrastructure for space activities using the systems engineering and project management concepts integrated. The concepts used aimed to improve the planning, execution and management of processes related to the infrastructure life cycle to be implemented for the development of activities in the space sector for assembly, integration and tests for large satellites at INPE, Brazil*

**Keywords**—*Systems Engineering, Project Management, Integrated Approach.*

## I. INTRODUCTION

The implementation of projects for large spacial infrastructures is always a challenge, due to the complexity of the requirements, definition of technical solutions and high level of administrative and managerial demands in order to achieve a successful implantation.

The organizations which operate space infrastructures do not usually design and construct the installations themselves, this is done by third party contractors through several different purchase agreements.

The complexity of multidisciplinary projects and technical and administrative procedures requires many specialties and disciplines to be applied together. In spacial infrastructure projects, the concepts of systems engineering (SE) are widely used, considering the complexity of the installations and equipment to be implanted.

Nowadays most part of projects in technical fields utilize the concepts of project management (PM) to complete projects as planned, mainly on the aspects of cost, quality and time.

When studying PM and SE separately and making a comparison between both, we can find overlaps between these two solid disciplines. This article relates the experience of combining both fields of PM and SE to achieve an implantation of a laboratory infrastructure expansion according to the requirements and exigencies of cost, time and quality.

Despite the large impact that a large space infrastructure implantation has on the results of space system projects,

the vast majority of current literature addresses the issue marginally, with greater emphasis on the development of the space segment products.

The expansion project of the Integration and Testing Laboratory for satellites on the Brazilian National Institute of Spatial Research (INPE), involving the executive project, the execution of the physical facilities (construction of the buildings) and the utilities installation (energy, fluids, air conditioning, etc.) to permit the installation of systems to manipulation, assembly, integration and testing (functional and climatic) of large satellites or their subsystems is a complex project that has benefited from an integrated systemic approach from the beginning of its deployment to the current phase.

The use of SE and PM concepts in complex projects is a common practice in the professional community that operates in the project implementation segment. A joint research promoted by PMI and INCOSE and published by Conforto et al. (2013) shows, according to their results illustrated in figure 1, the percentages of use of the concepts of Systems Engineering and Project Management by program managers and chief systems engineers often involved in this type of project. While approximately 55% of systems engineering chiefs use ES concepts and 20% use PM concepts, program managers have an inverse proportion, with 13% using ES concepts and 58% using PM concepts.



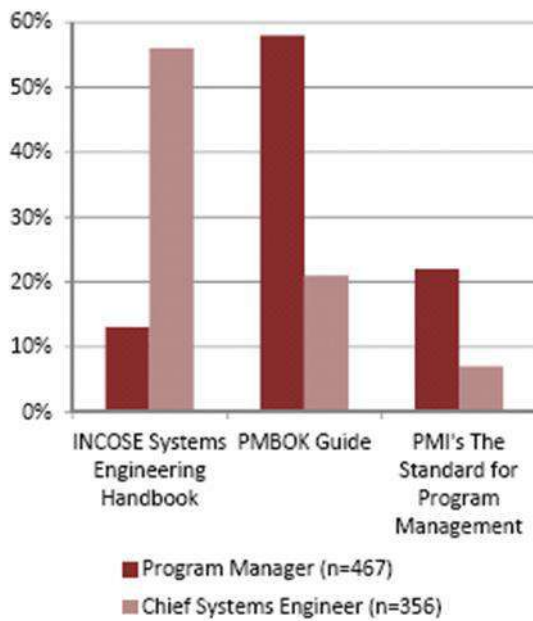


Fig. 1: Use of INCOSE and PMI standards by Systems Engineering and Project Management professionals [Conforto et al. 2013].

## II. SYSTEMS ENGINEERING APPROACH

Systems Engineering is a collaborative multidisciplinary engineering approach to develop, follow up and verify a life-cycle balanced system solution that meets stakeholder expectations (LOUREIRO, 1999).

Systems Engineering has its main focus on defining the needs and required functionality of customers in the early stages of the development cycle, with emphasis on formalization and registration of these requirements, and then to proceed with the design synthesis and system validation, considering all aspects of the system: operations, cost, schedule, performance, testing, fabrication, training, support and disposal. Systems engineering considers the business aspects and technical needs of all customers in order to offer a quality product that meets the user's needs. (INCOSE 2004).

According to NASA's Handbook, which is one of the models for using Systems Engineering concepts for space projects, project management consists of three main objectives: managing the project team, managing the technical aspects of the project and managing the project cost & schedule. As shown in Figure 2, these three functions are interrelated and complementary.

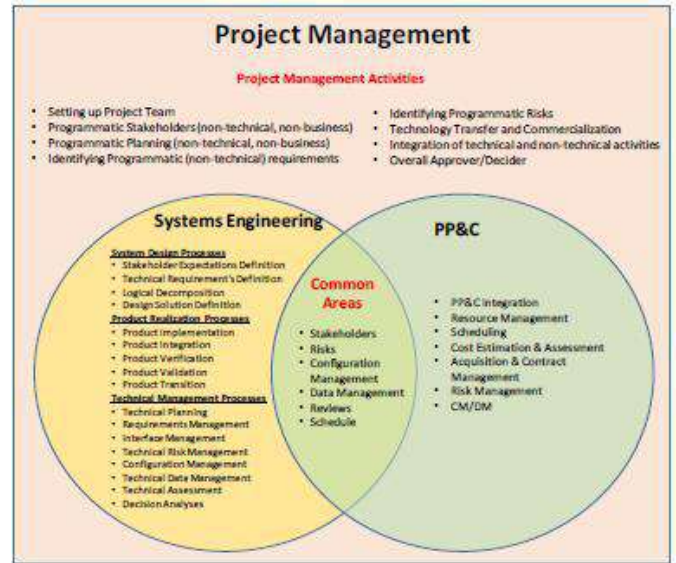


Fig. 2: SE as context of Overall Project Management [NASA SE Handbook 2017, fig. 2.0-1].

According to Fig. 3 (NASANPR 7123.1B,2013), systems engineering requires a systematic and disciplined set of processes that are recursively and iteratively applied to design, development, operation, maintenance and closure of systems, throughout overall programs and projects lifecycle.

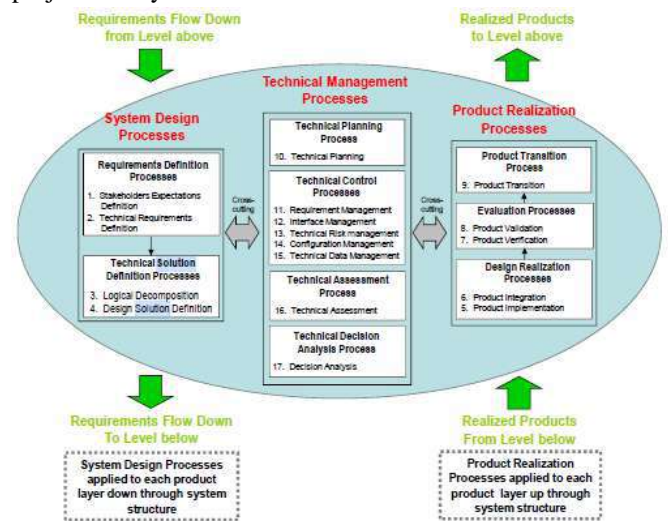


Fig. 3: SE engine [NASA NPR 7123.1B-, 2013, fig. 3-1].

As shown in Fig. 3, the evolution of systems design and product execution processes are supported by the technical project management process. In the case of space products, often all activities represented in the diagram are performed by professionals with a background in systems engineering, due to the particularities of the final product. When the system under development is an infrastructure for the space sector, there are design and implantation specificities that complement the requirements of the activities or systems which will be operated in the



infrastructure, often extrapolating the experience and specific technical knowledge of the system engineers involved in the project.

The systems engineering approach in the management of the technical aspects of the project, with emphasis on the definition of technical requirements and the definition of the project solutions is extremely useful in the requirements definition and executive project development phases of an infrastructure implantation for space segment projects.

### III. PROJECT MANAGEMENT APPROACH

We can define Project Management (PM) as a multidisciplinary approach consisting of a set of management processes, focusing on the definition of resources, planning and control of activities aiming the successful implementation of projects, achieving all the project requirements.

As projects evolve in complexity and importance, a segment of the professional community associated on the Project Management Institute (PMI) and involved in project management has identified best management practices and recorded this information in the PMBOK (Project Management Body of Knowledge) guide, designed to develop and disseminate project management best practices that are widely accepted in professional and academic circles. As per PMBOK best practices, project management is divided into five process groups:

- a) Initiating
- b) Planning
- c) Executing
- d) Monitoring and Controlling
- e) Closing

As shown in Figure 4, the integrative nature of project management requires interaction between its process groups for the correct evolution of projects.

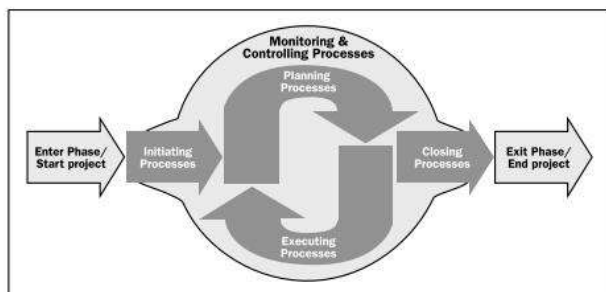


Fig. 4: Project Management Process Groups [PMBOK,2008, fig. 3-1].

According PMBOK, to be an efficient Project Manager, one requires flexibility, good judgement, strong leadership, negotiating skills and a solid knowledge of project management practices. The project team is a group of

professionals involved with management of the project and individuals with knowledge of the particularities of the installation or characteristics of the equipment and activities which will be performed on the facility.

PMBOK divides project management into ten knowledge areas, each of them containing the five process groups and their recommended processes.

Considering PMBOK's recommendations that process selection for each project should be tailored for the project's characteristics, an illustrative example of project management process for a large space infrastructure is shown in table 1.

Table 1: Project Management Process Groups and Knowledge Areas Mapping tailored for a specific project

KNOWLEDGE AREAS	ACTIVITIES BY PROJECT MANAGEMENT PROCESS GROUPS		
	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group
6. Project Schedule Management	6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activities Durations 6.5 Develop Schedule		6.6 Control Schedule
7. Project Cost Management	7.1 Plan Costs Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs
9. Project Resources Management	9.1 Plan Resources Management 9.2 Estimate Activities Resources	9.3 Acquire Resources 9.4 Develop Project Team 9.5 Manage Team Project	9.6 Control Resources
12. Project Procurement Management	12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements

[based on PMBOK,2017, table 3.1].

### IV. INTEGRATED MANAGEMENT APPROACH

The objective of the expansion project of INPE's Integration and Testing Laboratory for satellites is to increase the capacity for manipulation, assembly, integration, and functional & environmental testing of large satellites (telecommunications class) and their subsystems in its various stages of integration. This article reports the main aspects of the approach used in the first phase of the expansion project, which includes the elaboration of the complete executive project, the construction of the Area 2, destined to the implantation of the testing equipment and its utilities. In Figure 5 we can see the representation of the current laboratory layout and the two areas covered by the expansion project (Area 1 and Area 2).

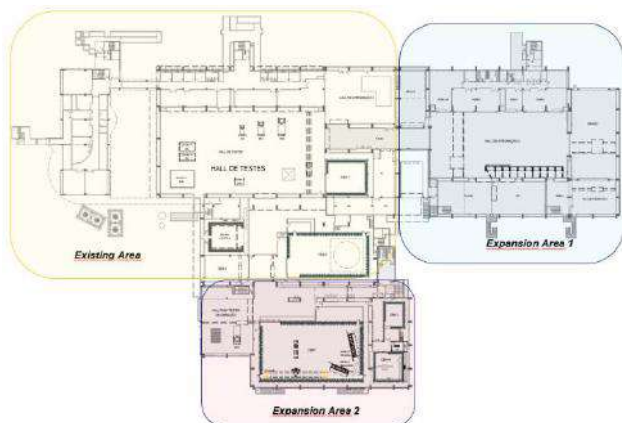


Fig. 5: LIT expansion project layout including new areas 1 and 2.

According to Ermes et al (2012), Project Management and Systems Engineering are highly overlapping endeavors and, while the SE has the primary responsibility of ensuring the quality and performance level of the deliverables, PM is responsible for ensuring that the project is completed in conformity with cost and schedule, following the quality requirements.

In infrastructure projects implantation, activities are often divided into two distinct phases: the design phase and the construction phase. According Sharon et al (2010), the technical issues are related to the product domain and the managerial aspects are related to the project domain. In the design phase, we are in the product domain and the main activity to be developed by the technical team is to define the requirements and functionalities desired for the installation. In this phase it is necessary to define the equipment which will be installed in the infrastructure, even preliminary, to avoid missing the necessary interfaces between the operational equipment installation and infrastructure utilities. In the construction phase we are in the project domain and the main activities are related to the management of the project evolution, making sure the targets established are met.

To compose a team for managing a complex project, Eisner [2013] proposes an organization chart consisting of three main roles: the Project Manager (PM), a Chief Systems Engineer (CSE) and a Project Controller (PC). According to Eisner, the CSE is responsible for the systems integrity of the overall system. The PC is responsible for scheduling, costing, resource assignments, facilities and contract related activities. All activities are coordinated by the PM.

According to the European Cooperation for Space Standardization [ECSS 2009], in its ECSS-M-ST-10 standard, project implementation activities can be carried out by a single project group, composed by a group of

specialists who master all the project disciplines or, more often, by a project group that serves the core operational activities, complemented by the support of an outside staff or technical experts for other specialties not covered by the project team.

To implement the INPE’s laboratory expansion project, the project team was established including members of the laboratory test operational teams whose main profile is systems engineering with knowledge on the equipment and operations to be performed in the new installation and members of the engineering group, specialists with extensive experience in Project Management, including the elaboration of procurement public processes, infrastructure project and building works management. Figure 6 represents the organization chart established for the LIT expansion project.

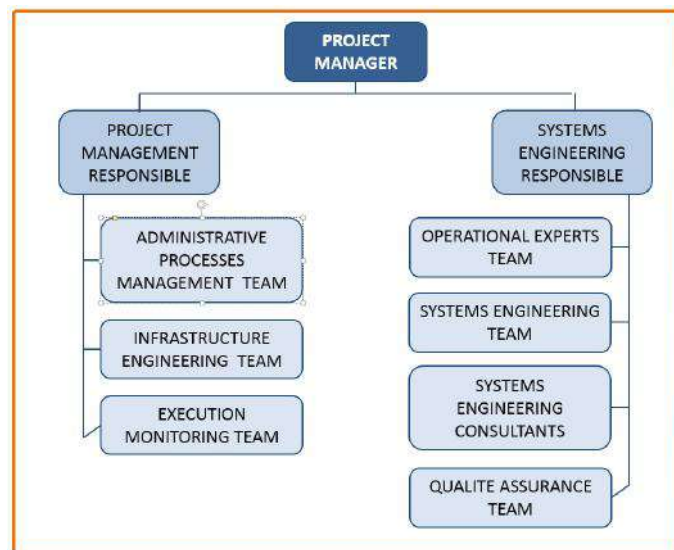


Fig. 6: LIT laboratory extension project group organizational chart.

According to the Guide for the Application of Systems Engineering in Large Infrastructure Projects from INCOSE (2012), large infrastructures projects are composed by the lifecycle indicated in fig. 7, and the activities can be classified in two main stages: the development of an engineering solution in the form of a detailed design (executive project) and the execution of the solution by procuring contractors to build the solution.

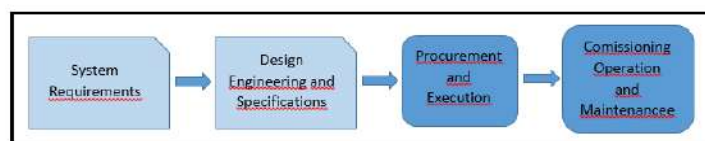


Fig. 7: Traditional Lifecycle for Large Infrastructure Projects [based on INCOSE-TP-2010-007-01, 2012, fig. 2.1].

In the LIT expansion project, the technical requirements of the equipment to be installed, its interfaces with the building, utilities and its conditions for installation and operation were conducted by team members with knowledge in systems engineering, coordinated by the "Systems Engineering Responsible". Specialists of the laboratory also participated actively in these activities, as well as national and international consultancies specialized in activities for the space segment.

The main equipment to be installed in the New Area 2, as illustrated in figure 8, is specifically designed to perform sophisticated and high precision tests. This equipment's performance is sensitive and can be strongly impacted by civil works and utilities interfaces.

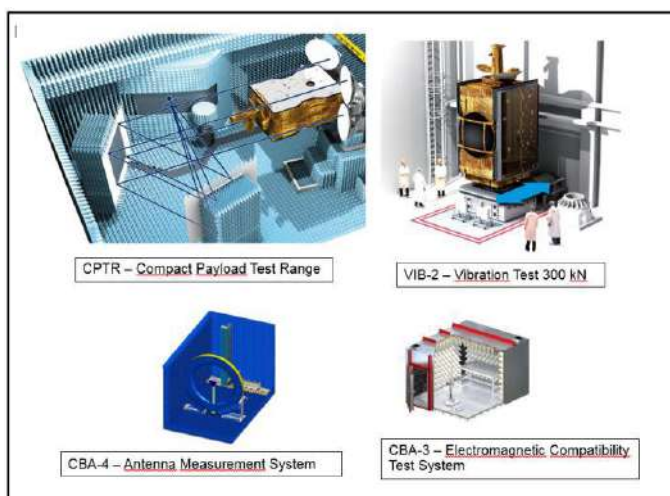


Fig. 8: Illustration of the main equipment to be installed.

The executive project of utilities and the introduction of the functional aspects of installation for areas such as maintenance, administration and technical operational support were defined in majority by the technical team of engineers with experience in implementation and monitoring of execution works. The definition of the scope of services to be contracted and material purchasing, the management of the delivery schedules of goods and services, the quality of the work execution and the acquisitions process were performed by the team members who presented project management profile, coordinated by the "Project Management Responsible".

The first phase of the project, including the elaboration of the complete executive project, the execution of the civil works and installation of utilities, was budgeted at around US\$ 10 million. We can see in figure 9 images with the chronology of the evolution of the civil works. The works were executed in accordance with the scope, costs and schedule defined for this phase.



Fig. 9: Evolution of the works on LIT laboratory extension project.

## V. CONCLUSION

The methodology used in the development of LIT expansion project activities sought to integrate the concepts of development and management of space systems advocated by the System Engineering discipline to the aspects of organization and management of large projects disseminated by the Project Management discipline.

The project was developed in its initial phase through one of the pillars of the systems engineering discipline, which is the definition of requirements, by the initial identification of a problem to be solved and the subsequent definition of the needs of the system to be developed.

The systems engineering team, by analyzing the activities to be developed in the infrastructure and the characteristics of the test equipment needed to perform these activities, elaborated the technical requirements that the infrastructure should meet for these needs. These requirements guided the definition of the infrastructure areas and volumes, as well as the fundamental utility characteristics (electricity, hydraulic, air conditioning) for the test equipment.

The infrastructure engineering team, through the analysis of operational support activities such as administration, maintenance, cleaning, surveillance and security, elaborated the technical requirements that the infrastructure should meet for these needs. These requirements complemented the guidelines for preparing the infrastructure layout, as well as complementing and consolidating the fundamental characteristics of utilities with the administrative needs of IT, access control and asset security surveillance.

Upon completion of the requirements definition and registration in the technical specification documents of the services, the administrative processes group elaborated the procurement processes, complementing the technical specifications with the technical requirements for suppliers



qualification of project, execution, supply of materials and equipment, observing the legal requirements for contracting these services, following the procedures which are mandatory for a project financed by public resources. The integrated approach used serves as a reference for future projects for the implementation of large space system infrastructures that may be implemented by similar institutions, as well as the basis and inspiration for further complementary studies aiming at the development of the integration theme between Systems Engineering and Project Management applied to the development of complex projects.

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# Antinociceptive and physiological effects of subcutaneously administration of fentanyl in *Trachemyssp.* (Testudines: Emydidae)

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**Abstract**— Control of pain in reptiles is a challenge and there is few information about it. This is the first study that evaluate fentanyl on testudines, of genus *Trachemys sp.* A total of 30 animals were used, 15 *T. dorbigni* and 15 *T. scripta*. Two groups composed of ten specimens each were created, as well as two control groups of five animals, for each species. A dose of 0.05 mg/kg of fentanyl was administered to experimental groups, and a 1 mL/kg physiological solution was administered to control, all subcutaneously (SC). The reptiles were monitored in terms of the color of the oral mucosa, cloacal temperature and heart rate, response to the nociceptive stimulus, and myorelaxation. The effects started 10 minutes after the administration and lasted  $134 \pm 26$  minutes and  $120 \pm 20$  minutes for *T. dorbigni* and *T. scripta*, respectively. In 80% of the animals, there was a total absence of reaction to a nociceptive stimulus, with an average duration of  $39 \pm 10$  minutes for *T. dorbigni* and  $30 \pm 12$  minutes for *T. scripta*. It was concluded that fentanyl 0.05 mg/kg SC is capable of promoting the absence of nociceptive response in *Trachemys sp.*

**Keywords**— Analgesia, opioid, red-eared slider, Testudines.

## I. INTRODUCTION

The genus *Trachemys* of the Emydidae family has the widest distribution among the semi-aquatic testudines in America [1]. In Brazil, it is naturally represented by *T. dorbigni* species, in the south, and *T. adiutrix*, in the north [2]. The *Trachemys scripta elegans* species naturally occurs in North America and is included in the International Union for Conservation of Nature (IUCN) list of 100 high-potential invasive exotic animals [3].

Popularly known as red-eared slider, specimens of *Trachemys* adapt to a wide variety of habitats, diets, and conditions, and have high growth and reproduction rate [4]. The population interest for trading and keeping these animals as pets, coupled with the lack of knowledge about the biology of *T. scripta elegans*, represents an even greater

impact on the global distribution chain of these turtles as an invasive species, which is worsened by their indiscriminate release in unnatural habitats [5].

For centuries, philosophers and scientists have debated the perception of pain by animals. There is controversy regarding the correspondence of structures present in the central and peripheral nervous system among mammals and animals of other orders. Although data is scarce, recent studies prove the ability of reptiles to detect and process nociceptive stimuli, and pain is now recognized as one of the vital signs and an integral part of the entire patient assessment [6].

Reptiles have the brain structures required for perception of nociceptive stimuli in the neocortex and, morphologically, there are direct spinal connections with the



brainstem and dorsal thalamus of the mesencephalon, as well as endogenous opioid receptors [7]. The mu, kappa, and delta-opioid receptors have been described in the central nervous system of reptiles [8]. However, pain information is still lacking in these animals and protocols are often extrapolated from domestic mammalian medicine, which is one thing that must be thoughtfully undertaken [7].

Different studies have evaluated the efficacy of reptile anesthesia and chemical containment protocols, and most available literature indicates the use of  $\mu$ -opioid receptor agonists as the best option for producing analgesia.<sup>8</sup> Fentanyl is a  $\mu$ -opioid nearly 75 to 100 times more powerful than morphine, it has short latency and period of action when administered via intramuscular, subcutaneous or intravenous bolus [9].

The efficacy of fentanyl citrate in reptiles has not been well determined; however, in a study of *Python regius* specimens, plasma concentrations reached 1 ng/mL after 4 hours of application of transdermal fentanyl (12.5 ng/h). The active ingredient was detected for 4 to 6 hours, with a significant reduction in respiratory rate in animals by 23% and 41% after 24 and 48 hours of patch application, respectively, but there was no change in response to nociceptive thermal stimulus, which indicated  $\mu$ -dependent antinociception resistance in this species [10].

In another study on a *Coruciazebrata* lizard species, fentanyl plasma concentration was detected after 4 to 6 hours of application of a 25  $\mu$ g/h patch over 10% of the animals' body surface, and lasted for up to 72 hours [11]. Given the lack of statistical data and the variability in species-specific response, the biological significance for fentanyl plasma concentrations is not yet clear, so the antinociceptive action of the drug requires further study [12].

Despite the use of preventive analgesia to avoid pain chain sensitization in pre-, trans- and post-anesthetic phases, little is known about the nociceptive mechanisms, pharmacological efficacy and adverse effects of analgesics in reptiles. Among the potent analgesic drugs used in veterinary medicine, opioids act on the modulation of peripheral, medullary and supraspinal central nervous system (CNS) nociception [13]. Given the above, the present study aimed to evaluate the effects of subcutaneous fentanyl citrate (SC) in *Trachemys dorbignii* and *Trachemys scripta elegans*.

## II. MATERIAL AND METHODS

Thirty healthy adults of both genders of the genus *Trachemys* were used, with body weight between 750g and 1800g, being half of the species *T. dorbignii* (DG) and the

remaining *T. scripta elegans* (SG). For each species, two random groups were created with five specimens for the control group and ten specimens for the treated groups.

The animals were weighed on a digital scale (Balmak, model ELP-6/15/30, with a capacity of 30kg and precision of 2 g, Campinas, SP, Brazil) and marked on the carapace with tape and pen. To monitor the ambient temperature, a digital thermo hygrometer (Incoterm, Porto Alegre, RS, Brazil) was used and the research was conducted in October and November, with an ambient temperature between 25 and 29°C.

The administration of fentanyl citrate (Fentanest<sup>®</sup>, 0.05 mg/mL, Laboratorial Cristalia Chemicals Pharmaceuticals Ltda., Itapira, SP, Brazil) at a dose of 0.05 mg/kg subcutaneously (SC) was evaluated. The drug was applied to the left thoracic limb region [14] by previous antisepsis with 70° GL alcohol. Control groups were given water in the volume of 1mL/kg, SC.

The effects of nociceptive stimulus-response, heart rate, cloacal temperature, and mucosal color were observed. For the evaluation of the first parameter, the von Frey pressure test [15] was performed with the aid of a 16cm Kelly hemostatic forceps with the latex coated serrations [16], [17]. Sufficient pressure was applied to produce nociceptive stimulation in interdigital tissue (superficial pain), phalanges and tail end (deep pain).

The nociceptive stimulus was performed before the drug application, signed as time zero (T0) and, after every ten minutes, until the reaction return equivalent to T0. It was considered the reaction to the painful stimulus movements of the head to the side of the pinched limb and the retraction of the stimulated limb, neglecting movements produced by touch or fright to approach. This parameter was classified into four scores: 0 for response equivalent to T0, 1 for response reduction, 2 for intense response delay, with slight reaction to the stimulus, and score 3 for no response to clamping.

Heart rate was monitored using a vascular doppler (MEDPEJ. Ribeirão Preto - SP. Brazil) [18] with a probe positioned between the thoracic limb and neck, counting for one minute. This evaluation was performed at T0 and thereafter every 20 minutes until normal reactions returned. The cloacal temperature was also monitored with the aid of a digital thermometer (Incoterm, Porto Alegre, RS, Brazil) with degrees Celsius scale from -50°C to 300°C, inserted up to 2 cm inside the cloaca.

As respiratory movements were masked by physiological apnea and voluntary movement, it was decided

not to perform respiratory rate monitoring. However, oral mucosa staining was observed every 10 minutes to assess peripheral tissue oxygenation [19].

Data on the onset of drug action, duration of no response to clamping (score 3) and return to nociceptive response equivalent to T0 were also recorded. The collected data was analyzed through the BioEstat 5.3 program [20]. Data distribution patterns were analyzed and the average among T0 and the other times within each group were compared, as well as the difference in latency time, deep sedation duration and total recovery between the control and treated groups.

### III. RESULTS

In the first evaluation interval after fentanyl citrate application, signs of deletion in the nociceptive response were observed in all (100%) *T. dorbigni* and in nine (90%) *T. scripta elegans*. This last specimen of SG showed signs of analgesia from the second evaluation at 20 minutes.

Nociceptive response deletion (score 2) was observed in all (100%) animals treated with the 0.05 mg/kg SC fentanyl citrate protocol and only two individuals (20%) from each group did not achieve the complete absence of response to clamping (score 3).

The heart rate of the two species did not vary statistically when compared with the initial frequencies (T0) and the control group (Graph 1). The DGan average of  $32.2 \pm 3.01$  beats per minute (bpm) and its control group presented  $33.3 \pm 2.86$  bpm ( $P=0.4139$ ). While SG presented  $33.5 \pm 3.62$  bpm, and its control group showed  $31.2 \pm 2.34$  bpm ( $P=0.1096$ ).

Regarding the cloacal temperature, it remained between 24 and 28°C, with averages and standard deviations of  $25.2 \pm 0.97^\circ\text{C}$  and  $26.3 \pm 1.95^\circ\text{C}$  for *T. dorbigni* and *T. scripta*, respectively. Also, there were no statistical differences ( $p > 0.05$ ) between the time intervals for the effects of fentanyl citrate on the two species tested (Table 1).

Graph 1. Average in minutes of heart rate of *Trachemys dorbigni* and *Trachemys scripta elegans* on subcutaneous fentanyl citrate 0.05 mg/kg

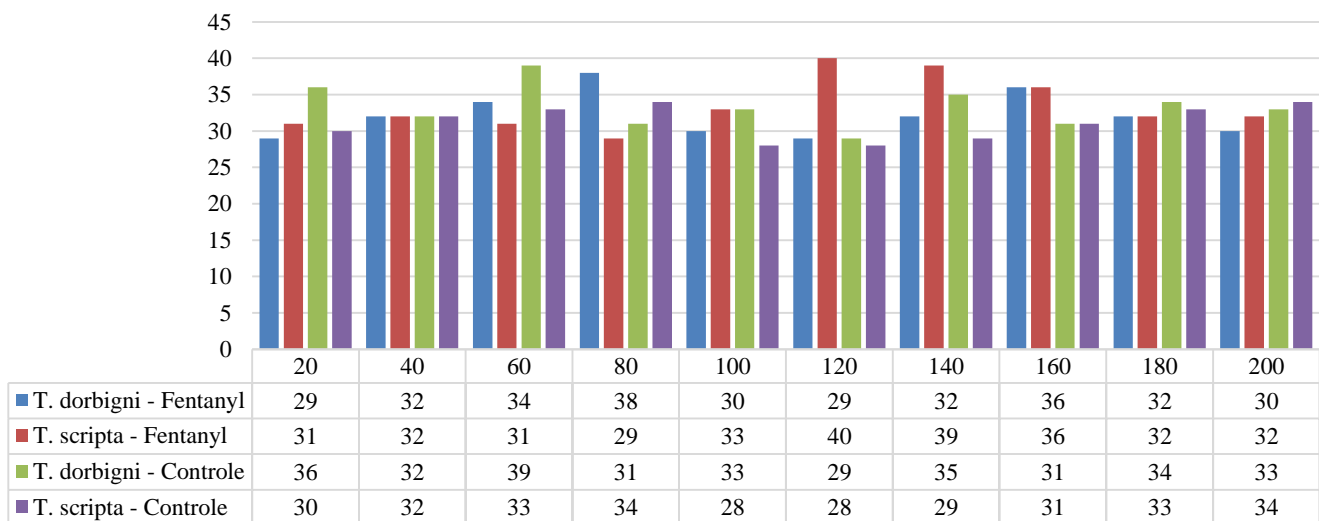


Table 1. Average and standard deviation, in minutes, for latency, the total absence of nociceptive response (TANR), TANR duration and end of action of subcutaneous fentanyl citrate 0.05 mg/kg in *Trachemys dorbigni* and *Trachemys scripta elegans*

	<i>Trachemys dorbigni</i>	<i>Trachemys scripta elegans</i>	<i>p</i>
<b>Latency</b>	10 ± 0	11 ± 3,16	0,33
<b>TANR</b>	20 ± 11,55	15 ± 10,8	0,33
<b>TANR Duration</b>	45 ± 16,90	36,25 ± 15,98	0,62
<b>End of action</b>	144 ± 25,9	131 ± 19,12	0,21

#### IV. DISCUSSION

No loss of proprioception, central nervous system depression and/or loss of consciousness were observed in any of the animals evaluated. These findings confirm observations made by Bouts and Gasthuys[21] when describing reptiles' resistance to opioid depressive effects.

As a high-affinity agonist opioid to  $\mu$  receptors, fentanyl citrate belongs to the class of opioids best suited to achieve satisfactory analgesia in invasive procedures [8], [22], [23]. Waara-Wolleat et al. [24] describe fentanyl as an ultra-rapid, short-acting, and high-potency analgesic. In agreement with the authors, practically all experimental animals showed signs of analgesia within 10 minutes after subcutaneous application, and 80% of them showed a total absence of response to nociceptive stimulus lasting about 15 minutes.

Analgesia produced by fentanyl citrate at 0.05 mg/kg SC confirmed its analgesic potential. Compared with butorphanol and morphine [13], [25], it has higher analgesic capacity and shorter duration, since the other two drugs remain active in the animal organism for more than 24 hours. In *Salvatormerinae*, between morphine and butorphanol, only morphine promoted antinociception at doses of 5 and 10 mg/kg [26]. Similar to fentanyl, tapentadol, another  $\mu$ -opioid receptor agonist, has also demonstrated effective analgesia in *T. scripta* after a single intramuscular application at a concentration of 5 mg/kg [27], [28].

Although the subcutaneous route of administration is ineffective in reptiles because it is a poorly vascularized and slowly absorbing region [12], it is adequate for fentanyl administration. Similarly, meperidine administered subcutaneously in *T. scripta* caused 30-minute analgesic effects on the tested specimens [12], [13].

Hawkins et al. [29] recently investigated the pharmacokinetics of subcutaneous application of the opioid hydromorphone in *T. scripta* and *Pogona vitticeps*. High plasma concentrations were observed after 30 minutes of application for both species and five of the six *Pogona vitticeps* showed decreased response to stimuli at 1.0 mg/kg. However, none of the turtles showed signs of clinical sedation at any dosage [29]. In the present study, fentanyl caused a lack of nociceptive response similar to the 30-minute SC hydromorphone peak.

Darrow et al. [30] evaluating the transdermally applied plasma fentanyl concentration in two *Python regius* specimens, noticed a high and continuous plasma concentration of the active principle during the seven days of evaluation, without behavioral changes. Kharbush et al. [31]

researched the same pathway in *T. scripta*, and also detected high plasma concentration, however, with no change in thermal antinociception. This may have been due to the resistance of this species to  $\mu$  agonist opioids or to a variation in response to thermal stimuli in these ectothermic individuals, since in the present study, the pressure stimulus was reduced with the drug. According to Mark & Tully[32], reptiles do not have the same natural reflex to avoid the heat found in vertebrates of other classes, which makes them stay in contact with the thermal source even when trauma occurs. Therefore, there is divergence on the reliability of the use of this type of stimulus in analgesic evaluation.

Fentanyl has excellent fat solubility, which contributes to its distribution and binding to nervous tissue [33]. Besides that, hypotension and bradycardia produced by most  $\mu$ -receptor agonist opioids are caused by histamine release, but fentanyl citrate does not stimulate such release [34]. This property reflected the absence of change in heart rate of the specimens of the present study and corroborates with Lervik et al. [35] and Williamson et al. [36], which cite the cardiovascular stability provided by fentanyl citrate.

Fentanyl overdoses can lead to intense muscle stiffness in mammals[37] and a drastic decrease in spinal cord sensitivity to carbon dioxide partial pressure (PaCO<sub>2</sub>), resulting in marked respiratory depression [33], [38]. This fact may elucidate the episodes of apnea observed in the present study, but it is worth noting the advantage of opioid antagonists such as naloxone [39], [40]. Despite the apnea, the reverser was not used in the specimens of *Trachemys* sp., in order not to compromise the duration evaluation. To monitor the absence of tissue hypoxia, mucosal staining was evaluated, which remained stable compared to T<sub>0</sub>. The worked dose was previously used by Souza[41] in *Trachemys* sp. as pre-anesthetic medication, using propofol as inducer, but without detailing the effects of fentanyl specifically.

Respiratory depression is the main risk factor for opioid use. From the monitoring of mucosal staining and the presence of sporadic breathing movements, it was decided not to promote assisted ventilation indicated by Frye[19]. The animals were still alert during the evaluated period and obtained a safe return with the dose used, without associated deleterious effects. The central nervous system of reptiles has resistance to hypoxia and apnea is a physiological event for Testudines [42], [43]. Additionally, the cloacal temperature in the treated groups followed the values presented by the control groups, according to Hicks and Wang [43], [44], the

presence of hypoxia can be induced by hypothermia in reptiles.

## V. ETHICAL CONSIDERATIONS

This study was approved by the Ethics Committee on Animal Use of the Federal University of Uberlândia (CEUA/UFU), protocol 080/12, and authorized by the Biodiversity Authorization and Information System (SISBio), protocol 63133-1.

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# Solid Waste Management in a Civil Construction Company in Amazonas

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**Abstract**— The construction industry occupies a prominent position in the Brazilian economy, but it is a major generator of environmental impacts that result in the formation of degraded areas. Thus, the development of construction activities that are more appropriate to the principles of sustainable construction, which do not cause so many degrading actions, is inevitable. Concern with the environment has brought an alert where various sectors of society are involved, promoting environmental education actions, so it is called for the strong and effective participation of all agents involved (public sector, owners, companies, engineers and architects, teachers and students, collectors' associations) for a common good - the sustainability of cities. Therefore, there was an initiative to verify if the construction companies are actually reusing to reduce waste and extracting more raw materials and offer subsidies so that the environmental problem can be faced in this construction company by giving appropriate waste disposal.

**Keywords**— About five key words in alphabetical order, separated by comma.

## I. INTRODUCTION

Taking into account society's growing concern with environmental preservation and sustainable development, civil construction has a gum of needs, given the amount of waste generated.

To carry out the study of a solid waste management plan of the companies, we observe the different forms of treatment, material used and thus contribute to reducing material waste and incorrect disposal in the environment, in order to minimize the impact caused by these. waste, which highlights its importance in the management process, since civil construction is necessary for urban development.

Still, it is justified to understand this analysis by the fact that all unsustainable issues that impact the environment on people's lives should verify the effectiveness of the process seeking to mitigate the negative effects caused by inappropriate actions.

The transformation process that society is going through today leaves significant consequences on the environment that arouse society's attention. This transformation has increased the production of solid waste resulting from increased buildings and new building standards.

Law 12.305 [1], established the National Policy of Solid Waste (PNRS), proposing the prevention and reduction of solid waste production, where in article 3 it is

observed that the amount of this material generated by civil construction has been the subject of discussions. , given its quantity causing numerous urban, social and economic problems.

The environmental problem generated by the waste that is unregulated in clandestine landfills, shoulders and highways must be solved in order to preserve the environment. Actions have been created to reverse this situation, such as Resolution [2], which establishes guidelines, criteria and procedures for the Management of Construction Waste and creates the chain of responsibilities: generator - transporter - municipalities.

Solid waste, according to [3], is all material discarded from commercial activities, industries, domestic, among others, i.e. products for which there is no economic interest. In the case of civil construction, the disposable result is rubble, which comes from the enlargement, reconstruction, alteration, conservation and demolition of buildings.

According to [4] construction wastes can be classified into class A, wastes that can be reused even in construction; Class B, used for other purposes; Class C, which has no economic demand; Class D hazardous waste and Class E common waste.

The current consumer culture contributes to the productive development of various sectors. Where according to [5], it provides an increase in the amount of

waste to be disposed of. Thus, according to the PNRS, described by [1], all regions of Brazil should be able to reuse their waste, have recovery sites and eliminate irregular disposal by 2027, minimizing the impacts generated by the lack of articulation for a correct management.

Waste produced by construction requires greater attention, especially aggregate volume debris, which according to [6] may account for more than half of solid waste generated in urban areas. This construction waste causes important environmental problems, such as the siltation of urban drainage systems and also important social problems, as their irregular deposition in the urban network imposes heavy costs on society, diverting scarce resources.

For [7], environmental management is on the agenda of government and companies, seeking alternatives to minimize the effects of economic development on the environment, aiming to reduce the consumption of raw materials and solid waste production.

Construction is one of the fastest moving branches of the economy. Thus, [4] says that construction companies should proceed according to a PGRCC construction waste management plan, meeting the plan guidelines. For [8], the management of solid waste GRS, must collect, transfer, treat, recycle, recover resources and release them even in urban areas, involves cooperation between public and private sectors.

The solid waste management plan in civil construction is foreseen by law, since it is part of actions that aim to minimize the impacts of this waste on the environment, besides contributing to the reduction of the high expenses by the public administration with cleaning in the uneven dumping sites.

Resolution 307 of [2], later amended by [9], established important references for the management of this waste and that are already beginning to generate demands for manufacturers of different materials. The construction project must estimate the waste to be generated and specify legal destinations for the material generated.

According to [1], debris generators are responsible for the reintegration of the material into the production process and may be disposed of in appropriate places for temporary storage. The only inert waste sent to landfills is from excavations. The implementation of a reverse logistics network for the processing of construction waste that caters to small generators scattered around the city, with the creation of adequate infrastructure for segregation of materials at source, seems to be the only viable way to

provide the same type of waste. treatment currently given to the residues of major works with installed sites.

The current linear industrial process, with construction waste generating significant waste and environmental impacts on the urban environment, must be replaced by a sustainable circular logistics in which waste generated, segregated by class, can be incorporated back into the production chain. , or properly disposed of, producing social, economic and environmental benefits.

Waste management of any kind must be treated seriously to avoid harmful and irreversible consequences. Regarding social relevance, the study will show the importance of waste management for the environment and the quality of life of people. As a scientific contribution, the study will be based on technical standards, in order to describe the management of solid waste quality in a construction company in Manaus / AM.

## II. METHODOLOGY

The methodology to be applied for the analysis will be used a qualitative approach, aiming to make a description of the findings about the solid waste management plan of the company that will be object of study of this work that consists basically of five steps: observe, measure, sketch, think and correct.

Experience shows that the great tool of rationalization is thinking, stopping in a given situation and not being afraid to dare. You have to try to go beyond everyday life, venture into unusual solutions, and test and record your results. The analyzed process will be observed, the necessary mediations will be made, time spent in each process, distances traveled, number of people and machines involved.

Rationalization only works if it is viewed as a whole, not just by sticking to one part of the production process, but by joining all the projects together so that they can achieve a good result (Figure 1). When not working in isolation, everything becomes more accessible until resources generate better income. In a work that has a very limited site area, for example, it is paramount to think of the work as a whole, paying attention to the moment when each stage of the work must begin and end, if one stage can be done at the same time. how long does it take, how long does it take to use a certain amount of raw material during the production process, how much available space does it have to store, how many people will be needed to complete this work.

According to [10], rationalization must methodically analyze existing structures and processes in order to discover weaknesses, such as unnecessary waiting times, failures in the preparation and transmission of information,

avoidable intermediate stocks and excessively long transport routes, Then, it is to perceive the possibilities for improvement, analyze them and introduce them to test them and be accepted by those involved. Evolution in the system is the main progress of rationalization implemented in the company.

It is then understood that rationalization is divided into three steps: verification of the company's failures; analysis of the possibility of improvements and; Finally, these are implemented, and each of these steps has methods of working. In the construction industry, rationalization is one of the major factors for success in the industry, as it is highly targeted by the amount of solid waste produced and the image of environmental aggressor [11].

In civil construction the loss and failure are basically related to the waste of materials, but the losses extend beyond this concept and should be understood as any lack of efficiency reflected in the use of equipment, materials, labor and capital, that is, any resource, in quantities greater than those required for the production of the building [12]. According to [13], the waste begins, or originates from all stages of the construction process, which are: planning, design, manufacture of materials and components, execution and use and maintenance.

It is of utmost importance to undo the idea that for the rationalization of the processes to be successful, a large financial investment on the part of the organization is necessary, with the introduction of new construction technologies or the implementation of new equipment in the construction site. The rationalization does not always have complex actions, can be made with small changes in the work routine of workers that will produce better quality in the construction process, saving time, material and labor, and may even end the generation of waste.

According to [10], a methodology for promoting rationalization on the construction site is presented, highlighting that production in civil construction is marked by a series of particularities: individual product, each product has a new production site, short-term projects, workplace subject to climate variations, customer interfering in the production process, among others.

This process makes the construction management always busy keeping the work in progress and managing the issues that arise most actively. With these difficulties, there is little time left to analyze the processes and make improvements, it becomes minimal, where at this point the methods developed in this case study intend to provide subsidies to promote rationalization.

The entire rationalization process takes place at three distinct levels, namely: Type 1 (R1) r rationalization - efforts that aim at material flow, minimizing transport

distances, optimizing the machines employed, improving information exchange, and empowering personnel. involved, focused on the most important factors at the moment - the production process and the construction site; rationalization type 2 (R2) g - efforts that target the overall processes of a company, and the framework that surrounds it, includes the management of support functions: procurement, logistics, new technologies, resource availability, information management, administration and staff development, strategies; rationalization of type 3 (R3) g - organizes the production chain and its interferences in the company's focus. (Figure 1).

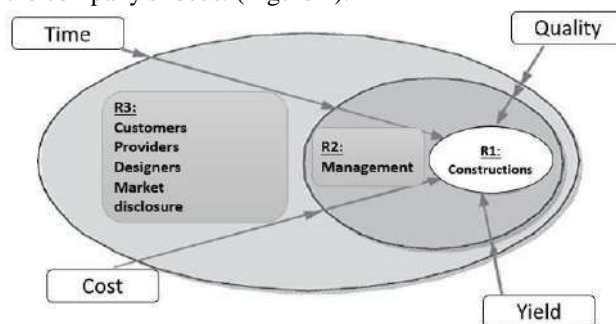


Fig. 1: Rationalization process scheme  
Source: engenhafrankweb.wordpress.com

### III. RESULTS AND DISCUSSION

Table 1 shows the indication of all waste generated on site, according to resolution [2], and, finally, the amount of waste in a month, indicating which materials should be given more attention.

Table. 1: Types and quantities of waste generated

WASTE TYPE	QUANTITY GENERATED (M3 / MONTH)
MORTAR	1,95
CERAMIC COMPONENTS	7,35
CONCRETE	9,75
PLASTER	3,00
WOODS	2,10
METALS	0,75
ORGANIC	0,30
PAPER / CARDBOARD / PLASTICS	0,30
PAINTS AND SOLVENTS	1,35
GLASSES	0,30

Source: Own authorship

For [14], waste generation is directly linked to lifestyle, culture, work, diet, hygiene and human consumption. In Brazil, the transportation of solid waste is regulated by



[15], created with the purpose of regulating parameters to avoid damage to the environment and to protect public health. It was found that the internal transportation of waste is performed by employees with the aid of wheelbarrows, garbage bags or winches, according to the need of the type of waste handled. External transport is carried out by the specific companies that transport each type of waste, which is closely related to the final destination of the waste.

Organic waste, together with paper, plastic and cardboard is collected by the public collection truck and destined for the landfill; construction debris, that is, ceramic components, mortar, concrete and plaster are transported by companies that carry construction debris, the wood is collected by professionals in the bakery industry for use in ovens; Metals are collected by waste pickers or scrap traders. The paints and solvents are placed directly on the ground of the construction site without any treatment.

The following instruments can be adopted: environmental education; environmental monitoring; social and environmental responsibility; waste minimization and recycling; environmental audit; risk analysis; laws, rules and regulations, among others. This whole procedure must be applied to the study of a given process, under the conditions in which it is performed, which we call the existing situation.

After the observation, measurement and recording of the existing situation is completed, we go to the stages of thinking, developing process improvement and if possible simulating the operations in the spreadsheet to have an overview of the effect it will cause. The results are compared, and if they are positive enough to justify the change, a field management plan is implemented. The company needs to reformulate spending so that it can make this management plan without cost and without reaching the environmental plan.

The methodology used in the elaboration of the theme was systemic; seeking to understand information within a context and establish the nature of their relationships. Any action proposed to reduce the impacts of construction on the environment ultimately contributes to the sustainability of the entire planet. Therefore, it is clear that the engineering processes of works to achieve sustainability should not be isolated. The processes should involve various sectors of society, promoting environmental education actions, allowing all involved to have knowledge of the importance and scope of their actions in the pursuit of sustainability as a whole.

During the research period it was found that companies with PBQPHA certification still do not manage the waste

of municipal works according to the guidelines recommended by [2]. The most commonly implemented procedure by companies is the screening of their RCD as a way to market them and thus make some profit, so companies do not place the environmental issue as a priority.

In carrying out the observation, a Waste Management Plan was created, which should establish specific conditions for initial packaging, internal transportation and final packaging of each identified and collected waste.

The initial packaging should take place as close as possible to the waste generation sites, disposing them in a manner compatible with their volume and preserving the good organization of the spaces in the various sectors of the work. In some cases, waste should be collected and taken directly to the final packaging sites. (Table 2).

Table. 2: Initial packaging considering waste type

TYPE OF WASTE	INITIAL PACKAGING
<b>CONCRETE BLOCKS, CERAMIC BLOCKS, MORTARS, OTHER CERAMIC COMPONENTS, CONCRETE, BRICKS AND THE LIKE.</b>	In piles formed near the generation sites, in the respective floors.
<b>WOOD.</b>	In piles formed near the site and arrangement for vertical transport (large pieces).
<b>PLASTICS (PACKAGING SACKS, PIPE SHAVINGS, ETC.)</b>	In raffia bags.
<b>CARDBOARD (BAGS AND PACKAGING BOXES OF INPUTS USED DURING THE WORK) AND PAPERS (OFFICE)</b>	In raffia bags, for small volumes. As an alternative to large volumes: the bales.
<b>METAL (IRON, STEEL, COATED WIRING, WIRES ETC.)</b>	In signposted packaging.
<b>CLADDING PLASTER, CARDBOARDS AND ARTIFACTS.</b>	In piles formed near the waste generation sites on the respective floors.
<b>FAÇADE AND PROTECTIVE SCREENS.</b>	Collect after use and dispose of properly.
<b>HAZARDOUS WASTE IN PLASTIC AND METAL PACKAGING, APPLICATION INSTRUMENTS SUCH AS BRUSHES, BRUSHES AND OTHER AUXILIARY MATERIALS SUCH AS CLOTHS, RAGS, TOW.</b>	Handling with care observed by the manufacturer of the input in the safety data sheet of the package or contaminant of the working instrument. Immediate transport by user to final packaging location.

Source: Own authorship

Internal transport should be specifically assigned to workers who take charge of waste collection at workplaces. They are responsible for exchanging the raffia bags with waste contained in the pails for empty bags and for transporting the raffia bags with the waste to their final packaging sites. Internal transport may use conventional and available means: Horizontal transport (trolleys, manual transport) or vertical transport (freight elevator, rubble conductor). Waste collection routines at established pavement levels should be adjusted to the availability of equipment for vertical transport (crane and freight lift, for example).

For [16], the solution or reduction of environmental problems must start with new attitudes of entrepreneurs and managers who should expand their projects taking into consideration the environment and adopt new administrative and technological measures that contribute to a better lifestyle in the environment. planet.

Ideally, in planning the implementation of the work, there should be specific concern with the movement of waste to minimize the possibility of formation of "bottlenecks". Equipment such as the rubble conductor, for example, can provide better results, speeding up the internal transport of masonry, concrete and ceramic waste (Figure 2).



Fig. 2: Rubble conductor

Source: Own authorship

The final packaging is reserved for defining the size, quantity, location and type of device to be used in the final process of waste rationalization in which this set of factors should be considered: volume and physical characteristics of the waste, facilitation for collection, control of the use of the devices (especially when disposed outside the site), safety for users and preservation of the quality of the waste under the conditions necessary for disposal. During the execution of the work the solutions for final packaging may vary (Table 3).

Table. 3: Final packaging by type of waste generated

TYPE OF WASTE	FINAL PACKAGING
<b>CONCRETE BLOCKS, CERAMIC BLOCKS, MORTARS, OTHER CERAMIC COMPONENTS, CONCRETE, BRICKS AND THE LIKE.</b>	Preferably in stationary buckets.
<b>WOOD</b>	Used stationary buckets.
<b>PLASTICS (PACKAGING SACKS, PIPE SHAVINGS, ETC.)</b>	In identified bags.
<b>CARDBOARD (BAGS AND PACKAGING BOXES OF INPUTS USED DURING THE WORK) AND PAPERS (OFFICE)</b>	In signposted packages or bales, both kept in a covered place.
<b>METAL (IRON, STEEL, COATED WIRING, WIRES ETC.)</b>	In signposted packaging.
<b>CLADDING PLASTER, CARDBOARDS AND ARTIFACTS</b>	In stationary buckets, respecting the condition of segregation in relation to masonry and concrete waste
<b>FAÇADE AND PROTECTIVE SCREENS</b>	Dispose of in an easily accessible place and immediately request withdrawal from the recipient.
<b>HAZARDOUS WASTE IN PLASTIC AND METAL PACKAGING, APPLICATION INSTRUMENTS SUCH AS BRUSHES, BRUSHES AND OTHER AUXILIARY MATERIALS SUCH AS CLOTHS, RAGS, TOW.</b>	In duly signposted bays and for restricted use by people who, during their tasks, handle this waste.

Source: Own authorship

Based on the observations we have seen that this practice not only reduces the amount of waste, but also recovers already produced products, saves raw material, energy and arouses conservationist habits, and reduces environmental degradation [17].

Considering thus the segregation of waste at source prior to transport for any quantity generated; reuse planning and final disposal of waste as part of the project; waste reception points (copoints) in locations scattered throughout the city's neighborhoods; implementation of an efficient infrastructure for the treatment of construction waste aimed at the production of recycled materials; and raising public awareness of the benefits of the initiative and encouraging their participation to ensure the creation of a sustainable culture in relation to building materials.

#### IV. CONCLUSION

The treatment of construction and demolition waste requires a new approach, such as circular logistics with recycling and reuse of materials. Based on the following assumptions, the strong and effective participation of all actors involved (public sector, owners, companies, engineers and architects, teachers and students, waste pickers associations) is called for a common good - sustainability of the cities.

Companies must adapt to the environmental requirements currently imposed, for this adaptation, an environmental management system (EMS) can be adopted in the company, it is the way it has to achieve the desired environmental quality by reaching a goal with the lowest cost. The EMS acts correctly on the due impacts that are occurring to the environment, with preventive and viable measures for the company and, mainly for its image.

In view of the shared responsibility established by Law 12.305 of 2010, it is up to companies to adopt the guidelines and procedures of CONAMA Resolution 307/2002 as a way to improve their management, and the Municipality to support companies by providing transshipment, sorting and processing areas (plant). recycling), thus introducing a cyclical system for the use of the RCD.

The PGRCC final evaluation of the completed executive projects should propose viable alternatives for the correct reduction of waste on the site. And so, all issues that affect the city, whether environment or unsustainable or unsustainable buildings, would have gradually corrected their distortions to achieve ecological and sustainable balance.

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# Main Advantages of Steel in Bridges Construction using improved corrosion

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**Abstract**— The main cause of the poor condition of bridges is the lack of maintenance since the cost can reach 10% of the project and, in the environment, the use of oil-based paint are dangerous air pollutants. So is necessary is the use of Cor-Ten steel as an alternative material for the development of functionality and economy. The total lifetime cost of a weather-resistant steel bridge can be up to 30% lower than a conventional steel cladding. In most cases, opting as a solution for weather-resistant steel is more cost effective than a coated steel optimized for most internal environments. It is known as structural steel with improved resistance to atmospheric corrosion containing alloys of copper, nickel, chromium and silicon; taking a reddish-brown color and over time, it darkens

**Keywords**—Cor-Ten Steel, Weathering Steel, Maintenance, Cost reduction, Atmospheric Corrosion

## I. INTRODUCTION

Corrosion is an important instrument of degradation in steel structures that are affected in a wide range of aggressive environments. Direct exposure to moisture and air pollutants causes steel to corrode at rates that depend primarily on exposure conditions and steel characteristics. [1] This is more important in areas where the level of environmental aggressiveness is high. Atmospheric parameters can lead to metal corrosion, which are temperature, humidity, temperature, solar radiation, wind speed and direction, and air pollutants such as chlorides, sulfur dioxide, carbon dioxide, hydrogen sulfide, etc. [2]



Fig 1. - Corrosion of steel beam

A study conducted between 1999 and 2001 shows that a total of \$ 276 billion was spent on issues related to corrosion in the commercial, residential and transportation sectors. This cost is approximately 3% of US GDP in 1998 (United States GDP in 1998 was \$ 9.09 billion). Corrosion costs in the infrastructure industry to \$ 22.6 billion, of which \$ 8.3 billion was spent on road bridges.[3]

### 1.1 COR-TEN STEEL DESCRIPTIONS

These steels defined in the European standard are intended for use in welded, rivets or bolted structures, whose operating temperature is the environment and must have an improved resistance to atmospheric corrosion.[4] These are not intended to be heat treated, except for products that undergo a standardization forming (lamination process in which the final deformation is carried out within a temperature range such that the state of the material is equivalent to that of would be obtained after a normalization treatment and that allows the specified values of the mechanical characteristics to be maintained even after a new normalization treatment). Stress removal annealing is allowed. As said, it is a steel with improved resistance to atmospheric corrosion, which is added resistance elements, tales such as phosphorus (P), copper (Cu), chromium (Cr), nickel (Ni), molybdenum (Mo), etc. to increase the resistance to atmospheric corrosion, forming a layer of oxides that protects the base metal underlying the influence of atmospheric conditions. [5]

Table. 1: Chemical Composition (%)

Steel Grade		C	Si	Mn	P	S	Cu	Ni	Cr
COR-TEN	Cold rolled sheet	0.08	0.65	0.3	0.09	0.020	0.41	0.48	0.85
	Hot rolled Sheet and plate	0.09	0.6	0.37	0.1	0.022	0.37	0.46	0.92





Fig 3. - Hokkaido Centennial Memorial Tower (1969, 1973, 1977, 1991 y 2010)

## 1.2 STEEL PROTECTION OXIDE IN TIME

### 1.2.1 Protective oxide formation

When weather-resistant steel is exposed to the atmosphere, an orange oxide forms during the first wet period. This oxide resembles the oxide in ordinary steel exposed to the atmosphere. In the surface oxidation of Cor-Ten steel, an oxide film impermeable to water and water vapor is created, which prevents the oxidation of the steel and its progress towards the inside of the piece. [6] A large part of iron corrosion products are retained in the oxide that is formed by the reaction of oxygen present in the air along with the soluble ferrous salts that the corrosion reaction produces. However, some soluble corrosion products are not incorporated into the oxide as evidenced by iron oxide stains on concrete pillars subject to water runoff from exposed steel aging. Subsequent wet periods produce additional rust on the weathering of steel and leakage corrosion products.

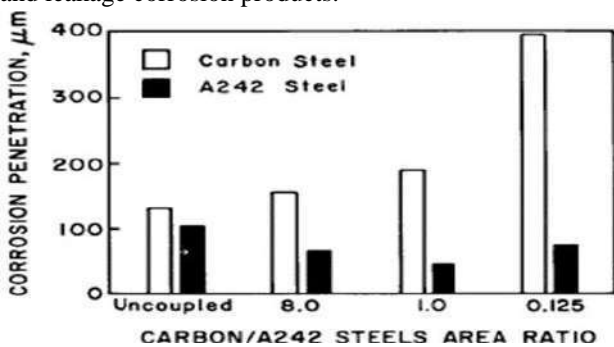


Fig 4. - Corrosion penetration of uncoupled and coupled steels after 6 months in seawater. [Ellis and LaQue, 1951]

Over time, Cor-Ten steel will change to a dark brown, almost purple color. The rate of patina development depends on the degree of exposure to the climate and the presence of pollutants such as chlorides and sulfides in the atmosphere. [7]

### 1.2.2 Benefits of Cor-Ten steel

Depending on the market price of Cor-Ten steel, it may be higher than carbon steels; however, the cost savings by removing the protective coating system generally outweigh the additional costs of the material. The total lifetime cost of a weather-resistant steel bridge can be up to 30% lower than a conventional steel cladding (El Sarraf and Mandeno, 2010). In most cases, opting as a solution for weather-resistant steel is more cost effective than a coated steel optimized for most internal environments.[8]

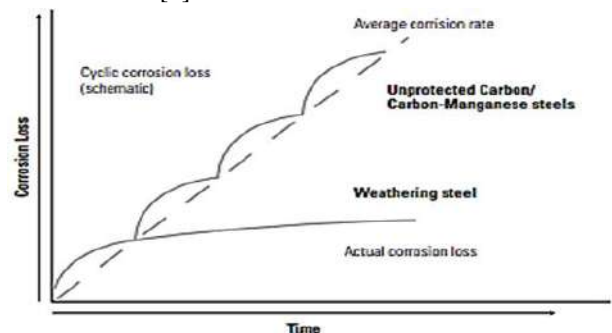


Fig 5. - Schematic comparison between corrosion loss of carbon steels and WS.

## II. DEVELOPING

Weather resistant steels are suitable for use in most locations. However, certain environments may limit the durability of weathering steels. Major problems can occur in environments with constant humidity, an aggressive atmosphere or high levels of air pollution.

### 1.3 No constant humidity

If left in conditions of permanent humidity or humidity, stainless steel will oxidize like any other unprotected carbon steel. A succession of wet and dry phases is required to form a stable oxide layer on the surface. [9]

### 1.4 No aggressive atmosphere

High concentrations of chloride ions adversely affect the adhesion of WS. According to EN ISO 9223, weather-resistant steels should not be used within two kilometers of coastal waters unless chloride levels in the air do not exceed the S2 salinity classification (i.e. Cl <300 mg / m<sup>2</sup> / day). Direct contact between weather-resistant steels and de-icing salts used on roads should be avoided. [10]

### 1.5 No atmospheric pollution

Airborne contaminants and industrial fumes can affect patina development. Corrosion is much higher if the metal surface is covered by solid particles such as dust or dirt. These particles can retain moisture and salts. In an industrial atmosphere, large amounts of sulfur dioxide (SO<sub>2</sub>) [11] are detrimental to the compactness of the patina. EN ISO 9223 advises that weather-resistant steels should not be used without protection in an environment greater than P3 (i.e., SO<sub>2</sub>> 200 mg / m<sup>2</sup> / day).

### 1.6 Different types and grades of Cor-Ten steel

Table. 2: Physical properties

Weather resistant steel	Standard	Tensile Strength Mpa	Yield Strength Mpa	Elongation in 2 inches (min.) %
CORTENA	US steel	470-630	355	20
IRSM 41-97	Indian Railways	480 min	340 min	21
ASTM A 588	ASTM	485 MIN	345 min	21

### 1.7 Different types and grades of Cor-Ten steel

From a practical point of view, an important objective of performing XRD and MS tests was to obtain quantitative data to determine a protective capacity index (EPI) based on oxide mass ratios. In particular, this index would serve to describe the quality (protection) of the WS surface patina. (2006) introduced for the first time a PAI, denoted as  $\alpha / \gamma^*$  (where  $\alpha$  = cumulative mass ratio of species of protective oxides, and  $\gamma^*$  = cumulative mass ratio of species of non-protective oxides), which is defined as: [12]

$$\alpha / \gamma^* = \frac{P\alpha}{P\gamma + P\beta + Pm} \tag{1}$$



Fig.6: Iowa Department of Transportation, Page 46

## 1.8 Process

### 1.8.1 Oxygen Cut

Weather-resistant steels can be cut with conventional oxygen gas equipment that uses procedures similar to those used in steel structures of the same thickness. As for standard carbon steels, Cor-Ten steels should be preheated between 120 and 150 ° C if:

It is customary to use stages that can be identified with letters as in the example:

- The steel sheets have been stored in a cold environment (< 5°C)
- Edges will undergo high stress or deformation in subsequent processes
- An exact thickness is important

### 1.8.2 Cold forming – Bending

Weather-resistant steels can be processed with conventional manufacturing methods. A minimum internal radius for bending of 90 ° is recommended, which depends on the thickness of the metal:

Table. 3: Minimum bending radius

Minimum bending radius			
Thickness (mm)	1.3 to 3	3 to 10	10 to 13
Inner radius $\mu$ (mm)	1.5	2	3

The radius can be reduced in the direction of flexion. Local surface grinding is recommended before bending. The pressure setting must be adapted to the type of material. A normalization phase may be necessary depending on the level of deformation. [13]

### 1.8.3 Hot Forming

Hot forming is recommended for:

- Plates over 20mm
- Sheets below 20 mm if the equipment does not have enough power to cold work

### 1.8.4 Normalising heat treatment

The reheating temperature should be set between 900 and 950°C and followed by air cooling. Annealing to restore the initial mechanical characteristics of the weathering steels is not required.

1.8.5 Bolding and Welding Weathering Steel

Welding and screwing are acceptable methods of joining steels for connections. To avoid the excessive development of corrosion, any space must be small enough to prevent oxygen and moisture from reaching the surface. Welding is the best option, since it is easy to perform. Welded joints eliminate spaces where water and moisture can accumulate and create favorable conditions for corrosion.

1.8.5.1 Bolding

Eurocode EN 1993-1-8 provides specific spacing values for bolt holes in weathering steels. If the shape or contour makes it difficult to closely fit nuts and bolts, the joint should be sealed. Alternatively, an anti-corrosive paint should be used on the contact surface. Bolts, nuts, and washers are available in weathering steels. They meet the requirements detailed in ASTM standards A325 and A490 (type 3). Experience shows that stainless steel bolts are also suitable for use with weathering steels. As their mass is negligible, no significant galvanic corrosion occurs. However, galvanized steel should be avoided for bolts and fasteners.

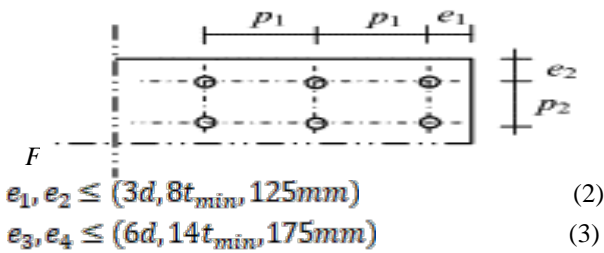


Fig 8.- Accumulation of sediments in the lower string of the truss (Bridge over the Pirris River - National Route 226)

1.8.5.2 Welding

Cor-Ten steel has excellent weldability thanks to its low carbon content and fine grain. It is compatible with all standard welding processes, including submerged arc, armored metal arc, gas metal arc and flux core arc welding. [14] All joints must be continuously welded to avoid moisture and corrosion by local contact.

In pure steel applications, special electrodes should be used if the welds need to reach the required level of (see table 3):

- Strength

- Corrosion resistance
- Weathered appearance (similar to that of the base metal)

$$f_c = \delta_b f_{2b} + \delta_s f_{2s} \tag{4}$$

$$M_c = \delta_b M_{2b} + \delta_s M_{2s} \tag{5}$$

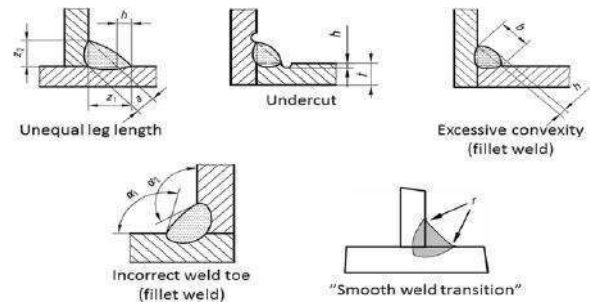


Fig.9: Types of welding

Table IV.- Welding filler Cor-Ten steel

Proveedor	Referencia	EN ISO	AWS
Esab	OK Autrod 12.51	440 / G3Si1	A5.18 / ER70S-6
	OK AristoRod 13.29	12534 / GMn3Ni1CrMo	A5.28 / ER110S-G
Lincoln Electric	LNM 28	12070 / G465MG3Ni1	A5.28 / ER80S-Gt
	LNM Ni1		A5.28 / ER80S-Ni1t
S. A. F. Air Liquide	Nertalic 70 A	440 / G3Si1	A5.18 / ER70S-6
Thyssen	Union Patinax	440 / G423CGO	A5.18 / ER70S-G



Fig.10.- Comparison of annual loss due to corrosion between carbon steel and Cor-Ten steel

1.9 Testing

Cor-Ten steels offer improved corrosion resistance thanks to the addition of copper during manufacturing. [15] Additional alloy elements can be added to increase the tensile strength of steel or facilitate forming processes. The different alloy elements added to weathering steels influence the properties of steel in the following ways:

- Copper increases the adhesion, compactness and elasticity of Steel
- Phosphorus acts as a catalyst for copper and

increases the initial reactivity of WS steel by conducting a uniform corrosion distribution without stains, giving the steel a more homogeneous appearance.

- The healing process is accelerated when the oxide layer is accidentally damaged
- Chromium, nickel and silicon increase the mechanical characteristics of the steel substrate.

### III. RESULTS

When weather-resistant steel is exposed to the ambient atmosphere, it develops an initial layer of iron oxide in the same way as carbon steel. The oxidation rate depends on how much oxygen, moisture and air pollutants can access the metal surface. In the initial stages, a complex mixture of iron oxides covers the surface to create an oxide layer. As the process progresses, the oxide layer forms a barrier against corrosive agents and decreases the rate of corrosion.

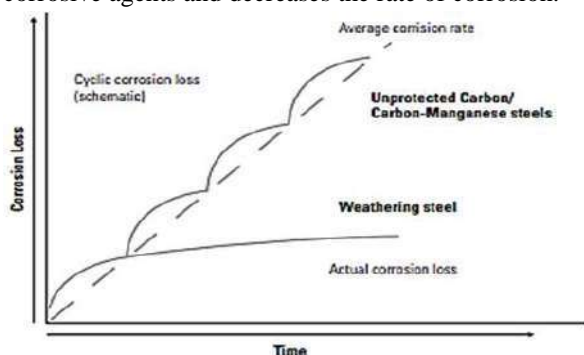


Fig. 11: Schematic comparison between corrosion loss of carbon steels and WS.

In a low alloy carbon steel, the iron oxide layer is porous. Over time, that layer comes off the metal surface and the corrosion process begins again. The oxidation rate progresses in increments that depend on the chemical and mechanical aggressiveness of the environment. It can end with the complete destruction of the metal.

Table captions appear centered above the table in upper and lower case letters. When referring to a table in the text, no abbreviation is used and "Table" is capitalized.

### IV. CONCLUSION

Cor-Ten steel is a viable alternative to carbon steels due to the improved corrosion resistance that can reduce the cost of up to 30% than a conventional coating. These steels are suitable for use in most locations. However, certain environments may limit the durability of weathering steels and significant problems may occur in

environments: with constant humidity, an aggressive atmosphere or high levels of air pollution.

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# Risk Assessment for Professionals Performing Excavation Services in Civil Construction: Case Study in Manaus - Amazonas

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**Abstract**— The purpose of this study is to analyze safety conditions during excavation services, seeking to identify risks to employees in situations of ignorance or use of safety measures. Therefore, this study was conducted through a qualitative study, exploratory and descriptive, seeking to diagnose the main impacts of the adequacy of NR-8, NR-12 and NR-18 in a construction site in Manaus-AM. The results showed lack of signaling on the excavation perimeter, no use of personal protective equipment and residue around the excavation perimeter. The nonconformities found imply exposure of the employee to situations of imminent risk, compromising their safety and health. Training proposals to raise awareness of the importance of safety standards for the execution of activities can contribute to a safer scenario regarding working conditions.

**Keywords**— Risk assessment, Construction, Excavation.

## I. INTRODUCTION

The high indirect costs of health and safety issues draw attention to the amount of resources spent each time an accident occurs, which is a strong argument to motivate research in the area. It is also noted the possibility of expanding the knowledge regarding the understanding of the nature of accidents in a broader aspect. Possible causes of accidents on a construction site include poor diet, managerial authoritarianism, neglect of health, and even the employee's poor preparation to perform their daily tasks.

Ignorance of the risks present in the workplace is perhaps the most relevant factor in the precariousness of Occupational Safety and Health (OSH) in Brazil. In civil construction, this picture is evident, especially for employees not directly linked to the OSH service (managers, architects, engineers, clerks, human resources sector, masons, servants, carpenters, etc.), who do not know the basics about these risks. It will be seen throughout the text the seriousness of the OSH situation in an open pit excavation site and how important is the participation of all involved in the production process of buildings and infrastructure, in general, in this prevention exercise, aiming at the health and well-being of all workers.

Prior to commencing the excavation task, access to the containment and excavation design for site knowledge is required[1]. Generally speaking, structural works require previous earthmoving or earthmoving work. Open-pit excavation is a particular earthmoving work designed to deepen the lower elevation to coincide with the foundations work. This paper analyzes one of the most important earthmoving or earthmoving operations - excavation.

## II. THEORETICAL REFERENCE

Each Brazilian regulatory standard (NR's), determines minimum requirements to be met, if the Labor Inspection Agents observe the breach of legal requirements determined by the NR's, they can notify employers granting deadlines for their regularization, or even fine the company [2].

### 2.1 NR - 18 - Buildings

NR-18 establishes administrative, planning and organizational guidelines that aim to implement control measures and preventive safety systems in the processes, conditions and working environment in the Construction Industry[3].

### 2.2 Work Accidents

Civil construction is a branch of activity of great importance in the Brazilian economic scenario. Beside its

importance, it also houses a harsh reality with regard to working conditions: is considered one of the most dangerous in the world, including Brazil, leading the rates of fatal, non-fatal work accidents and lost years of life [4].

There are several factors that, articulated, make work accidents in this field of activity gain such dimensions: the low wages of workers; lack of infrastructure and carelessness of those responsible for safety at construction sites; intensified use of the workforce; the disorganization of work collectives; and the way work is organized.

### 2.3 Open Pit Excavations

Open pit excavation is a manually or mechanically opened foundation in the ground consisting of dug-out pits using drill-driven augers above the water table. The open pit excavation can be carried out according to the quota agreed in the construction project and afterwards the base is widened and the concrete filling process is started, preferably thickened. The construction of foundations with sharks is especially suitable for works with loads considered high (above 3,000 kN), – such as bridges, overpasses, and large buildings - for groundwater and landslide hazards[5].

In order to avoid landslides, landslides the standard sets the required safety conditions to be observed in project design and execution of open-air civil works on soils and rocks, not included for tunnel mining [6].

### 2.3 Equipments for Individual Safety (EIS)

The use of Personal Protective Equipment is provided for in the Labor Consolidation Laws (CLT) and regulated by the Regulatory Standard of the Ministry of Labor and Employment., being the same, the current legislation, obligatory [7]. The provision of EIS's is the responsibility of the employer who also has the obligation to supervise the use by his employees.

Under Federal Law 3214/78, last amended by Ordinance No. 292 of 2011, the PPE is "(...) any device or product, individual use used by the worker to protect risks that may threaten safety and health at work". Knowing that the construction sector is an environment where accidents are very easy to deal with, the use of EIS's is one of the ways provided by law to prevent injuries caused by work accidents[8] [9].

## III. METODOLOGIA APLICADA

The present study was carried out in a construction works classified as "works of foundations" and therefore has a degree of risk 4. The total number of employees is less than 250, so there is a need for a work safety technician, a work safety engineer and a work doctor. The work is located at José Romão Street, Novo Aleixo, s / n,

Construction Company Soma S / A, in Manaus-AM, (Figure 1).

Data collection was carried out during the period from 10 to 20 September 2019. The mechanical excavation of the open pit was followed for the construction of the retaining wall, observing the conformity in the processes of execution of the work and the proper use of EIS's.

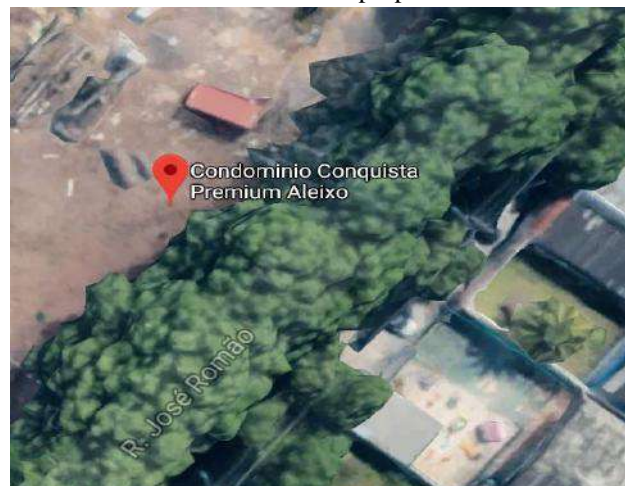


Fig. 1: Study Area Location, Source: Google Maps (2019)

## IV. RESULTS ANALYSIS AND DISCUSSION

### 4.1 Excavations and Foundations

The excavation was observed, and proved that it is not in accordance with the legality of the NR-18, in the process of digging ditches, where it happens in soil or rock, with the lack of proper signs, warning not to cause accidents (Figure 2).

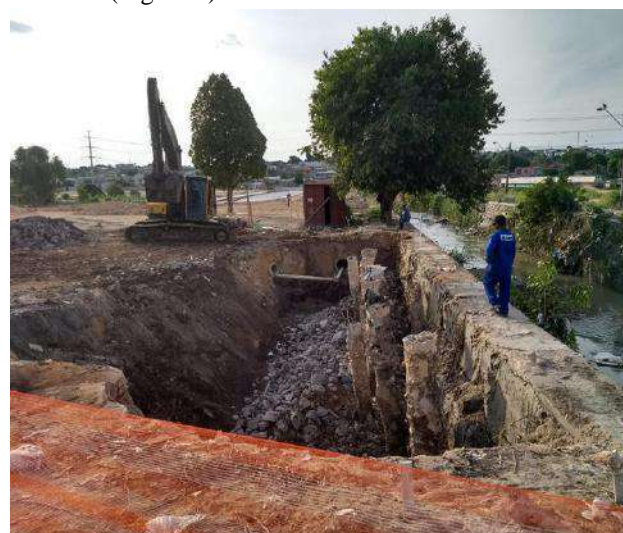


Fig. 2: Excavation for the construction of the retaining wall.

### 4.3 Signaling and EIS's

Two errors were found in the work: 1- lack of signaling in the excavation perimeter, disagreeing with the NR-18; 2- employees without protective equipment characterizing

unlawfulness in the safety norms NR-6. Figure 3 shows the conformities and nonconformities of excavation items as observed at the construction site.

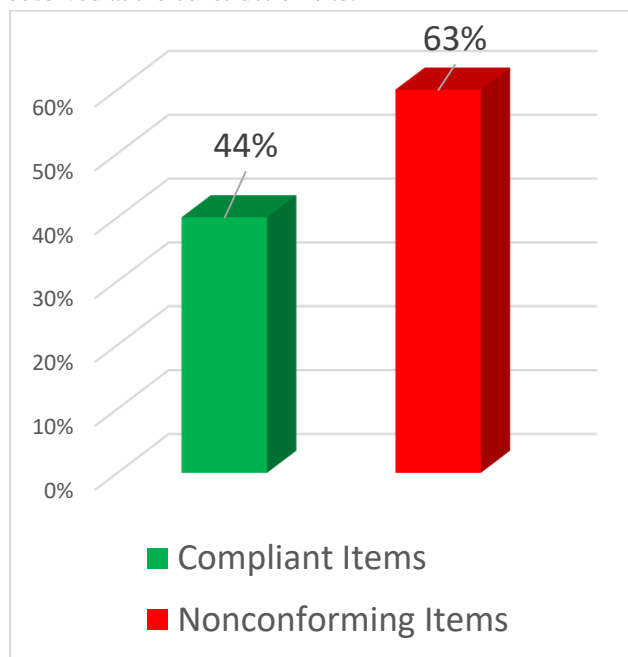


Fig. 3: Compliance and nonconformity chart of excavation items.

The entire perimeter of the excavation work should have warning signs that define the traffic of people, vehicles, machinery and equipment. Safety signs should be planned to prevent accidents. Traffic near excavations should be diverted and, if not possible, vehicle speeds should be reduced. At least two access roads must be built, one for pedestrians and one for heavy machinery, vehicles and equipment. Excavations should be signaled and isolated to prevent falls from people and / or equipment.

For the safety of all workers involved in the excavation, it is necessary to evaluate and select the applicable collective protections as well as safe means of access in the areas where the services will be performed [9] [10] [11].

In this type of work the PPE must be used to suit the existing risks, namely, helmet, safety shoes, goggles, protective gloves and reflective vest. Being able to do these jobs without human intervention at the bottom of the excavation and being outside would avoid many problems and a large number of fatal accidents.

For now, and waiting for new technologies to avoid worker presence in ditches and wells, we must use the means available to us by applying the necessary safety measures for risk control in accordance with the regulations in force.

In order to minimize accidents at the site, the inspection carried out by occupational safety agents should

be maintained and, instruct employees daily to use EIS's and tools properly.

## V. CONCLUSION

It is concluded that in civil construction, there are several activities that can endanger the safety and physical integrity of employees. Several factors contribute to this, among them the following can be mentioned: work environment not in compliance with safety standards, lack of correct use of safety equipment, lack of instructions, misuse of tools and equipment among others.

Initial planning for the execution of the work is extremely important, thus identifying the safety conditions during the excavation services, thus avoiding the risks to the employees in the excavation perimeter.

The results of the study, and the implementation of safety improvement programs in open pit excavation services for workers, are beneficial when integrating around an objective to minimize the risks to which they are exposed.

To preserve the integrity of employees, investing in quality of life must be provided to provide a working environment with adequate conditions. This leads all employees to direct their full potential for better quality.

## ACKNOWLEDGEMENTS

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# Sustainable Alternative: Economic Feasibility Analysis of Using Soil-Cement Brick in the Construction of Popular Housing

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**Abstract**—The aim of this study is to present an analysis of the economic viability of using soil-cement bricks in the construction of popular housing. The study of this material is a way to promote an ecological, social and economic vision, fundamental for the civil construction. The present study presents a proposal for the use of soil-cement brick in the construction of a popular dwelling in accordance with the Manaus City Works Code. The items are made of Portland cement and ground sand, easy to assemble and at a much lower cost. It was concluded that the masonry of soil-cement modular bricks has a lower cost when compared to the masonry of structural ceramic blocks.

**Keywords**—Sustainability, Soil-Cement Brick, Economic Feasibility.

## I. INTRODUCTION

Civil construction is one of the activities that most generates environmental impacts, using natural resources from the manufacturing process of materials to the execution of the work. The search for sustainable alternatives becomes necessary to mitigate the environmental impacts that may be allied to the cost reduction of a work.

Thus, ground-cement brick, known as a type of modular or ecological brick, emerges as an element that seeks to meet the demand for sustainable construction. This brick is produced from the pressing of soil, cement and water, standing out for presenting less aggression to the environment in its manufacture, when compared to the most used types of blocks - concrete blocks and ceramic blocks.

In addition to seeking to minimize environmental impacts, the use of soil-cement brick presupposes a reduction in construction costs due to the abundance of its raw material. Thus, this material can facilitate access to popular housing by low-income groups, showing itself as a way to find ways of promoting an ecological, social and economic vision, fundamental for sustainable development in the field of Civil Engineering.

## II. THEORETICAL REFERENCE

### 2.1 Sustainability in Civil Construction

Anthropogenic actions and activities related to economic and material development without causing harm to the environment are defined as sustainability[1].

Thus, a company must base its economic growth on strategies that allow the preservation of the environment. Solving environmental problems requires a new attitude from entrepreneurs and managers, who must consider the environment in their decisions and adopt administrative and technological conceptions that contribute to expand the carrying capacity of the planet [2].

Soil-cement brick emerges as a sustainable alternative, as its manufacturing process has a lower environmental impact and is economically viable due to the abundance of its raw material and other factors, such as reduction of material waste during its production and production. even execution of the work.

### 2.2 Soil-Cement Bricks

Soil-cement brick has been detached due to the abundance of its raw material and low cost, as well as its more economical manufacturing process, as it does not have to go through the burning process [3].

According to ABNT NBR 12023: 1992-Soil-Cement: compaction test, soil-cement is a hardened product formed from the cure of a compacted mixture of soil, cement and water [4].

2.2.1 Soil characterization for the manufacture of soil-cement brick

Soil particle size is a key feature to differentiate soil types, and specific determinations are employed for the various grain size ranges [5]. The limits of these ranges are presented in Table 1 and vary according to the classification system adopted.

Table 1: Soil particle size classification.

Soil Types	Size (mm)
Boulder	60 a 2
Sand	2 a 0,06
Silt	0,06 a 0,002
Clay	< 0,002

Source: [6]

Regarding the geotechnical profile of the soil, it is considered that the surface of the earth's crust has three distinct layers, called horizons (Figure 1) [7].

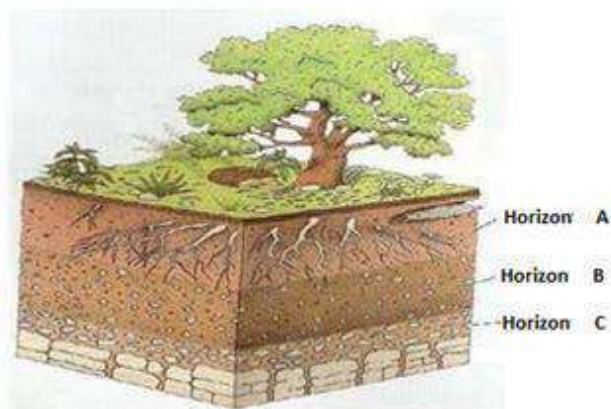


Fig. 1: Soil Formation Horizons, Source: [7].

**Horizon A** -It consists of products resulting from the decomposition of living things along with some mineral matter. In this layer some animals and plant roots can be found.

**Horizon B** -It is formed by mineral fragments and some materials from the decomposition of living beings.

**Horizon C** -It consists of mineral fragments, resulting from the breakdown of Mother Rock, a rock that gives rise to the soil.

Horizon C soils have sandy configuration, being preferable in the preparation of soil-cement. Sandy soils usually require smaller amounts of cement than clay and silt. However, the presence of clay in the soil composition is important to ensure cohesion to the soil and cement mixture when moistened and compacted, for demoulding and handling of the bricks after pressing. Soils containing organic matter should be avoided as this component influences cement hydration and soil stabilization [8].

#### 2.2.2 Feasibility of using soil-cement brick

The determining factor for better soil-cement quality depends on the soil type, molding moisture, press type, soil / cement ratio, stabilizer type and the curing process. For

higher compressive strength, absorption and durability of soil-cement, a higher percentage of cement should be used in the mix [9].

The manufacture of ecological brick helps in environmental preservation, due to the exclusion of the burning process and, consequently, the need not to promote the felling of trees for the production of firewood. Its technical viability occurs due to its great durability and reduced maintenance in buildings with its construction [10].

The benefits of using ecological brick are not only environmental, but also economical, as they provide material savings and do not require plaster to finish the walls, leaving them exposed.

### III. APPLIED METHODOLOGY

O presente estudo apresenta uma proposta de utilização de tijolo de solo-cimento na construção de uma moradia popular em conformidade com o Código de Obras e Edificações do Município de Manaus, conforme medidas apresentadas no Art. 55 da lei complementar nº 003 do Plano Diretor (Tabela 2):

Table 2: Measurements of a popular dwelling.

COMPARTIMENTO	ÁREA MIN.	LARGURA MIN.	PÉ DIREITO MÍN.
SALA	8,00 m <sup>2</sup>	2,40 m	2,60 m
QUARTOS	8,00m <sup>2</sup>	2,40 m	2,60 m
CÔMODO DIFERENCIADO	7,00 m <sup>2</sup>	2,40 m	2,60 m
COZINHA	4,50 m <sup>2</sup>	1,60 m	2,20 m
BANHEIRO	2,00 m <sup>2</sup>	1,00 m	2,20 m

Source: Lei complementar nº 003 (2014) adaptado.

The popular housing will have 46.80 m<sup>2</sup> of living space and will have 3D facade architectural plans, elevations, floor plan, roof plan, humanized plan and internal sections. To develop your architectural project, AutoCAD 2019.1 and SketchUp Pro 2018 software will be used.

The economic viability analysis of the work will be carried out by comparing with the apparent structural bricks (soil-cement brick) building system with the building system using ceramic sealing block through budget worksheets constructed from the Budget Price Composition Table - TCPO and SINAPI - National System of Costs Research and Indexes of Civil Construction.

### IV. RESULTS ANALYSIS AND DISCUSSION

For the project of building a single-family house of 46.8 m<sup>2</sup>, according to the dimensions presented in Table 2,

ABNT NBR 8491: 2012 determines that the soil-cement bricks should have a parallelepiped shape, in dimensions (in millimeters) shown in Figure 3.

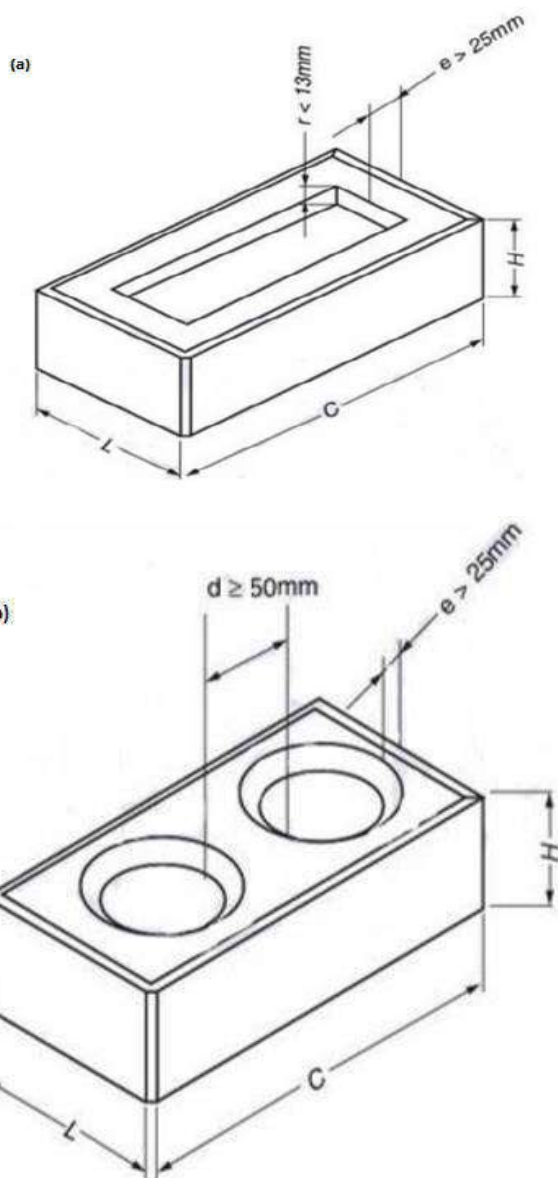


Fig. 3: (a) Solid cement-brick, (b) Hollow Cement Brick, Source:[11].

For budget composition, the following steps were considered:

**For ground-cement brick masonry:**

- Soil-cement brick with application of 45 un / m<sup>2</sup>.
- Concrete columns of 0,066 m in diameter, with 1 steel bar of 8,00 mm for each 1,0 m of wall according to door and window openings, generating a concrete volume of 0,09 m<sup>3</sup> each m<sup>2</sup> of wall.
- Laying of bricks with cement and sand mortar in 1: 4.

The cost of one thousand pieces of soil-cement brick is around R \$ 850.00 (RS 0.85 / piece), adding the amount

charged for the execution of the installation work, the cost is estimated at R \$ 38.25 / m<sup>2</sup>.

**For structural ceramic block masonry:**

- 14 x 19 x 29 structural ceramic block with application of 16 units / m<sup>2</sup> (Figure 4).

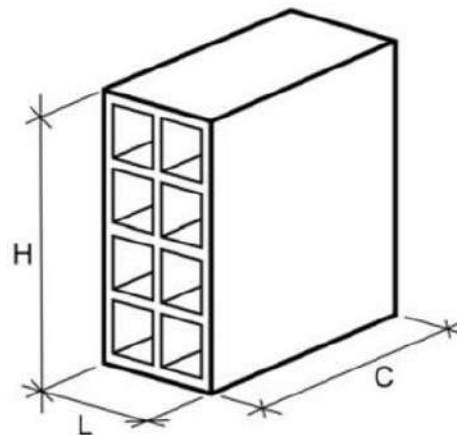


Fig. 4: Ceramic sealing block with horizontal holes, Source: [12].

The cost was around R \$ 2,900.00 (R \$ 2,90 / piece), adding the amount charged for the execution of the installation labor the cost is estimated at R \$ 46,40 / m<sup>2</sup>.

A cost survey was carried out for the construction of the popular housing, using soil-cement brick (Table 3) and using masonry with structural ceramic block (Table 4), following BDI according to TCU AGREEMENT, SINAPI 2018 COMPOSITION.

Table. 3: Budget for the construction of housing with brick soil-cimetno.

Budget 1			
Materials	Amount	Price Unitary	Total
Soil-cement modular bricks (m <sup>2</sup> )	116,04	38,25	4438,53
Column Concrete (m <sup>2</sup> )	0,573	416,84	238,94
Steel for bollards (8.0)	68,57	5,94	407,94
Mooring beams (steel 6.3)	12,86	5,99	77,03
Beams tie. (concr.) (m <sup>3</sup> )	0,0036	416,84	1,50
Gutter beams windows and doors (steel 6.3) (kg)	5,76	5,94	34,21
Gutter beams windows and doors (concr.) (m <sup>3</sup> )	0,0016	5,94	8,64
Lintel windows (steel) (kg)	3,67	5,94	21,80
Against lintel windows (concr.) (kg)	0,00092	416,84	0.38,34
Tile 20x20 (m <sup>2</sup> )	28	31,80	890,4
External painting (m <sup>2</sup> )	89,47	5,81	510,87
Total (R\$)			6.621,94

Table. 4: Budget for housing construction with structural ceramic block.

Budget 2			
Materials	Amount	Price Unitary	Total
Soil-cement modular bricks (m <sup>2</sup> )	116,04	46,40	5384,25
Column Concrete (m <sup>2</sup> )	0,573	5,94	238,94
Steel for bollards (8.0) (kg)	68,57	38,25	407,7
Mooring beams (steel) 6.3) (kg)	12,86	416,84	77,03
Mooring beams (concr.) (m <sup>3</sup> )	0,0036	5,94	1,50
Gutter beams windows and doors (steel 6.3)	5,76	5,99	34,21
Gutter beams windows and doors (concr.) (m <sup>3</sup> )	0,0016	416,84	8,64
Lintel windows (steel) (kg)	3,67	5,94	21,80
Against lintel windows (concr.) (kg)	0,00092	5,94	0.38,34
Tile 20x20 (m <sup>2</sup> )	28	5,94	890,4
External painting (m <sup>2</sup> )	89,47	5,81	510,87
Total (R\$)			7.575,72

Tables 3 and 4 show that the popular housing project using soil-cement brick is less expensive. when compared to the cost of housing built using a structural ceramic block. The value reduction is approximately 15%. This reduction is justifiable since most of the popular housing is built by low-income families.

## V. CONCLUSION

The cost of work with modular soil-cement bricks reduces by 15% the cost of work designed with structural ceramic block bricks. A significant reduction in the economic aspect of the project, since housing projects are executed by low-income families, who do not have surplus financial resources and seek savings in the realization of their projects. Therefore, it was concluded that its use in civil construction is feasible because there is a reduction in expenses with material, labor and construction time.

It presents itself as an environmentally positive alternative as it is manufactured using abundant raw material on the planet. Moreover, it is a simpler construction process than the others, which allows the construction of large-scale houses in social projects to favor low-income families.

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# Comparative Analysis between Burnt Cement Floor and Porcelain Floor in a Commercial Area of Manaus-AM

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**Abstract**— The field of civil engineering has been evolving over the years, with increasing technological advances and innovations in several areas. Agility combined with quality are fundamental and must be thought of in all works, in addition to economic viability. The construction methods and materials for flooring and flooring available in the market should be analyzed to choose which one is the most suitable for the project model. Thus, it is questioned what the ideal floor type to be used in a commercial project is aiming at the best cost-benefit. The objective of this article is to present to the reader simply and directly the advantages and disadvantages of using burnt cement compared to porcelain in the execution of a work in a commercial area in the city of Manaus - AM. Given this quantitative research, a comparative analysis was performed between the execution of two types of floors used in civil construction, which are the burnt cement floor and the porcelain-type ceramic floor. The result of this work indicates that the burnt cement coating has the best cost-benefit because the execution time is relatively shorter, and the cost is also low when compared to porcelain.

**Keywords**—Burnt cement; Materials; Porcelain tile; Coating.

## I. INTRODUCTION

Commercial areas are mainly leveraged by the product they offer their customers. However, other aspects must also be observed to make the place inviting and attractive to users, such as lighting, acoustic and thermal comfort, among others.

Among the mentioned items, it is very important to pay attention to the typology of the floor used, because it is the one that ensures the mobility of customers with comfort and safety.

Once a building is built, whether residential or industrial, there is a need to promote comfort to its users, and nothing is more uncomfortable than living in places where the floor has irregularities, compromising visual well-being and sometimes even safety, as well as making hygiene difficult. [10]

This article is limited to address the advantages and disadvantages of using burnt cement floor compared to porcelain ceramic floor in the execution of a work in a commercial area located in the city of Manaus, examining the processes of execution of pavements, comparing the execution time between both and analyzing the economic viability between these two types of floors.

## II. THEORETICAL REFERENCE

### 2.1 Floor

The floor is defined as a flat horizontal surface designed to withstand certain stresses and is one of the constructive steps in finishing a work. [10]

The whole environment needs regularization of the floor for your safety. The subfloor is defined by a layer applied on a base, which can be of structural slab of concrete ballast. Indoors of a building, whether residential or commercial, are used from 200 to 250 kg / m<sup>3</sup> of mortar, and the trace of the commonly used cement and wet sand mortar is 1: 5 to 1: 7, thus obtaining the average dash of 1: 6 in its usability. [8]

The subfloor usually has a thickness of 5 cm giving a support for floor regularization. Using the "masters" ensures leveling and trim, they can be used with grounded wood, reaching the desired level, aligned and spaced every 1.80 m. For better adhesion of the subfloor to the smoothing layer, consideration is given to cleaning the surface by sweeping with hard fiber brooms. [5]

Some requirements are fundamental given the finish and already regularized surfaces. For the flatness of the floors, the values of 3 mm in relation to the ruler with 2 m in length, in any direction and position of the floor. [5]

New flooring materials and innovative technologies have been worrying about the applicability with regard to durability in return over time for the performance of new found solutions. Thus, it is necessary to adopt measures that aim at the long duration of the buildings ensuring the quality in the construction processes and materials used in them. [5]

Regarding the types of floors, the most common is the type of ceramic tile. However, the manufacture of concrete floors, which support large loads on its surface, has grown. [10]

**2.2 Cement**

Portland cement is the name given to cement obtained by the intimate mixture of limestone, clay or other silica materials, alumina and materials containing iron oxide. [6]

Concrete is an attempt to make an artificial stone with the enormous advantage of having the shape, strength and dimensions you want. [3]

Burnt cement is a technique made from a mixture of cement, sand and water and can be used in almost any environment, as it is a coating that has high abrasion resistance. [4]

It is already a constructive stage that many consider the finishing stage of the work, but it is important that its support base is correctly executed and, in some cases, an efficient waterproofing treatment is necessary. A very common defect is not respecting the required slopes towards runoff points, especially in areas considered “wet” where water use is constant, such as in residential buildings such as bathrooms, utility areas, kitchen, laundries, balconies and kennels. [2]

**2.3 Porcelain**

Porcelain is defined as a ceramic slab formed of clay, feldspar, and other inorganic raw materials, formed by extrusion, pressing or other processes, whether or not enameled, polished or natural, rectified or unrectified. [1]

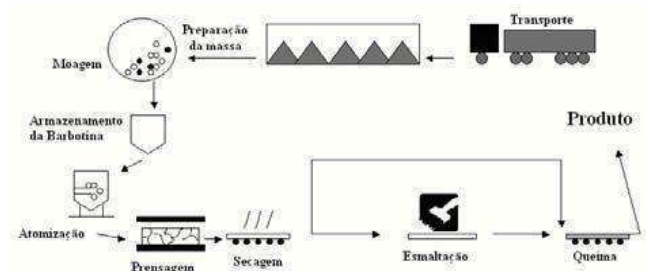


Fig. 1: Porcelain Manufacturing Process, Source: The Tile, 2014.

Ceramic floors are classified into three types, enameled ceramic, gres ceramic and ceramic tile. These are obtained by baking clay, are used for residential, commercial and industrial use. Presenting several textures with finishes that

please the most diverse tastes and different sizes, we have the most commercialized, according to Table 1.

Table. 1: Porcelain Plate Measurements

30x30	45x45	50x50	60x60	30x60
40x60	80x80	90x90	100x100	120x120

Source: Own authorship, 2019

Ceramic coatings are graded according to the enamel wear resistance test of abrasion. This classification is known as the PEI Index, where the most suitable environments for its application are indicated. [12]

**III. METHODOLOGY**

The research used in this work is quantitative. Interpretation is the main factor to perform a comparative data and can demonstrate the results through collection, analysis and supporting numerical information such as proportion, ratio and software. [9]

The context used was in a commercial environment at Amazonas Shopping located at Avenida Djalma Batista, 482 - Parque 10 de Novembro, Manaus-AM (Figure 2). The quantitative method was used, analyzing the advantages and disadvantages between both types of floors.



Fig. 2: Satellite Image of Shopping Location, Source: Google Earth, 2019.

The architectural design was reproduced in AUTOCAD 2018 software, as shown in Figure 3, to calculate the area and follow up the activities proposals. In the next step, A survey of materials and time was performed for each stage of the activities.

From this, the fastest and most cost-effective activity for the work was observed.

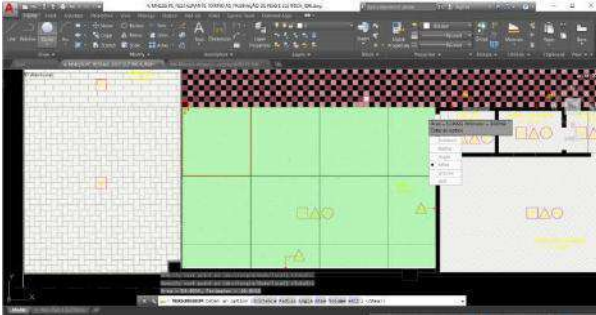


Fig. 3: Architectural project, Source: Santos Damasceno Architect, 2019.

### 3.1 Execution of burnt cement floor

The initial step for the execution of the burnt concrete is to perform the cleaning of the existing surface, so as not to damage the adhesion of the mortar to the soil. Then fix the expansion joints to the surface every two meters as shown in Figure 4.



Fig. 4: Fixation of expansion joints, Source: Own authorship, 2019.

It is necessary to apply mortar made with cement, sand and water. It needs to be executed with a height between 30 and 50 millimeters according to Figure 5. Once applied For mortar, the surface must be leveled using the ruler. After leveling the surface, the floor should be sprayed with sieved cement powder with the mortar still damp.



Fig. 5: Leveling with the ruler, Source: Own authorship, 2019.

If the project specifies a different color, some kind of coloring powder can be mixed with the dry cement. Immediately after spraying the powder, stick it to the paste for about ten minutes.

In the next step, the tread smoothing is started, which can be done manually or automatically as shown in Figure 6. This feature provides the adhesion of materials, forming a different finish depending on the mode performed.



Fig. 6: Floor straightening, Source: Own authorship, 2019.

The curing process of the floor is slow and to ensure that it occurs as smoothly as possible, it is necessary to humidify the floor at intervals of 8 to 12 hours in the first 07 days, taking care to avoid sunlight on the floor within 03 days. initials. This is important so that drying occurs slowly, wetly, not soaked. Once the mortar is fully cured, allow the surface to dry completely to complete the process.

Depending on the final use of the pavement, it is necessary to finish with waterproofing made with wax or own resins and is the step that will ensure its poleness, and the burnt cement floor is characterized by its natural porosity.

### 3.2 Execution of porcelain floor

The first step resembles that of burnt cement, which is cleaning the subfloor. Then, the mortar is prepared, following the manufacturer's recommendations, in a proper trough. Then apply the mortar to the subfloor with the aid of a trowel. Lay the plate together with the appropriate spacer, placing the leveler base between the mortar and floor, as shown in Figure 7, and with the help of a rubber hammer, adjust the plate.



Fig. 7 - Placement of porcelain floor, Source: Own authorship, 2019.



After the mortar has hardened, prepare the paste for grout application. Carry out grouting with the aid of a plastic spatula so as not to damage the porcelain tile according to Figure 8.



Fig. 8 - Placement of porcelain floor, Source: Own authorship, 2019.

### III. RESULTS ANALYSIS AND DISCUSSION

Analyzing both types of internal floors, it was noticed that both have the same initial execution procedure cleaning the area and regularizing the floor.

In the next steps it was noted that the porcelain tile laying service presented the high execution time, high labor value and consequently a higher total cost of the service according to the following tables 2 and 3:

Table 2: Value per m<sup>2</sup> of porcelain

PORCELAIN TILE ELJANE 60X60				
SERVICE	UNITS	AMOUNT	UNIT PRICE	SUB TOTAL
MORTAR SUBFLOOR TRACE 1: 4 (CEMENT AND SAND), MECHANICAL PREPARATION	MP	53,40	R\$ 15,00	R\$ 801,00
PORCELAIN TILE DIMENSIONS 60X60 CM BRAND ELJANE	MP	53,40	R\$ 20,00	R\$ 1.068,00
			TOTAL =	R\$ 1.869,00

Source: Own authorship, 2019.

Table 3: Value per m<sup>2</sup> of burnt cement

BURNT CEMENT				
SERVICE	UNITS	AMOUNT	UNIT PRICE	SUB TOTAL
MORTAR SUBFLOOR TRACE 1: 4 (CEMENT AND SAND), MECHANICAL PREPARATION WITH CONCRETE 400 L, THICKNESS 5CM	MP	53,40	R\$ 15,00	R\$ 801,00
FLOOR BURNISHED CEMENT TRACK 1: 4 (CEMENT AND SAND) Smooth Finish THICKNESS 2.0 CM, MORTAR MANUAL PREPARATION	MP	53,40	R\$ 15,00	R\$ 801,00
			TOTAL	R\$ 1.602,00

Source: Own authorship, 2019.

Since the subfloor is easier and faster to perform, it takes advantage of it even in the curing process to do all the detail of cement burning, saving time in execution, speed in the process and guaranteeing the delivery of finish and coating to the cement (Figure 9).

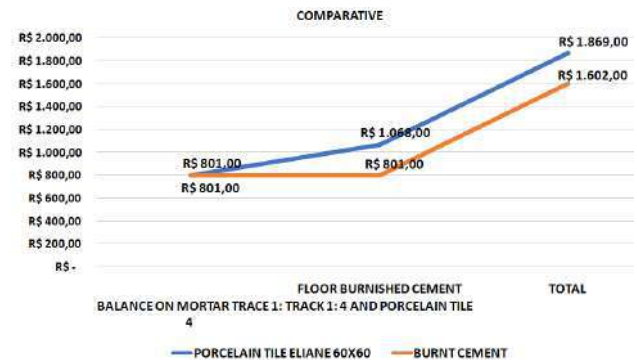


Fig. 9 – Comparative chart of values, Source: Own authorship, 2019.

Porcelain tiles have disadvantages compared to burnt cement, because the execution time is clearly higher, labor value becomes more expensive, consequently the total cost of service is higher.

### IV. CONCLUSION

This article was developed to address two types of materials and two types of construction techniques in the finishing part of floor covering, which are concrete and porcelain.

The burnt cement floor, being concrete, has a long service life. Easy to deploy, durable, durable and inexpensive, and cost-effective. This execution process has the advantage of being very elegant due to the fire effect it has, and in addition, pigments can be added during concrete preparation, so that the floor acquires a desired coloration [11]. For not having amendments in its surface because the expansion joints are flush, the floor presents a flat and even surface, making it difficult to accumulate dirt and facilitating cleaning.

The use of porcelain tiles is popular in residential and commercial areas because it is a common technique, but it brings different types of pagination, pleasing the customer for its delicate and elegant form. The material has different textures and colors, but is prone to reach cracks and cracks, being necessary to reserve a spare parts stock, which does not occur with burnt cement.

When comparing the burned cement and porcelain tiles coatings, it can be concluded that both types of floors are viable for commercial areas, being the burnt cement the most favorable to places with higher load intensity, however, the culture of the country still not fully receptive to the constructive method as it refers to low-income places.

This comparative analysis does not propose replacing the porcelain tile floor with burnt cement, but rather exposes another option in a constructive manner, taking



into account the execution time and the service life of the two materials.

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# Communication Strategies in Rural Tourism Routes in the State of Rio Grande do Sul, Brazil: Tools for Capturing Tourists

Marcelo Pellegrini, Morgana Secchi, Ana Claudia Machado Padilha, Amanda Regina Leite, Jaqueline Berdian de Oliveira, Geizi Cássia Bettin do Amarante

*Abstract*— Tourism is consolidating itself as one of the fastest growing economic activities in the world. Thus, it is necessary to use tools to publicize enterprises that are part of tourist routes. In this context, the objective of the study is to identify the dissemination practices implemented by the tourism route enterprises in the state of Rio Grande do Sul, Brazil. Through the marketing mix literature with emphasis on promotion. For this purpose, a qualitative research was carried out and the interview technique used, structured script with a priori determined categories that emerged from the literature review for six tourism routes in the state of Rio Grande do Sul, Brazil, accounting for 31 researched enterprises, where responses were recorded, recorded, tabulated and analyzed with the support of Microsoft® Excel™ software. As significant data from the study, it is considered that the use of communication tools in the dissemination of tourism routes in the state is presented as a strategy for promoting tourist destinations, since most of these tools are accessible and easily accessible to the public.

*Keywords*— Tourism Routes; Tourist Attraction, Disclosure; Tourist destinations.

## I. INTRODUCTION

Tourism is one of the fastest growing industries in the world, providing opportunities for economic growth and development in countries (Grigaliunaite, Pileliene & Bakanauskas, 2015). This emerging growth, allied to the transformations that occurred in society became popularized to the point of becoming one of the main drivers of the world economy (Wttc, 2016). The dynamism and the constant changes that occur in this market lead the tourist activity to a constant renewal.

Over the years and the growing adherence to tourism, new possibilities for services such as tourist routes have emerged. Routes usually consist of a mix of services, from food, lodging and leisure options. As a result, the way tourism is communicated to the market has also changed, thus introducing integrated marketing communication, which is the expansion of strategic organizational communication with the market, introducing, positioning and disseminating products, services, brand, benefits and solutions. Tanager search, with the holistic use of all elements of this compound, an efficient communication by the issuer with its target consumer (Santiago, 2002).

Disclosure has been taking place day by day whether it be through social networks, flyers, word of mouth, radio or television (Hartley 2007). In a rapidly evolving globalized world, there are numerous

implications and practices associated with social media, which are used by different groups from teens to seniors (Lenhart, Purcell, Smith & Zickuhr, 2010).

The innovations of the tourism market have brought new challenges for the sector, as tourists are increasingly informed and independent (Perinotto & Siqueira, 2016). Tourists have more choice, the range of services has grown, so competition is no longer just between companies in the same industry in a traditional way, now includes the consumer himself who, with access to information through digital platforms, for him to be loyal to a company, there must be a really advantageous differential because otherwise he feels able to offer himself the services that companies do not get (Perinotto & Siqueira, 2016).

Social media is not only used for online entertainment or shopping, but there are many possible utilities, as evidenced by different everyday practices (Kaplan & Haenlein, 2010). In addition to shopping, social media is used especially in tourism to search for information (Xiang & Gretzel, 2010). Different tourist audiences use social media to search and select locations, thus the role of media in tourism, considered a crucial tool for its growth and development (Gilbert, Karahalios & Sandvig, 2008).

Transforming the type of tourists requires creative and innovative methods, as organizations must always be

one step ahead in order to create new possibilities and remain in line with market competitiveness. The advantages of digital marketing are diverse, and for the tourism industry that uses new trends in order to get closer to tourists through positioning, branding and business growth (Perinotto & Siqueira, 2016).

Tourism routes are presented as an element of development of the regional economy, contributing to the relationship between small properties and the appreciation of the local population (Lunardi & Almeida, 2008). Thus, the development of tourism contributes to the dissemination of the municipality, highlighting the culture of the region, as well as caring for the environment (Pellegrini, Secchi, Padilha, Amarante & Perreira, 2019). Given this, the objective of the research is to identify the communication strategies implemented in the enterprises that integrate tourism routes in the state of Rio Grande do Sul, Brazil.

The municipalities and enterprises surveyed are: Erechim with the “Rota Vale das Cantinas e dos Parreirais”, “Rota Morro do Vicini” and the “Rota das Agroindústrias”. In the municipality of Marau, the “Salamarias” route. The municipality of Garibaldi located in the northwest of the state the route was the “Via Orgânica” created in 2016, a pioneer in Brazil for exploiting the production, industrialization, marketing and consumption of certified organic foods as attractive. Finally, in the municipality of Três Cachoeiras the route went to “Vale do Paraíso”.

The importance of the promotion strategies that tourism provides to the rural environment (Fávero, 2000), justifies this research. The tourist routes contribute to the revitalization of “dormant” regions and the settlement of man in the countryside, consequently, with the reduction of rural exodus, enhancement and rescue of local culture. It results in the improvement of the living conditions of the local population, job creation, valorization of local products and closer relations established between the countryside and the city, through the exchange of information and experiences between them (Fávero, 2000).

## II. LITERATURE REVIEW

### 2.1 Marketing

Since the 1960s, there have been advances in the field of marketing, so over time the term marketing has been dealt with more thoroughly (Carasila & Milton, 2008). Thus comes the first definition of marketing by the American Marketing Association (AMA), which defines the term as conducting business activities that drive the flow of goods and services from producer to consumer or user (Carasila & Milton, 2008). Thus, one of the

definitions that most impacted over time was presented by Jerome McCarthy, with the goal of satisfying consumers and helping to achieve business goals (Carasila & Milton, 2008; Traynor, 2015).

A few years later, a new definition of marketing was developed by the University of Ohio, the process by which a company anticipates, postpones, or satisfies the structure of demand for economic goods and services through the physical development, promotion, exchange, and distribution of goods and services (Carasila & Milton, 2008). The concept of marketing that is still widely used was developed in the 1990s, a set of institutions and processes to create, communicate, deliver and exchange offers that have value to consumers, customers, partners and society in general (Carasila & Milton, 2008).

Marketing is also presented as the process that facilitates the exchange of values between a buyer and a seller, in which the former seeks to satisfy their needs and wants and the latter to their organizational goals (Pinheiro & Gulo, 2005). The essence of modern marketing thinking is to deliver customer value and satisfaction. Good marketing is indispensable to the success of any company. The two main marketing goals are to attract new customers, promising them superior value, and to preserve current customers by offering them satisfaction (Kotler & Armstrong, 2007).

### 2.2 Mix de Marketing

The term “marketing mix” was first coined by Borden in 1964 and involved twelve elements, but was later simplified by McCarthy into the famous “4 Ps” where it deals with a set of points of interest for organizations to be aware of want to pursue their marketing goals. This model is based on the idea that the organization produces a good or service (product), where the consumer should be informed that this good or service exists (promotion), and it should be distributed to various types and places of sale (plaza), and finally the company must charge an amount for the supply of the product which is called (price) (Carasila & Milton, 2008; Traynor, 2015).

Marketing Mix encompasses organizational decisions that include identifying product launch opportunities as well as tailoring them to customer needs (Traynor, 2015). In this sense, pricing decisions aim to generate competitive advantage and return for companies. Promotion decisions are related to investments in communication and sales promotion strategies, and square or distribution decisions involve choosing sales channels that meet customer needs (Traynor, 2015). Figure 1 presents the four variables that form the so-called

marketing composite, through the concepts presented by Kotler and Keller (2006).

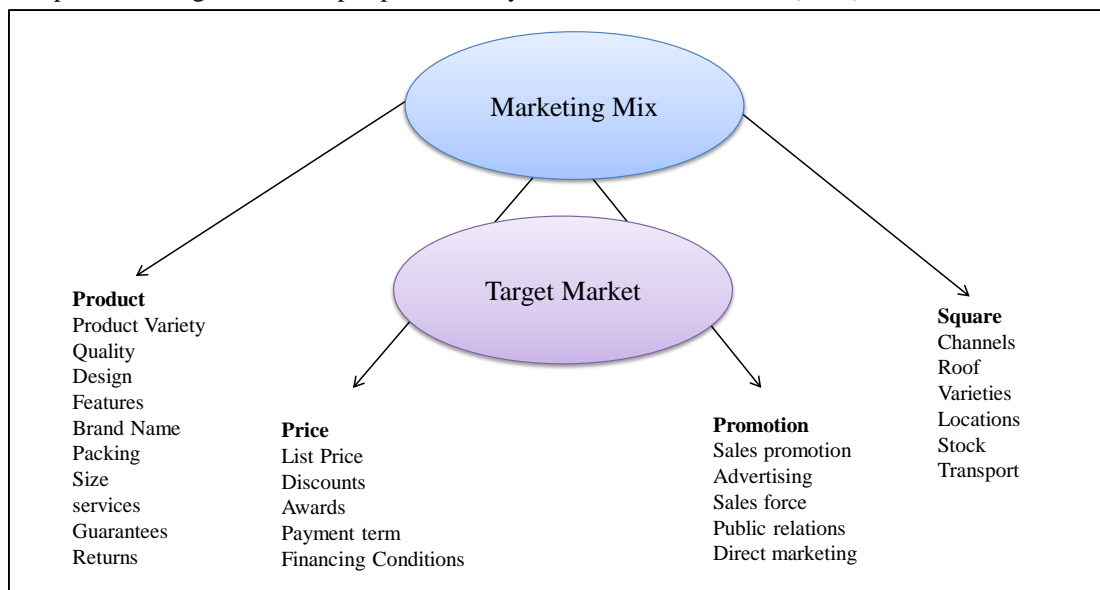


Fig.1: The 4 Ps of the Marketing Mix.

Source: Prepared from Kotler and Keller (2006).

It is noticed that the 4 Ps involve the whole communication process for the launch of a product (Figure 1), as well as the characteristics of the product, the price that will be offered to the consumer market, the ways of disclosure and the means where it will be disclosed.

According to Pinheiro&Gullo (2005), the product is linked to the idea of its value and its degree of quality, in order to satisfy the needs and desires of consumers, their attributes, their benefits and design and consumption ratio, all these elements can be expressed by brand and packaging. For the authors Odgen and Crescitelli (2008), the price is present among the decisions in the marketing mix, each price choice must be in accordance with the others. For the author Cobra (1997), the promotional compound of the product or service comprises advertising, public relations, sales promotion, personal selling and product merchandising. The distribution channels (plaza) are employed to take the manufacturer's product to the final consumer, or rather to walk the path that is between the producer and the final consumer (Odgen&Crescitelli, 2008).

2.3 Promotion

The American Marketing Association- AMA (2019) defines promotional marketing that includes tactics that encourage short-term buying, influence buying and quantity as well as being measurable in volume, share and profit. According to the American of National Advertisers - ANA (2019) some examples include coupons, sweepstakes, discounts, prizes, special packaging, cause marketing and licensing.

Las Casas (2006) defines promotion as a controllable variable of the marketing mix that receives the meaning of communication. For Kotler (1998), promotion is the set of actions that will be focusing on a certain product or service, in order to stimulate its commercialization and its dissemination. Companies also need to communicate with customers, and this communication must be a combination of a consistent marketing program, where the composition of communication tools can be defined as the main promotion tools such as advertising, sales promotion, public relations or advertising, sales force and direct marketing (Kotler& Armstrong, 2007).

Public relations are other components of communication, which involve developing good relationships with the company's various audiences by gaining favorable publicity, building a good corporate image, and managing unfavorable rumors, stories or events (Kotler& Armstrong, 2007). Direct marketing occurs as an interactive system that uses one or more advertising media to get a plausible response in any location benefiting consumers in many ways (Kotler, 1998), as a strategy for communicating products or services directly to customers. without intermediaries (Dias & Cassar, 2005).

2.3.1 Advertising

It is defined as any persuasive advertisement or communication in the mass media during a given period and in a given space paid or donated by an individual, company or organization (Churchill & Peter, 2000). It may also be any paid form of non-personal presentation of ideas,



productsorservicesbyanidentifiedsponsor (Las Casas, 2006).

Advertising on radio, TV, magazines and newspapers aims to guide consumers through the five levels of communication: ignorance, knowledge, understanding, conviction and action (Sant'Anna, 2005). The cycle begins at the lowest level where the object is unknown and passes through the others, until it reaches the final level that is where the consumer takes action (Sant'Anna, 2005). A typical example is based on a new tourism venture, where advertising serves as a link between this new venture and the customer, with the purpose of informing him initially, and finally convincing him to visit him (Sant'Anna, 2005).

Therefore, the media planner needs to know the ability of major media types to achieve coverage, frequency and impact (Kotler & Keller, 2006). These professionals choose among the various media categories, studying their advantages and disadvantages, considering the audience's media habits, product characteristics, message characteristics and cost as variables (Kotler & Keller, 2006).

Thus, the media strategy seeks to ensure the transmission that will bring the best proportionality between investment and the efficiency with which consumers will be reached, bringing a higher return according to the objective of the advertising campaign (Sant'Anna, 2005). Not only that, there are some factors that affect media choice, such as ad objectives, audience coverage, message requirements, timing and location of the purchase decision, and media cost (Etzer, Walker & Stanton, 2001).

### 2.3.2 Word-of-mouth

There are also other tourist outreach tools in addition to social media, such as word-of-mouth, where individuals enjoy their travel experiences not only looking for news, but also knowing and communicating with others. other travelers (Wang, 1999). Thus, interactions with other tourists play an important role in the process of shaping the travel experience and indicating places to visit (Wang, 1999).

Customer service experiences can be significantly influenced by the actions and behaviors of other customers (Jung, Yoo and Arnold, 2017). Studies argue that the presence of other customers enjoying services together with others can alter service experiences since word-of-mouth brings expectations (Thakor, Suri, & Saleh, 2008). Thus, customer-customer interaction became an emerging topic within service marketing during the first decade of the XXI century (Nicholls, 2010). Thus, the interaction

between acquaintances is important, since they indicate places to be visited for friends, thus contributing to the dissemination of places to be visited (Gorman, 1979; Murphy, 2001).

### 2.3.3 Internet

The Internet is among the media as the tool with the largest adherence to consumers and provides integration of companies making the various tourist services easily accessible (Beni, 2003). In this sense, the internet establishes itself as a fundamental tool for tourism enterprises, thus achieving a rapid expansion of information services such as commercial applications, promotion, dissemination and e-commerce (Cruz, Mota & Perinotto, 2012). In addition, the internet allows actions that were impossible through traditional marketing methods, such as mass customization that makes each consumer feel special and convey this positive perception to the company's brand (Vaz, 2008).

The development of Information and Communication Technologies, coupled with the popularization of the Internet, has expanded to reach industries (Vaz, 2008). Thus, it ends up requiring equipment modernization, communication virtualization and product customization (Vaz, 2008). The consumer increasingly becomes a content producer and demands open communication with the company, which in turn, through the internet has the possibility to talk directly with him, without the need for intermediaries (Vaz, 2008).

As modernization and digitization transform the tourism sector, there is a promotion of hitherto non-existent benefits for entrepreneurs, and tourists are also affected by these changes (Sánchez, 2015). In addition, the main benefits of searching for information on the Internet are related to the time savings, convenience and variety of products available anytime and anywhere (Melo, 2013).

On the one hand, companies have access to tools that bring them closer to the consumer, gaining their trust and being able to easily measure the scope of their marketing efforts (Arruda & Pimenta, 2005). On the other hand, the consumer becomes independent and can make comparisons and surveys among competitors more easily, requiring companies innovative strategies to achieve customer loyalty (Arruda & Pimenta, 2005).

## III. METHOD

Considering that the objective of the study is to identify the dissemination practices implemented by the tourism route enterprises in the state of Rio Grande do Sul, Brazil. Data were extracted from secondary sources

detailed in Table 1. Where 6 routes were studied accounting for 31 tourist enterprises in the state.

Table 1. Research Data

Searched Route	County	Data collection period	Researcher(s)
Salamarias	Marau	June and August/2016	Faoro, Daiane
Via Orgânica	Garibaldi	January/2018	Padilha, Ana Claudia Machado
Vale Do Paraíso	Três Cachoeiras	November/2018	Padilha, Ana Claudia Machado
Vale Das Cantinas e dos Parreirais	Erechim	December/2018	Berdian, Jaqueline de Oliveira; Leite, Amanda Regina
Morro Do Vicini	Erechim	December/2018	Berdian, Jaqueline de Oliveira; Leite, Amanda Regina
Agroindústrias	Erechim	December/2018	Berdian, Jaqueline de Oliveira; Leite, Amanda Regina

A methodological choice, we adopted the qualitative approach of multiple case study (Yin, 1989). The technique used by the researchers was the interview, with the application of a questionnaire, through a priori determined categories that emerged from the literature review tools for the dissemination of tourist enterprises. It was integrated by an open question, and the answers were recorded in audio, recorded, tabulated in Excel software and analyzed. Finally, the data analysis technique selected was the content analysis of the interviewees suggested by Bardin (1997), considering the following steps in this type of analysis: pre-analysis, material exploration and treatment of results and interpretations.

IV. RESULTS

The projects surveyed in the “Rota das Salamarias” (Marau) four projects are located in rural areas and one in urban areas. On the “Via Orgânica” (Garibaldi) route, five are located in rural areas and three in urban areas. In the “Vale das Cantinas e dos Parreirais” (Erechim) route, all the projects are located in rural areas, as well as the other routes of the “Morro do Vicini” and “Rota das Agroindústrias” municipalities. On the “Vale do Paraíso” route (TrêsCachoeiras), all the projects are located in rural areas within the municipality.

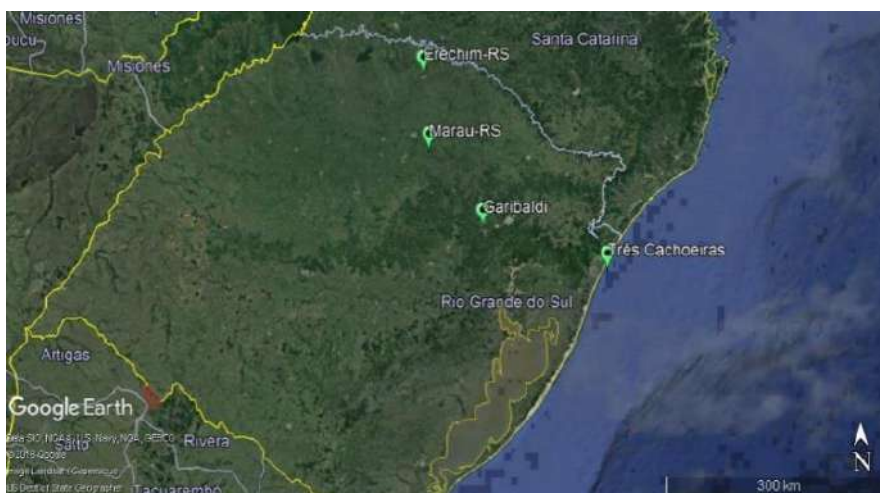


Fig.2: Map of municipalities with the surveyed routes.

Source: Google Earth (2019).

It is possible to verify that the oldest enterprises that started tourism in the twentieth century (Table 2), were the Via Orgânica route located in the municipality of Garibaldi. This is due to the fact that the city of Garibaldi is recognized for its vocation of offering tourism products

that are recognized for the economic benefits they offer as well as the self-esteem and socio-cultural development of the traditionally family-oriented regions (Padilha, Matos de Sá& Rodrigues, 2018).

Table 2. Characterization of Enterprises

Route	Entreprise	Attractives	Beginning of tourism
Salamarias	Cantina Bordignon	Wine and Juice Tasting	2008
	Casa Camera Ristorante	Restaurant with typical Italian colonial food.	2009
	Cantina da Terra	Restaurant with typical Italian colonial food. Sale of products manufactured on the Salamarias Route.	2006
	Maculam	Wine and Juice Tasting and visit the grape vineyard.	2009
	Ervateira Pagnussat	Sampling of yerba mate production.	2008
	Pol Cachaçaria	Colonial Coffee and Handmade Alembic.	2009
Via Orgânica	Cooperativa Vinícola Garibaldi	Wine and Juice	1931
	Sítio Crescer	Vegetables and fruits	2009
	Econatura	Juices, Vinegars & Flours	1996
	Sabor Ecológico	Organic food	2009
	Família Mariane	Cereals, legumes and vegetables	1998
	Família Boroto	Wine, fruits and cereals	1998
	Restaurante Valle Rustico	Vegetables, Fruits and Meals	2009
	Fit UP	Juices	2016
Vale Das Cantinas e dos Parreirais	Embutidos Bandiera	Visit to sausage agro-industry and product tasting	2016
	Cantina Bandiera	Tasting and selling cheese, salami and wine	2008
	Choperia Ágape	Tasting, brewing courses, guided tours, meal, happy hour and events Canteen and Grapevines	2012
	Cantina Batistella	Canteen and Grapevines	2004
	La Cantina Slongo	Juice and wine making process and the restaurant. The property also works with events.	2010
Morro do Vicini	Ficks Sabores do Campo	Sale of products made in the agribusiness of the property such as fig, mandarin, pumpkin, blueberry, pickled jams and brown sugar.	2002
	Vinícola Bianchi	Wine tasting and vineyard tour	2013
	Morro do Vicini	Family history, vineyards for tasting, visit to grandparents and family objects.	2002
	Granjinha do Thiso	Visit to the property, vineyard tasting and wine tasting.	2000
	Villa Trentin	Gastronomy, restaurant and colonial cafe, events inns (the whole project is made of reused material).	2015
Agro-indústrias	Café Colonial Andreolla	Gastronomy, property tour and agribusiness.	2003
Vale Do Paraíso	Alambique Terceiro Gole	Visit to the still, history of the Sugarcane liquor production by the family.	1997
	Casa do Filó	Waterfall, waterfall, restored old house, historical staging, dances at the end a typical Italian dinner,	2006

		preservation of ancient artifacts and monjolo.	
	Moinho de Pedra	Visit of the stone mill.	2006
	Sítio Dona Cenira	Memorial history, natural beauty, waterfalls, colonial coffee, lodging, trail and sale of jams and liqueurs.	2006
	Sítio Dona Lucia	Trails, colonial coffee, jams, liqueurs, artisanal sugarcane liquor.	2005
	Pousada Casa da Tia Laura	Religious trail, lodging houses, cabins, rural cafe, lunch, dinner, landscape, historic house from the year 1904.	2004

It is noted that most enterprises and other routes started their tourism activities in the first decade of the XXI century, which confirms what theorists Dias and Cassar (2005) mention that tourism in the early years of the century has been consolidating itself as an important economic activity of the world. Some researched enterprises have in their environment the production of grapes and the manufacture of wines, juices, liqueurs and sugarcane liquor that are marketed during the visit on the properties. It is noticed that the tourist practices near the

wine regions are responsible for a considerable increase in wine sales, helping the product dissemination and making the producers redouble efforts in search of quality and variety (Lavandoski, Tonini&Barretto, 2012). .

It is observed that the researched enterprises use various dissemination tools (Table 3), since advertising becomes a link between this new venture and the customer, with the purpose of informing it initially, and finally convincing it you visit him.

Table 3. Disclosure of the projects

Route	Enterprise	Project disclosureway
Salamarias	Cantina Bordignon	National Salami Festival, word-of-mouth
	Casa CameraRistorante	National Salami Festival, Facebook, newspapers, site
	Cantina da Terra	National Salami Festival, Facebook
	Maculam	National Salami Festival, newspapers, site
	Ervateira Pagnussat	word-of-mouth, Facebook
	Pol Cachaçaria	word-of-mouth
Via Orgânica	Cooperativa Vinícola Garibaldi	Site, Facebook, Whatsapp, Instagram
	Sítio Crescer	AirBNB, Facebook, Booking, Site
	Econatura	Facebook
	Sabor Ecológico	Facebook, Instagram, Radio
	Família Mariane	Word of mouth, fairs, referral, website, city hall campaigns, Facebook, Instagram, Whatsapp
	Família Boroto	Television reports and newspapers, and city hall that publishes Via Orgânica. Organic shops, restaurants, inns. Participation in trade shows in Sao Paulo, Rio de Janeiro, Brasilia, events like Vintage in Garibaldi and Fenachamp.
	Restaurante Valle Rustico	Facebook
	Fit UP	Instagram, Facebook, Blog, tastings
Vale das Cantinas e dos Parreirais	Embutidos Bandiera	Radio and believes that the visitations (word of mouth) leverages the disclosure of the property.
	Cantina Bandiera	Folders at community fairs and parties
	Choperia Ágape	Radio, Facebook, word of mouth and at events
	Cantina Batistella	Facebook
	La Cantina Slongo	TV, wordofmouth
do	Ficks Sabores do Campo	Divulcation in the Di Bacco party, with brochures and leaflets



	Vinícola Bianchi	Divulcation in the Di Bacco party, with brochures and leaflets
	Morro do Vicini	Divulcation in the Di Bacco party, with brochures and leaflets
	Granjinha do Thiso	Divulcation in the Di Bacco party, with brochures and leaflets
	Villa Trentin	Site, Facebook
<b>Agroindústrias</b>	Café Colonial Andreolla	word of mouth, Facebook
<b>Vale do paraíso</b>	Alambique Terceiro Gole	word of mouth
	Casa do Filó	Folders, word of mouth
	Moinho de Pedra	Facebook
	Sítio Dona Cenira	word of mouth, Facebook, Instagram
	Sítio Dona Lucia	word of mouth
	Pousada Casa da Tia Laura	word of mouth, Site, Facebook

It is noticed that among the media stand out the social networks like facebook, instagram and whatsapp, as well as the websites of the projects. This confirms that the internet establishes itself as a fundamental tool for tourism enterprises, thereby achieving rapid expansion of information services such as commercial applications, promotion, dissemination and e-commerce (Cruz, Mota & Perinotto, 2012).

Publicity at festivals and fairs in the region is also a tool for publicizing the projects, as a number of tourists visit these events in order to know the region. Thus, the contact of the enterprises with the tourists becomes closer, thus convincing them to enjoy the experience of tourism in rural areas thus knowing better the region and its peculiarities. Other ventures use radio as a means of dissemination where author Sant'Anna (2005) mentions that the media strategy in radios, tv, seeks to ensure transmission that will bring the best proportionality between investment and the efficiency with which consumers will be reached, thus bringing a higher return according to the purpose of the advertising campaign.

Word of mouth also known as word-of-mouth is a widely used tool in the researched enterprises, since for the interviewed tourists themselves mention to acquaintances about the place, indicating the visit. This tool justifies the studies by Jung, Yoo & Arnold (2017) where customer service experiences can be significantly influenced by the actions and behaviors of other customers. According to studies by Thakor, Suri, & Saleh (2008), the referral of other customers increases the expectation of enjoying the services, as word-of-mouth brings expectations.

## V. FINAL CONSIDERATIONS

The objective of the study was to identify the dissemination practices implemented by tourism

enterprises in the state of Rio Grande do Sul, Brazil. The tools for publicizing the tourism routes are an opportunity to increase the value of the products and services offered and make the enterprises known to potential tourists. Dissemination tools can make a significant contribution to tourism consolidation in areas where it has never been explored.

The results of the study can contribute by helping incipient ventures as well as motivating other ventures to adopt outreach tools. The wide variety of tourism routes makes dissemination the differential, attracting tourists to know the tourist enterprises. It is noticed that the use of dissemination strategies becomes an essential tool for the consolidation of tourism, as tourists are increasingly looking for tourist destinations through the internet and social networks.

In this way, ventures, when advertised on the Internet, may be an alternative for tourists from other regions who would never know of their existence. Thus it is possible to state that the different dissemination tools are important reaching specific audiences, collaborating with the successful success of tourism in the state of Rio Grande do Sul, Brazil.

Research indicates limitations and suggestions for future studies. As limitations, we can highlight the difficulty of access to data, since they were collected by 3 researchers during the period of 3 years from 2016 to 2018. As for future studies, the potential for investigation of which are the dissemination tools used by tourists from the state of Rio Grande do Sul to visit the projects and which times of the year would be most in demand.

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# Studies on cooperativism at the Brazilian Cost Congress: Bibliometric analysis of scientific production from 1994 to 2018

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**Abstract** — The present study sought to map and analyze the scientific production on cooperativism in the Anais of the Brazilian Cost Congress from 1994 to 2018. For this, 55 articles selected from the defined sampling criteria, published in nineteen editions of the Congress, were analyzed. From the bibliometric analysis of the data it was possible to identify that the year 1999, the sixth edition of Congress, was the year in which the first work on cooperativism was published and that the majority (10.91%) of the studies was published in the 11th edition in 2004. The study allowed identifying a number of 148 different authors, which generated an average of 2.7 authors per study; 67.8% of the authors come from the southern region of Brazil; there is the predominance of 40.0% of papers written by 3 authors and the use of the case study as a research instrument, being present in 69.1% of the publications. It is hoped that the study can contribute to the knowledge of the state of the art of research on cooperativism and assist in the dissemination of studies on this theme.

**Keywords** — Cooperatives. Cooperativism. Bibliometric study. CBC.

## I. INTRODUCTION

Cooperativism, understood as a social movement, is an ideal alternative to capitalist individualism and private enterprise arising precisely at the end of the 18th century and early 19th century in the search for a solution to the poor working conditions generated by the insertion of the capitalist political, economic and social model. (TESCH, 2000; COSTA, 2007).

Since the emergence of the first cooperatives, there has been little understanding of the cooperative model. Studies involving cooperatives have increased the degree of understanding of the social importance of these organizations and has still allowed to know the obstacles still faced and the adoption of measures to overcome them. (COSTA, 2007; BEGNIS, AREND and ESTIVALETE, 2014).

In the understanding that research and scientific studies allow this knowledge of processes, obstacles and solutions to a given problem is understood that research is the nuclear activity of any scientific field, because it allows approximation and a understanding of a reality to be investigated. For Silveira and Córdoba (2009) the research is an unfinished process and provides subsidies for real intervention. Scientific research guide the production of

new knowledge, enabling a solution to the investigative realities under study.

In this context, in the search for defining a research problem, that is, "look for solutions to achieve a goal or perform a possible solution observed." (SILVA, 2008, p. 47), the study focuses on mapping and analyzing scientific production on cooperativism published in the Anais of the Brazilian Cost Congress from 1994 to 2018, through bibliometric analysis.

The study analyzes the number of articles per edition, number of authors per article, institutional link of authors, Brazilian region of origin of authors, distribution of authors by state, the types of cooperatives studied by article, the verbs used in the definition of objectives, the types of research used, the most productive authors and their networks of cooperation and the frequency of words of the titles.

The importance of conducting a bibliometric study is supported by the need to know and analyze scientific production and evaluate research and its articulators (authors/researchers), enabling the perception of models and patterns of scientific activities. Understanding the economic and social importance of cooperatives and how research can allow their evolution and systematization, this



study cooperates in "[...] understand how scientific knowledge is disseminated and incorporated between actors and their peers, as well as the general public" on the theme in cooperativism. (SOUZA, 2013a, p. 21).

In addition to this introductory section that contextualizes the theme, defines the objectives, the research problem and presents the justification, the article is organized in four other sections: the second section, theoretical foundation, which revises a brief history and the main definitions about cooperatives and cooperatives; section three describing the research method employed; section four that demonstrates and analyzes the data and results found and the fifth section that brings the final considerations of the work.

## II. COOPERATIVE AND COOPERATIVE ORGANIZATIONS

The cooperative organization system, arising with rochdale pioneers, is now widespread in the vast majority of countries as a social alternative based on the act of cooperation and opposition to dictates of the political and economic system of capitalism, which proclaims man's exploitation by man and class division. (RATNER, 2009; SALES, 2010; MORAL et. al., 2011; OURO-SALIM, BA and ROSALEM, 2018).

A cooperative organization is an association that aims to meet the needs of the cooperative members (members) and their common economic, social and cultural aspirations, the maximization of production and the consummation of goods and services. (OURO-SALIM, BA and ROSALEM, 2018; ACI, 2019).

The Organization of Brazilian Cooperatives (OCB) defines cooperativism as "[...] a philosophy of life that seeks to transform the world into a fairer, happier, balanced place with better opportunities for all." and that business "[...] replaces the employment-salary relationship with the employment-income relationship." (OCB, 2019a).

Royer (2014, p. 6) states that "the purpose of a cooperative is to operate not for its own economic gain, but for the benefit of its members", considering that cooperation is not satisfied in meeting individual interests, but to the collective interests of the group that decides how resources will be democratically used and benefit the whole. (RATNER, 2009).

In the definitions of Reisdorfer (2014) and Royer (2014), cooperatives are complex organizations that serve a variety of purposes and perform a variety of functions, but which consists of people who reciprocally contribute goods and/or services to the performance of an economic activity, without profit objective, and common income.

In Brazil, the Constitution of the Republic of 1988, in article 174, defines guidelines to promote cooperative activity. "The government is responsible for stimulating, providing and maintaining support to cooperatives in the interests of the country's socioeconomic development." (ROBLES, 2019, p. 16).

Law No. 5,764 of December 16, 1971 defines the National Policy of Cooperativism and establishes the legal regime of cooperative societies in Brazil. Article 3 of that law states that the cooperative company is constituted from the conclusion of a contract by "persons who each other undertake to contribute goods or services to the exercise of an economic activity, of common income, without profit objective." (BRAZIL, 1971).

According to Alliance Cooperative Internationale – ACI (2019), cooperatives are based on the values of mutual aid, their own responsibility, democracy, equality, equity and solidarity, values that guide cooperative principles. Members of a cooperative organization "develop projects of group, identity, feelings, needs, motives, interests and responsibilities. [...], resulting in social solidarity and support to members." (RATNER, 2009; ROYER, 2014).

In the same sense, Brazilian legislation - art. 4th Federal Law No. 5,764/71 and art. 1,094 of the Brazilian Civil Code – distinguishes cooperative society from other societies by characteristics that ratify the international cooperative current, as a limitation of the number of share shares of capital for each member, the uniqueness of the vote, quorum based on the number of associates, provision of assistance to associates, indivisibility of compulsory funds, among others.

According to the Yearbook of Brazilian Cooperativism 2019 of the Organization of Brazilian Cooperatives (OCB, 2019b), in the last eight years the number of cooperatives in Brazil grew by 62%, ending 2018 with 6,828 cooperatives. Following this growth, the emergence of 5.6 million new members and 127,300 new employees of cooperatives, totaling 14.6 million cooperatives and 425,300 cooperative employees, had been contacted.

The state of São Paulo is the one that has the largest number of cooperatives, there are 1,025 organizations that represent 15% of the national framework; the branch of agricultural cooperatives is the largest in the cooperative segment, there are 1,613 organizations representing 23.6% of national cooperatives.

## III. RESEARCH METHODOLOGY METHODOLOGICAL FRAMEWORK

According to Gil (2010) the research consists of rational and systematic procedures aimed at finding

answers to the proposed problems, consisting of phases that range from the origin of the problem to the discussion of the solution/result. This study presents an empirical approach, characterized by a descriptive-exploratory analysis of data, of a basic nature and quantitative approach.

From the point of view of nature, basic research aims to generate new knowledge for the development of science without predicting practical application; as for the objectives, descriptive-exploratory research aims to provide more information on a subject and describe the observed data. (GIL, 2010; PRODANOV, FREITAS, 2013).

It is characterized as quantitative research, because it considers that the problem should be answered through quantifiable and classifiable data, being analyzed from the use of statistical techniques. (PRODANOV, FREITAS, 2013; SILVA, 2008). As for the procedures, bibliographic research and data collection were used.

#### BIBLIOMETRY

Pritchard (1969) defines bibliometry as a field of Information Science that applies statistical methods to analyze the written communication processes of a given area; it is a study initiated in the nineteenth century and systematized from the twentieth century, whose objective is to study and evaluate the quality of scientific production.

A bibliometric analysis consists in the application of techniques and principles that aim to measure a certain area of knowledge and the productivity of authors, measure the frequency of occurrence of words in scientific articles and identify the elite of researchers in a given field, studying already published scientific production and promoting dissemination of relevant scientific information. (GUEDES, BORSCHIVER, 2005).

Bibliometric analysis, or statistical bibliografy, is an integral instrument of information science processes that aims at a description, through a data processing, written communication in books, journals and annaxs.

#### SAMPLE AND DATA COLLECTION

The target population of the study are the articles published in the anuals of the Brazilian Cost Congress of the Brazilian Cost Association (CBC-ABC) between 1994 and 2018. The year 1994 is defined as the temporal beginning of the survey due to being the year of the first edition of Congress, and the year 2018 as the final milestone for being the year of the last edition of Congress until the date of the study.

For sample selection, the Research Tool Content of the Journal of the Congress database (<https://anaiscbc.emnuvens.com.br/anais/issue/archive>) was used, and the articles they had in the Title were

selected the words: cooperative, or cooperatives, or cooperativism, a procedure that resulted in a sample of 55 articles.

The procedure for selecting and collecting the data occurred from the reading of the title, abstract and methodology section. The data collected were: title, year and edition of the Congress, objective, names and institutional bonds of the authors, type of applied research and the branch of cooperative studied.

The collected data was organized and tabulated using Microsoft Office Excel 2016. The following section demonstrates the findings of the research, as well as data analysis and presentation of the results.

#### IV. ANALYSIS OF DATA AND RESULTS

In line with the objectives proposed by the research, in this section will be presented and analyzed the collected data that portray the bibliometric aspects that characterize the scientific production analyzed, namely: number of articles per edition, number of authors by article, institutional link of the authors, brazilian region of origin of the authors, distribution of authors by state, the types of cooperatives studied by article, the verbs used in the objectives, the types of research used, the authors networks of cooperation and the frequency of words of titles.

Table 1 presents the number of articles and the percentage per year and by edition of the Congress.

Table 1: Sample and period analyzed

Year	Edição	City of realization	Nº of articles	fi %	Fi %
1999	6 <sup>a</sup>	São Paulo – SP	1	1,82%	1,82%
2000	7 <sup>a</sup>	Recife – PE	2	3,64%	5,45%
2001	8 <sup>a</sup>	São Leopoldo – RS	1	1,82%	7,27%
2002	9 <sup>a</sup>	São Paulo – SP	1	1,82%	9,09%
2004	11 <sup>a</sup>	Porto Seguro – BA	6	10,91 %	20,00 %
2005	12 <sup>a</sup>	Florianópolis – SC	4	7,27%	27,27 %
2006	13 <sup>a</sup>	Belo Horizonte – MG	2	3,64%	30,91 %
2007	14 <sup>aa</sup>	João Pessoa – PB	2	3,64%	34,55 %
2008	15 <sup>a</sup>	Curitiba – PR	5	9,09%	43,64 %
2009	16 <sup>a</sup>	Fortaleza – CE	2	3,64%	47,27 %
2010	17 <sup>a</sup>	Belo Horizonte - MG	4	7,27%	54,55 %
2011	18 <sup>a</sup>	Rio de Janeiro - RJ	3	5,45%	60,00 %
2012	19 <sup>a</sup>	Bento Gonçalves - RS	3	5,45%	65,45 %

2013	20 <sup>a</sup>	Uberlândia – MG	4	7,27%	72,73 %
2014	21 <sup>a</sup>	Natal – RN	5	9,09%	81,82 %
2015	22 <sup>a</sup>	Foz do Iguaçu – PR	2	3,64%	85,45 %
2016	23 <sup>a</sup>	Porto de Galinhas - PE	2	3,64%	89,09 %
2017	24 <sup>a</sup>	Florianópolis – SC	2	3,64%	92,73 %
2018	25 <sup>a</sup>	Vitória – ES	4	7,27%	100%
<b>Total</b>			<b>55</b>		

The Brazilian Cost Congress has twenty-five editions, I have published 6,300 articles. Of the twenty-five editions of the Brazilian Cost Congress, nineteen have studies on published cooperativism. Among the nineteen editions under analysis, seven editions were made in the Southeast region of Brazil, six in the Northeast region and six others in the South region.

The sixth edition, 1999, was the first edition to have work on cooperatives. In the first ten years of congress (1994 to 2003) only 5 studies on cooperatives were had; in the following ten years (2004 to 2013) 35 more studies on the subject were published, an increase of 600% compared to the previous decade. And in the last five years (2014 to 2018), 15 other studies have been published in the minutes of Congress.

The year 2004, 11th edition, is the period in which most articles (10.9%), followed by the years 2008 and 2014, with 5 articles (9.09%) each; 2005, 2010, 2013 and 2018 with 4 articles (7.27%) Each. The other editions have one (1.82%) to three (5.45%) published articles.

Table 2 presents the number of authors per articles, the relative frequency and the average number of authors per article.

Table 2: Number of authors per article

Number of authors	Number of articles	%
1	6	10,9%
2	14	25,5%
3	22	40,0%
4	5	9,1%
5	7	12,7%
6	1	1,8%
<b>Total of articles</b>	<b>55</b>	<b>100%</b>
<b>Total de authors</b>	<b>148</b>	
<b>Average authors/articles</b>	<b>2,7</b>	

The data reveal that the maximum number of authors per study was six, the maximum number of authors

defined in the congress submission rules; most jobs (40.0%) were written by three authors, followed by the studies with two authors (25.5%). The number of 148 different authors was also identified, which provided an average of 2.7 authors per article.

Table 3 presents the authors' institutional ties, that is, the academic institutions to which the authors are linked and informed in each article.

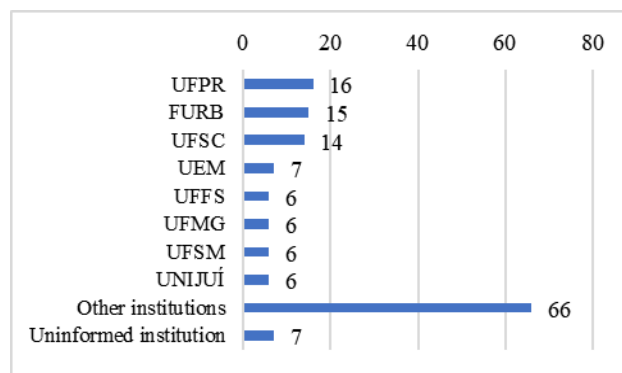


Fig. 1: Institutional link of authors

The institutional ties reported by the authors point to a total of 47 different academic institutions. From the data, it is possible to identify that most authors (10.8%, 16 authors) are linked to the Federal University of Paraná (UFPR), 10.1% (15 authors) to the Regional University of Blumenau (FURB) and 9.5% (14 authors) to the Federal University of Santa Catarina (UFSC). The Federal Universities of the Southern Border (UFFS), Minas Gerais (UFMG) and Santa Maria (UFSM) and the Regional University of the Northwest State of Rio Grande do Sul (UNIJUI) have six linked authors (4.1%) Each.

A percentage of 4.7% of the authors (7 authors) did not report their institutional link. Other institutions, to which 66 authors are linked, are represented by institutions with fewer than five linked authors. One of the authors reported in two articles institutional ties to two different institutions, which resulted in a total of 149 authors in this analysis.

Table 3 presents the Brazilian region of origin of the authors.

Table 3: Region of the Brazil of origin of the authors

Region	Number of authors	%
Northern Region	1	0,7%
Northeast Region	11	7,4%
Midwest Region	2	1,3%
Southern Region	101	67,8%
Southeast Region	26	17,4%
Uninformed region	7	4,7%
Outside	1	0,7%
<b>Total</b>	<b>149</b>	<b>100%</b>

The data allow us to infer that 67.8% of the authors are located in the Southern region, with a total of 101 different authors. 17.4% of the authors originate from the Southeast region, 7.4% from the northeast region, and another 2.1% from the North and Midwest regions. One of the authors, for informing different institutional links in two of the articles under analysis, is duplicated between the South and Midwest regions. Seven authors (4.7%) did not inform their institutional ties, which made it impossible to identify their regional origins and one of the authors (0.7%) is from Uruguay.

Of the 14.6 million members in Brazil, 48% come from the Southern region. (OCB, 2019b). It is believed that the strong concentration of authors and studies from this region is because it is the region that aggregates the majority of Brazilian cooperatives.

To better visualize the Brazilian states to which the authors belong, Figure 1 shows the distribution of authors by state.

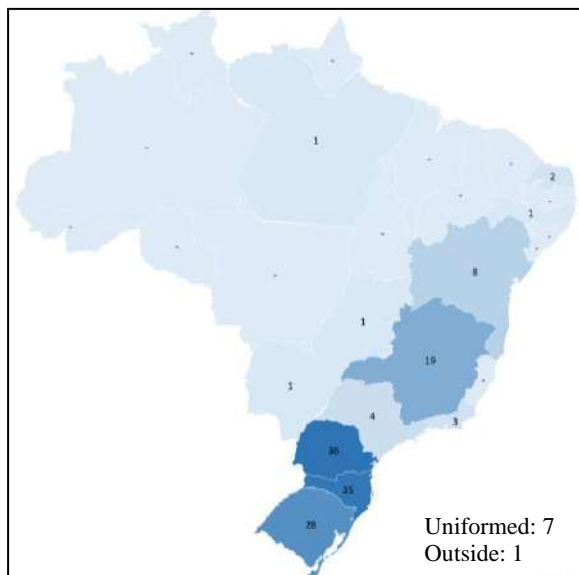


Fig. 2: Distribution of authors by state of the Brazil

As already observed, the authors of the scientific production under analysis originate mostly from the southern region, with 36 authors in the state of Paraná, 35 in the state of Santa Catarina and 28 in Rio Grande do Sul. From the state of Minas Gerais, 19 authors from Bahia 8 authors, from the state of São Paulo 4 authors and Rio de Janeiro 3 authors come from the state of Minas Gerais. From Rio Grande do Norte there are 2 authors, and the states of Pará, Goiás, Mato Grosso do Sul, Pernambuco and the Federal District, with 1 author each.

Table 4 presents the branches of cooperatives studied in the articles under analysis. For the purpose of defining the branches of cooperative society organization, business is feasible in several branches, namely:

agricultural cooperatives, which include livestock, rural and fishing activities; consumer cooperatives, which include common purchase of consumer goods among co-workers; credit unions, which aims to provide financial assistance to the cooperative; which offer all levels of education; special cooperatives, consisting of guardians; housing cooperatives, aimed at the construction and administration of housing estates; health cooperatives, which seek to offer health services; cooperatives, which maintain and recover jobs; production cooperatives, intended for the production of collective goods; and transport cooperatives, which provides transport service for people and cargo, among others. (BRAZIL, 2008; OCB, 2019c).

Table 4: Sectors of cooperatives studied

Sector	Number of the articles	%
Agricultural	31	55,4%
Credit	16	28,6%
Production	2	3,6%
Health	2	3,6%
Work	1	1,8%
Transport	1	1,8%
Unspecified	3	5,4%
<b>Total</b>	<b>56</b>	<b>100%</b>

The most articles (55.4%) concentrates its studies in agricultural cooperatives, among which are cooperatives that operate with dairy, coffee, rancher, rice production and agro-industrial activities. Sixteen studies, representing 28.6% of the sample, studied credit unions. One of the articles sought to study both credit cooperatives and production cooperatives, and this was considered in data collection. Another 5.4% did not specifically report the cooperative branch under study.

It was also tried to analyze the verbs used in the definition of the objectives of the studies. It was possible to identify the use of twenty-six different verbs in infinity to establish the overall objective of the study, according to Table 5.

Table 5: Verbs used in the definition of objectives

Verbs used	Number of the aticles	%
Analyze	12	22%
Identify	10	18%
Check	4	7%
Demonstrate	3	5%
Evidence	3	5%
Apply	2	4%
Examine	2	4%
Other verbs	19	35%
<b>Total</b>	<b>55</b>	<b>100%</b>



There is a predominance in the use of the verb analyze, which is perceived in 22% of the works, followed by the 18% of the verb identify, 7% of the verb verify and 5% of verbs demonstrate and evidence and another 4% of verbs demonstrate and evidence". Nineteen other verbs that were used once represent 35% of the works.

In the conception of Prodanov and Freitas (2013) the verb analyze determines a cognitive stage of research analysis, while verbs identify, verify and examine a cognitive stage of understanding, which aims to know.

Regarding the methodologies adopted in the studies, we identified the adoption of six different research methodologies: data wrap analysis, case study, ex post facto, field research, bibliographic review and documentary research, according to Table 6:

Table 6: Search type

Search type	Number of the articles	%
Data Wrap Analysis	4	7,3%
Study	38	69,1%
Ex post facto	1	1,8%
Search	3	5,5%
Bibliographic Review	3	5,5%
Documentary	6	10,9%
<b>Total</b>	<b>55</b>	<b>100%</b>

It is noted that the methodology of the case study is predominant, perceived in 38 studies, representing 69.1% of the sample. The results correspond to those found by Carrijo and Leal (2015), Souza et. al. (2013b), Duarte, Jesus-Lopes and Santos (2016) who, when conducting a bibliometric study on scientific production linked to cooperativism and third parties, identified that the case study is the most widely used research procedure in the theme.

Documentary research was found in 10.9% of the articles, data wrap analysis in 7.3%, field research and bibliographic review in 5.5% each and ex post facto research in only one article (1.8%).

Table 7 presents the most productive authors on the subject in Congress. It is noted that 14 of the 148 authors have two publications in the analyzed period and another 120 only one publication each.

Table 7: More productive authors

Aurthors	Number of the articles
NOGUEIRA, D. R.	2
FERNANDES, F. C.	2
BORGES, I. M. T.	2
FAGUNDES, J. A.	2
SANTOS DE JESUS, J. C.	2
OLIVEIRA, J. L. R.	2
ALMEIDA, L. B.	2
TARIFA, M. R.	2
MORCH, R. R.	2
RIBEIRO, R. R. M.	2
MAZZIONI, S.	2
OLIVEIRA, S. L.	2
KRUGER, A. D.	2
SILVA, T. P.	2
Other authors	120
<b>Total</b>	<b>148</b>

Among the authors who published the most prevails the methodology of the case study and the study with agricultural and credit cooperatives. Among the most productive authors, there is the existence of cooperation networks, that is, joint scientific production, according to Figure 2.

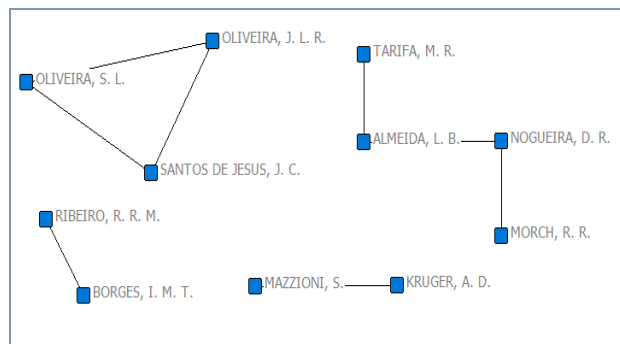


Fig. 3: Cooperation networks

The authors Oliveira, J. L. R., Oliveira, S. L. and Santos de Jesus, J. C. have published two articles together, both in 2004. The other network of collaboration perceived were one article each, namely: Nogueira, D. R. and Morch, R. R. R. in 2008; Nogueira, D. R. and Almeida, L. B. in 2008; Borges, I. M. T. and Ribeiro, R. R. M in 2013; Mazzioni, S. and Kruges, A.D. in 2014; and Almeida, L. B. and Tarifa, M. R. in 2017.

Finally, seeking to analyze the frequency of words used in the titles of the 55 articles under analysis, the cloud of words is presented in Figure 3:



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# Environment impacts and charges during the process of urban

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**Abstract**— *The city of Manaus has his urbanization pushed due to wide scale of migration of populations of the interior for the city in search of improvement in the Industrial Pole and Manaus (PIM), producing occupations messed up to the detriment of the forest and I use the ground altering the nature and intensifying changes in the space reducing to vegetation when the deforestation was owed. Before the exposed one, the work had as objective analysed the environmental impacts and the scenery losses in function of the urbanization. The collected data were through the navigator Google Earth referring to the 1985 years, 1990, 1995, 2000, 2005, 2010 and 2015 comparing the urbanization process to each five years. The year of 1985 suffered small urbane occupations whereas in 1990 the increase was significant in the urbanization when the economical outbreak and civil constructions were owed. From 2000, there were urbane occupations controlled by the government, as well as in the 2005's that had an increase in the vegetation area when laws were owed you implemented for the UC's and the New Code Forest. In 2015, the Top of the World of 2014 produced few occupations, but it kept on producing environmental impacts in the forests around the city.*

**Keywords**— *Urbanization; Geoprocessing; Environmental losses.*

## I. INTRODUCTION

The urban space gains a new visibility with the population growing due to migratory process that is caused by the formation of countless neighbourhood which becomes part of the city's periphery. Because of this accelerated urbanization, the city of Manaus, has been facing with an elevated number of irregular occupancy in the last three decades, the so called "invasions".

Due to Industrial pole of Manaus's (PIM) demands, there have been a migration in large scale of people from the country side to the cities, which in turn has no appropriate pan causing an expressive change in the urban environment [1].

In a fast way, the growth of these migrations, within the passing years, resulted in a messy occupancy to the detriment of the forest, not prioritizing the use of the soil, ceasing to be a government prerogative. According to [2], the urbanization in the country, with the growth of these centers, occurred mainly caused by the losses of the jobs in the rural sectors, the implementation of machines and equipment, decreasing the countryside manpower, resulting in the migration of many families looking for a better life.

[3] quotes that the Brazilian cities, within the passing years, have been exposing lack in infrastructure and they are growing against their administration capacity and local planning.

This process causes many environment changes like nature transformation and increasing the constant changes in the space, among them there are the reduction of the vegetation caused by the deforestation – initial process – in favour of the constructions of public ways, increase of paved areas, waterproofing, air pollution, enhancing the quality of buildings and, with these, changes of the winds, decrease in the absorption of air and water [4].

For [3] before degrading the natural environment, the society, between its relationships and economy, degrades itself, reflecting in the urban area above all else. The vegetation roof removal and its replacement for buildings constructions causes environment degradation, causing the fragmentation of the ecological cycles in the urban area [5].

The vegetation presented in the areas influences positively the comfort of the cities helping in the reduction of temperature, purification of the air, absorption of particles and polluting agents, quality of aquifers and reduction of sound pollution, and contributes enhancing the life quality at cities and the energy efficiency [6].

When the arborisation starts as a crucial alternative to mitigate the impacts caused to the environment, public politics with this objective are required, and they must be implemented continuously so the environment impacts are diminished with success,



minimizing losses of areas, diversity information and futures of their identity, be them cultural, landscape etc.

According to the Federal Constitution of 1988 (art. 30 and art. 182) and the City Statute [7], as part of urban development politics, it is proposed that the city should create, presser and protect the green areas of the city and also the arborisation system. The city must act through specific laws, restricted for each city, in a way to suppress the local interests, without going against federal and state laws [8].

The Resolution number 87/2016 [9], posts about the Urban Arborisation Master Plan, describing that: “the existence of arboreal individuals is fundamental to the maintenance of the quality of people’s life and ecological balance of the environment in the area of the City of Manaus”, as shown at Art. 225 [8], and emphasise the rights for an ecologically balanced environment.

Still mentioning the COMDEMA Resolution, at its art. 2<sup>nd</sup>, that shows the implementation of the Urban Arborisation Master Plan, the Municipal Secretary of Environment and Sustainability (SEMMAS) is in charge of the issues related to elaboration, analyses, project implementation, management of urban arborisation, as well as make covenants, corporations, partnerships and permissions with public institutions and privates to achieve the objectives of the Plan [9].

And so, the green urban spaces are divided in three kinds of fragments: the forests; gardens and yards; and the public places. These types described allowed a benefit in the social and environment use, like biotic and abiotic factors. The green spaces in the urban centers offer a great social and cultural contribution, aiming to understand the benefits of vegetation, air, soil and water [10; 11].

This study tries to evaluate the urban landscape of the city of Manaus/AM by analysing the data obtained from 1985 to 2015, between intervals of 5 years, starting from the geoprocessing, trying to explain the environmental impacts and the losses of landscape caused by the urbanization.

## II. MATERIAL AND METHOD

### Type of Study

It is about an exploratory research to define the changes of use of the modified soil during the urban expansion of the City Manaus, using the exploratory and descriptive methods. According to [12], the descriptive analysis tries to describe the characteristics of determined population or phenomena using standardized technics of data collect and/or systematic observation.

The explanatory analysis aims, or familiarizes the researcher with facts and phenomena related to the issues to be studied by investigations and allowances related to the theme [13].

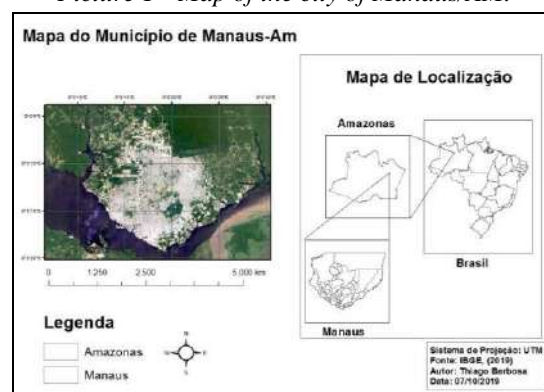
This work was developed with characteristics of quantitative research, for according [14], it seeks objectivity through the reality that can only be understood by using raw data collected using standardized and neuter instruments, and so being able to describe the causes of a phenomena, the relations between variables etc.

### Field of study

The field of study comprise the urban perimeter of the city of Manaus, at the coordinates 3°06’26” S and 60°01’34” W (Picture 1), according [15] the surface of the city exhibit 11,458,5 km<sup>2</sup>, which prevail the dense ombrophilous Forest of low soil, also known as primary forest, strands and shoals.

The climate is of 2.100 mm of annual rainfall, with dry seasons during June and October and rainy seasons between November and May, being its standard temperature varying between 24 and 28°C with relative elevated air moisture [16].

Picture 1 - Map of the city of Manaus/AM.



Source: Thiago Fernandes, 2019.

### Data Gathering

The information collected from the areas, during the passing time, tries to characterize the vegetation and the losses of landscape caused by urbanization in the city of Manaus, during the last 35 years, where satellite images were acquired available in the site database, referring to the years 1985, 1990, 2000, 2005, 2010 and 2015.

### Gathering Instruments

The Geoprocessing System is a computational area able to capture, manage and process geospatial data from objects with attributes having information about its

geographic location related to a system of geographic coordinates [17].

The specific images of vegetation maps and land occupation during the last three decades of the city of Manaus, were obtained through the free internet navigator Google Earth that made possible to compare the areas in process of urbanization through historical images, every five years. The free software ArcGis@ was used through the own app infrared ray to exhibit the areas of urban occupation and other characteristics of the city of Manaus.

### III. RESULTS AND DISCUSSION

The use of the soil surface can induce directly and indirectly in characteristics or proprieties of the water, the fluidity of the fauna, loss of habitat and biodiversity, when removed by environment impact, including when under social and economic conditions.

And so the society needs to follow and monitor the areas and their possible impacts, to understand, sensitize and to be responsible for possible losses in short and long terms, the development of these factors in different scales at local, regional and global level [18].

Through the maps generated for the analysis and occupation of the soil in the city of Manaus, from 1985 to 2015, it was to analyse the process of balance of the areas with vegetation (green areas) and increase of the areas of urban occupation (red area) regardless of the type of the use of the soil, with the losses of arborisation, landscape and further information that characterize this region.

In 1985 (picture 2), the urbanized area shows about 167,132 km<sup>2</sup> (6.82%) with characteristics of small urban areas related to its vegetation that had a bigger domain of 155,703 km<sup>2</sup> (93.18%). The analysis of this first year indicates a slow process, still a small occupation, even comparing the population of that time.

Even so, in Manaus, the accelerated urbanisation became problematic starting with the creation of the “Zona Franca” of Manaus, by the decree Law #288 of 02/28/1967, generating a process of development to Amazonas state and attracting a great number of people from other states and areas, increasing the population of the city of Manaus and, consequently, urban issues like public health care and social prejudice [19].

Picture 2: Characteristics of the Occupation of the city of Manaus/AM, in 1985.

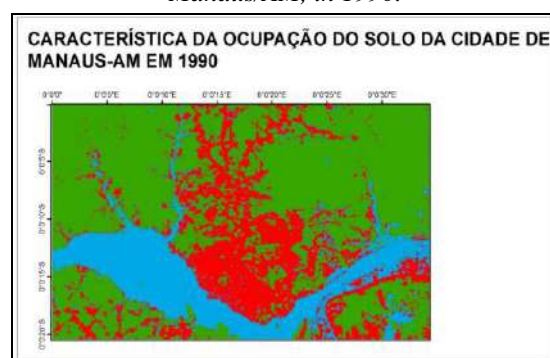


Source: Thiago Fernandes, 2019.

Five years later, in the year 1990, the area of the occupied soil shows an increase of 4% and the substitution of the forest for the occupied area being harmful about 185,537 km<sup>2</sup> (11.01%).

From the decade of 1990 (picture 3), the process of urbanization, attached to the new technologies, started a new process that caused great environmental impacts generating a massive urban occupation and changes in the use, collaboration with strong processes of environmental degeneration in native areas.

Picture 3: Characteristics of the Occupation of the city of Manaus/AM, in 1990.

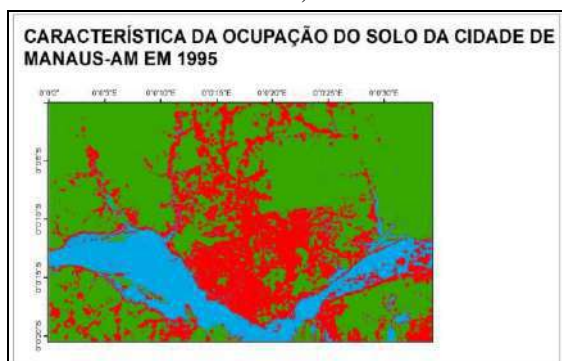


Source: Thiago Fernandes, 2019

There was an economical outbreak caused by the new jobs at the industrial area, just like in the commerce and services related to the industrial expansion, beginning an increase of the population, and increasing of the taxes and the construction market [20].

In 1995 (picture 4), the urban occupation in the soil shows 171,988 km<sup>2</sup> (7.3%) in relation to the previous five years, where happened a significant decreasing of urbanization, allowing the domain of the vegetation in the period.

Picture 4: Characteristics of the Occupation of the city of Manaus/AM, in 1995.



Source: Thiago Fernandes, 2019.

The incessant changes of landscape in the urban area, noted by the people, reveal a solid, concreted and artificial landscape [21], which [3] report that, before the degradation of the natural environment, the society degenerates itself in the social and economic relations, especially in the big cities.

In 2000, the urbanized area became 222,180 km<sup>2</sup>, about 19.75% of increase of urban occupation in relation to the vegetation, being 80.25% at this time, showing significant environmental impacts. The expansions of soil occupation are presented at more distant areas from the center of Manaus (Picture 5).

Between 1990 and 2000, the Brazilian politics of President Henrique Cardoso, offered great expectative to multinational enterprises and landowners, with liberal policies and favours, gaining trust with the real Plan [22].

Picture 5: Characteristics of the Occupation of the city of Manaus/AM, in 2000.



Source: Thiago Fernandes, 2019.

According to [22], social movements to fight for land pressed the government to acquire lands and families settlement, which the FHC government treated as a compensatory policy issue by offering small portions of lands to generate job and development at the countryside and diminishing the rural exodus, ignoring the real

expulsion and migration to the urban area that this kind of movement caused (even today).

The mapping of the city in 2005 (Figure 6) showed a reduction in land use of 182,802 km<sup>2</sup> (17.72%) compared to the previous five years, in which anthropogenic changes in vegetation characterized few mapping records, demonstrating urbanization approximately equal to the year 2000.

Picture 6: Characteristics of the Occupation of the city of Manaus/AM, in 2015.



Source: Thiago Fernandes, 2019.

The government of Luiz Inácio Lula da Silva, in this period, creates the Land Credit Program allowing the purchase and sale of land in which it was not possible to expropriation for social interest, aimed at individual farmers or groups that had incomes below 15 thousand and less than 30 thousand assets [22], a measure used to contain land use that, according to [23], individual credit only benefited family farmers with more capital and better articulated with the banking network.

In 2010 (Figure 7), the Manaus's city had its land occupation phenomenon of 194,486 km<sup>2</sup> (6.4%), a similar increase with 1985, leading to the deduction that new vegetation spaces were removed, where the urban occupation, demonstrates that during this period there was a recovery of vegetation in the urban perimeter.

Picture 7: Characteristics of the Occupation of the city of Manaus/AM, in 2010.



Source: Thiago Fernandes, 2019.

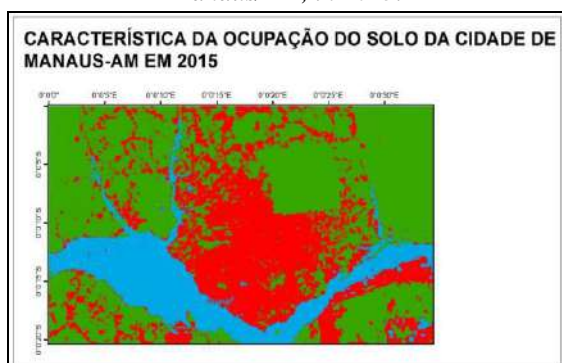


In this period there were already advances of environmental policies in the State of Amazonas with the creation of the State System of Amazonas Conservation Units (SEUC) instituted by the complementary Law 53 of 2007, in which it managed 33 Federal Conservation Units and 41 State Conservation Units being nine of integral protection (3.610.513,13 ha<sup>-1</sup>) and 32 of sustainable use (15.396.519,49 ha<sup>-1</sup>) [24].

In 2015, the land use in Manaus (Figure 8), an urbanized area of 171,589 km<sup>2</sup> (11.77%) in relation to the vegetation area, which continued with significant environmental degradation, even with the reduction of land occupation over the 5 years. previous years.

The new Forest Code was published by Law 12.651/2012 by President Dilma Roussef, in which were maintained rules and limits for APP's and Legal Reserve, with main novelty the Rural Environmental Registry (CAR) the mandatory national registration of rural properties allowing the government control and manage land use [25].

Picture 8: Characteristics of the Occupation of the city of Manaus/AM, in 2015.



Source: Thiago Fernandes, 2019.

However, it is known that after choosing Manaus to host the Football World Cup, by 2014, according to [26], the World Cup brought to Manaus serious problems related to the removal and occupation of people to make available places for the big event, as well as brought significant impacts on the surrounding forest due to the easing of environmental laws and minimizing the controls of the environmental impacts of the works. disregarding the laws of the country and the environment.

Given the results we can get a better understanding of the period of land occupation in the city of Manaus in the last 30 years through its loss of native vegetation due to the demographic increase of the city which caused landscape and cultural losses.

#### IV. CONCLUSIONS

In 1985 small occupied urban areas did not significantly measure vegetation, even with the migratory exodus due to the establishment of the Manaus Free Zone. In 1990, the city's land had an 11.01% increase in occupation in five years due to the economic boom, generating new jobs in the city, such as consumption in commerce. In 1995 and 2000, the occupation of urban land in Manaus decreased due to the Brazilian government's FHC's determination of land control and distribution policies to popular movements, as well as the interest of large rural investors.

In the years 2005 and 2010 the city of Manaus slowed the progress on new areas, but the degradation on vegetation continued even with the Lula government managing land purchase and sale for landowners, as well as complementary UC Laws and the New Forest Code. which legally limited land use; In 2015, the degradation of green areas remained high, even with the reduction of urban occupations, but due to major works in the city due to the 2014 World Cup, there was no control by the government over environmental impacts in this World Cup period.

The present work made it possible to understand land degradation and occupation in the city of Manaus over the last 30 years, which intends new scientific arguments about the Amazonian environment, indicating that there is a lot of information about landscape loss, culture, social characteristics, mainly given by disorderly occupation, advancement of new areas (most of them, invasions), declining GDP and ZFM instability.

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# A CFD Analysis of Wind Effects on Lifted Loads

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**Abstract**—This work presents a numerical investigation of the effects of wind blowing on lifted structures. The chosen case is an offshore oil & gas platform module lifted by a crane. The pendulum-like displacement of the lifted load is expected once wind blows on it, therefore a pendulum-like displacement is determined via a finite difference scheme whereas drag coefficients of the platform module are estimated through Computational Fluid Dynamics (CFD) via a finite volume method. Numerical results are compared to empirical data found in the literature and experiments carried out in a scaled model. Displacements of the lifted load are calculated for different gusts of wind and compared to standards commonly used by the oil & gas industry. It is confirmed that the recommended horizontal gap around the lifted structure is adequate for wind speeds of up to 20 m/s. For higher wind velocities, displacements become too large for a safe rigging and hook-up operation.

**Keywords**—Aerodynamics, CFD, fluid-structure interaction, lifting.

## I. INTRODUCTION

The offshore oil & gas industry is continuously evolving to explore more complex resources at higher rates, reaching deeper depths, harsher environments and unconventional reservoirs. Increased complexity requires more equipment that leads to larger and heavier facilities, which become more challenging to assemble. With the world's growing energy demand [1], it is understood that such facilities will continue to be built in the years to come as oil and gas will remain a significant part of the global energy mix.

Efforts to build platforms more efficiently and safely have led to several assembly methods such as modularization [2]. It consists of separate modules built separately in different locations and integrated together onto the final unit. Despite its broad use throughout the industry, it is argued that poor module architecture increases costs due to inefficient assembly, among other issues [3]. Integration and commissioning phases' complexity have led to project schedules and cost overruns of over 100%. To minimize risks associated with construction, integration and commissioning phases, modules' dimensions have increased while their quantities have been reduced, aiming to have the least possible scope to be executed on the final unit. Nevertheless, increasing modules' dimensions jeopardises the most complex step of modularization: lifting and transportation. Fig. 1 shows the lifting operation of a living quarter module of a platform, weighing just above 3000 tons.

Heavy lifting operation is a complex and dynamic problem. Beyond its own weight, which solicits structurally the lift crane and accessories (eye bolts, shackles and slings), the lifted load is subject to accelerations due to engineering and environmental factors. The lifted structure's vertical speed, added to

crane's horizontal speed, added to unexpected accelerations of the crane or of the load may produce undesirable displacements. Therefore, soil stability, wave activity and wind gusts must be clearly stated in the lifting plan as conditions to execute the operation. These shall be carefully analyzed and monitored to guarantee a safe rigging operation onshore and offshore. For instance, the tragic accident of the Milwaukee Brewers Basketball Stadium, was caused by lateral wind loads acting on the lifted load and crane boom [4].



Fig.1: Rigging of a living quarter module of a platform.

This work aims to provide a CFD approach to estimate the pendulum-like displacement of lifted structures due to wind effects. CFD analysis is utilized to estimate the drag coefficient ( $C_D$ ) of wind flow around the lifted platform module as it is a tool broadly used to solve industry problems [5], to model air flow in various applications [6], and to model hydrodynamic events [7].

## II. METHOD

A commercial CFD package, ANSYS CFX, release 15.0 is utilized to estimate drag coefficients for wind flow around the lifted load at different wind speeds. The pendulum-like displacement is then calculated via a finite difference scheme, using the CFD obtained drag coefficient as an input. The work is divided in four phases: set up a finite difference mathematical scheme that models pendulous motion, test it experimentally, obtain  $C_D$  for air flow around an oil & gas platform module (lifted load) through CFD and couple both analysis to obtain the load displacement.

In order to avoid running analysis not needed for the purpose of this work, a simplification was adopted, and a particularity shall be noted. Once a lifted body is set into motion by wind, a rotational and spinning movement can occur. As this work focus on potential for collision with nearby structures and people, lifted body motion is assumed to be a two-dimensional pendulous like movement. Such simplification has been previously adopted [8].

Further, modules of oil and gas platforms can be composed by various equipment of different shapes, allowing wind to flow through the module. The module utilized in this work is impermeable, there is no wind flow through its boundaries, it represents an electrical room, which is mostly enclosed by steel plates, similarly to the one shown in Fig. 1 (living quarter module).

### 2.1. Pendulum Mathematical Model

The mathematical model is based on the diagram shown in Fig. 2.

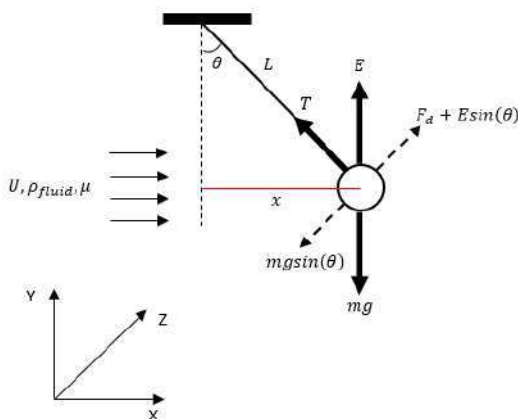


Fig.2: Pendulum model

There are three forces acting in the tangential direction: drag ( $F_D$ ), weight ( $mg$ ) tangential component and buoyancy ( $E$ ) tangential component, where  $F_t$  represents the tangential forces,  $m$  is the pendulum mass,  $a_t$  is the tangential acceleration,  $L$  is the pendulum's cable length,  $T$  is the cable traction,  $x$  represents load's horizontal displacement from vertical position,  $\theta$  is the pendulum opening angle,  $g$  is the gravity acceleration,  $E$  is the

$$\begin{aligned} \sum F_t &= m a_t = m L \left( \frac{d^2\theta}{dt^2} \right) \\ &= -mg \sin(\theta) \\ &\quad + E \sin(\theta) + F_D \end{aligned} \quad (1)$$

buoyancy,  $\mu$  fluid dynamic viscosity,  $\rho_{fluid}$  is the fluid density,  $U$  fluid velocity and  $F_D$  is the drag force. By applying Newton's second law:

Where:

$$F_D = \frac{C_D \rho_{fluid} (vel)^2 A}{2} \quad (2)$$

in which  $A$  is the body's area and  $vel$  is body's linear relative velocity to fluid, which can be written as:

$$vel = U \cos(\theta) - \omega L, \quad (3)$$

where  $\omega$  is the pendulum's angular velocity.

Equation (1) can be written as:

$$\frac{d^2\theta}{dt^2} = \alpha \sin(\theta) + \beta \quad (4)$$

Where:

$$\alpha = -\frac{g}{L} \left( 1 - \frac{\rho_{fluid}}{\rho_{body}} \right) \quad (5)$$

$$\beta = \pm \frac{C_D vel^2 A \rho_{fluid}}{2 mL} \quad (6)$$

where  $\rho_{body}$  represents body's density.

In order to obtain the lateral displacement, it is needed to determine the opening angle  $\theta$  at each time step. For this purpose, equation 4 is solved by means of an explicit fourth-order Runge-Kutta method, motivated by previous similar application [9] to solve a pendulum model immersed in fluid. Such method requires four auxiliary values ( $k_{1-8}$ ) for each solved variable. Therefore, equations for  $\theta(t)$  and  $\omega(t)$  are written as:

$$\omega_{n+1} = \omega_n + \frac{1}{6} (k_1 + 2k_3 + 2k_5 + k_7) \quad (8)$$

$$\theta_{n+1} = \theta_n + \frac{1}{6} (k_2 + 2k_4 + 2k_6 + k_8) \quad (9)$$

Where:

$$k_1 = h f(\omega_n, \theta_n) \quad (10)$$

$$k_2 = h \omega_n \quad (11)$$

$$k_3 = h f\left(\omega_n + \frac{k_1}{2}, \theta_n + \frac{k_2}{2}\right) \quad (12)$$

$$k_4 = h \left(\omega_n + \frac{k_1}{2}\right) \quad (13)$$

$$k_5 = h f\left(\omega_n + \frac{k_3}{2}, \theta_n + \frac{k_4}{2}\right) \quad (14)$$

$$k_6 = h \left(\omega_n + \frac{k_3}{2}\right) \quad (15)$$

$$k_7 = h f(\omega_n + k_5, \theta_n + k_6) \quad (16)$$

$$k_8 = h (\omega_n + k_5) \quad (17)$$

where  $h$  is the time step.

## 2.2. Experimental Model

In order to test and validate the mathematical model proposed in section 2.1, a scaled model experiment was developed. The purpose with the experiment is to test whether the mathematical model can determine the same motion observed in the experiment under the same conditions.

For this analysis, the chosen geometry for the pendulum is a sphere as  $C_D$  for flow around it can be easily obtained by an empirical formula [10] which has adequate accuracy for Reynolds number ranging from 0 to  $2 \times 10^5$ :

$$C_{D_{sphere}} = \frac{24}{Re} + \frac{6}{1 + \sqrt{Re}} + 0,4 \quad (18)$$

The experiment is made using a glass reservoir partially filled with water where a metallic sphere (200mm of diameter,  $1930 \text{ kg/m}^3$  of density) hangs by a nylon cable (154mm in length) immersed in water and a digital photographic camera (Panasonic LUMIX DMC-FZ5) stands on a tripod outside of the reservoir. The sphere is placed at an initial angle ( $\theta_0$ ) of 33 degrees, as shown in Fig. 3 and then at  $t=0+h$  it is released to swing. It is considered that the sphere only moves along the  $\theta$  direction. To acquire the time response of angle  $\theta$ , the digital camera captures (at a rate of 60 frames per second) the motion, which is later post-processed in MatLab.

Experiment's angle  $\theta$  time response, captured by the camera, is compared to pendulum mathematical model's

angle  $\theta$  time response applying the same conditions in a combined plot.

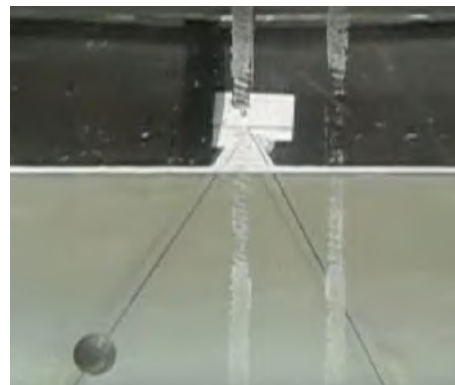


Fig.3: Sphere immersed in fluid placed at an initial angle of 33 degrees

## 2.3. CFD Analysis for Drag Coefficient Estimation

As presented by equation (2), the  $C_D$  for flow around the body is needed to estimate the drag force acting on it when subjected to air flow. To obtain  $C_D$  is a challenge that has been extensively studied by many, therefore several methods are available. This work has selected to use two of them: empirical formula and CFD analysis.

At first, a cylinder geometry is selected to test whether CFD is an adequate method to estimate  $C_D$ , motivated by the previous application with the same objective [11] and the existence of an empirical formula that estimates the  $C_D$  for flow around a cylinder [12] with adequate accuracy for Reynolds number ranging from  $10^{-4}$  to  $2 \times 10^5$ :

$$C_{D_{cylinder}} = 1,18 + \frac{6,8}{Re^{0,89}} + \frac{1,96}{Re^{0,5}} - \frac{0,0004Re}{1 + 3,64^{-7Re^2}} \quad (19)$$

An unsteady compressible flow over the cylinder was modeled by means of a commercial CFD software, ANSYS. Computational grids were generated with ANSYS ICEM 16.0. Long run computations were adopted in order to guarantee that a steady-state regime was achieved. All the computations were carried out on a 64 bit, 3.40 GHz Intel Core i7-2600 processor with 16 Gb of RAM. The unsteady flow is modeled in two-dimensions i.e. in the x-y plane (see Fig. 2), with mass and momentum being conserved in the fluid domain. To determine the velocity and pressure fields, a homogeneous multiphase Eulerian fluid approach is used. Continuity and Navier-Stokes equations are given by:

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{u}) = 0 \quad (20)$$

$$\rho \frac{D\mathbf{u}}{Dt} = \nabla \cdot \mathbf{T} + \rho \mathbf{f} \quad (21)$$

$\rho$  and  $\mu$  are the fluid's density and viscosity;  $\mathbf{u} = (v, w)$  is the fluid's velocity vector;  $\mathbf{f} = (0, -g)$  is the acceleration due



to gravity;  $T$  is the stress tensor of Newtonian fluids, which includes the effects of the dynamic pressure  $p$  and viscous forces. As the flow occurs in high Reynolds number, turbulence is taken into account by means of a Reynolds Averaged Navier-Stokes two-equation ( $\kappa - \omega$ ) turbulence model based on the SST (Shear Stress Transport) formulation proposed by Menter (1994). The initial value problem is solved by the CFD package ANSYS CFX release 15.0, which makes use of the finite volume method [13].

Then, to estimate  $C_D$  for air flow around a platform module, the geometry is changed from a cylinder to the module. The chosen module for this study is an electrical room module from a floating production storage platform, weighting 1145 tonnes, enclosed by steel plates. Module's external dimensions are: 22,5 x 17,6 x 19,2m. From module's lifting plan it is obtained that its sling length, holding it from the crane tip, is 47,19m long. Two dimensions projection is shown in Fig. 4.

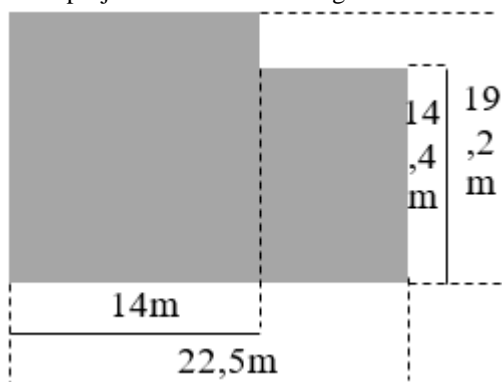


Fig.4: Module dimensions

The CFD model is an air filled domain surrounding the two dimensions module shape. Boundary conditions are such that the fluid domain at first,  $t=0$ , is at rest and at  $t=0+h$ , an uniform stream flow  $U=(U,0)$  is imposed to interact with the body. Four different stream velocity conditions are applied, where  $U$  is 10, 15, 20 and 40 m/s. Neumann and Dirichlet conditions (impermeable walls) are applied to all modules' surfaces, domain's lower and one side boundaries. While at domain's top and far-end boundaries atmospheric pressure is set and symmetry boundary condition is applied to other side boundary, as shown in Fig. 5.

The pressure field and shear stress are estimated and integrated across the module's area for each time step. A harmonic behavior was observed in the horizontal component of the drag force.

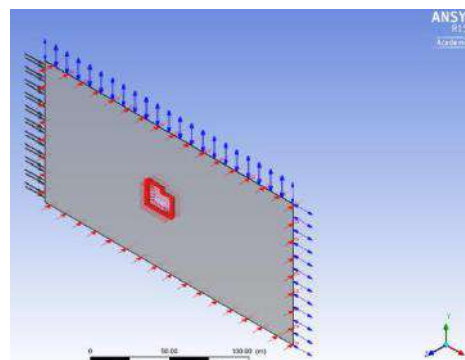


Fig. 5: CFD model set up

#### 2.4. Wind Load and Displacement Analysis

At the final and main phase of this work, all previous phases come together for the fluid-structure interaction. The drag force induced by wind on the module is introduced into the Newton's second law equation (1) as done in previous application [14] by coefficient for the module, obtained through CFD, is an input into equation (6) in the pendulum mathematical model. At first,  $t=0$ , the body is at rest and placed at  $\theta = 0$ , equations (3) and (4) can be written as:

$$vel = U \cos(0) \tag{22}$$

$$f(\omega, \theta) = f(0,0) = \alpha \sin(0) + \beta \tag{23}$$

at  $t=0+h$ , a stream flow of velocity  $U=(U,0)$  is introduced and maintained for 3 seconds. It is expected that the module swings in the flow direction. By using the pendulum model, module's wind induced displacement is estimated.

From obtained angle  $\theta$  time response, it is possible to calculate the module's (lifted load) horizontal displacement through equation 24:

$$x = L \sin(\theta) \tag{24}$$

$L$  being 47,19m from module's lifting plan.

### III. RESULTS

The results are compiled in the following subsections: experimental validation, drag coefficient and wind load analysis of lifted module.

#### 3.1. Experimental Validation

At first it is needed to confirm that the finite difference mathematical model proposed at section 2.1 can estimate the pendulous motion of a body. Fig. 6 shows the combined plot of the time response of angle  $\theta$  obtained by the finite difference model (dashed line) and by the experimentally (solid line) under the same conditions.

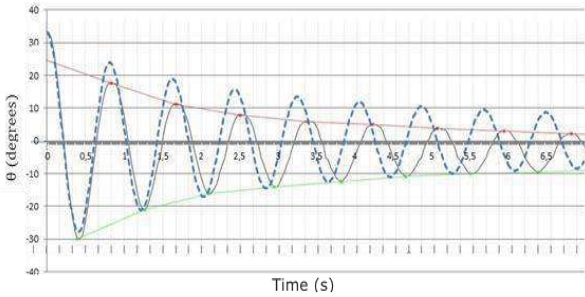


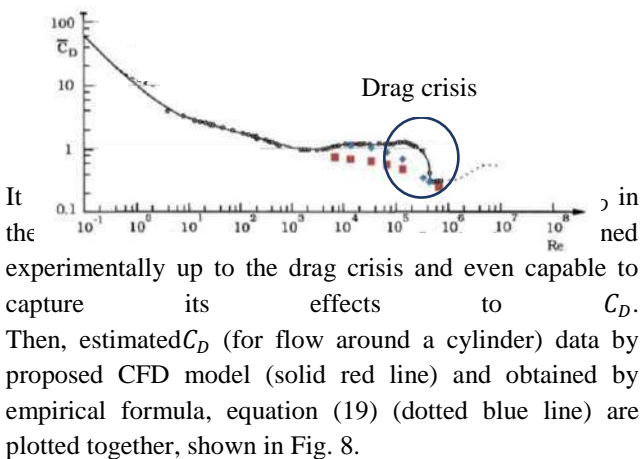
Fig 6: Angle time response

It is noticed that both models estimate maximum and minimum angle  $\theta$  in the same order of magnitude. Phase shift is observed between both, which can be explained by higher drag coefficient in the experimental model due to nylon cord interaction with the fluid and sphere's surface imperfect finishing. This would also explain reduced swinging amplitude when compared to mathematical model result.

3.2. Module Drag Coefficient

CFD analysis is applied to estimate the  $C_D$  for the wind flow around the electrical room module. Prior to applying it to the module, it is verified whether CFD is an adequate method for estimating  $C_D$ .

In Fig. 7 it is shown the  $C_D$  estimates, obtained through CFD (red squares represent a stationary regime, while blue diamonds indicate a transient one), for flow around a cylinder for Reynolds numbers up to  $2 \times 10^5$ . The cylinder shape is chosen as a  $C_D \times Re$  empirical curve (black line) is available [15], allowing for results benchmarking.



It is noted that both models estimate maximum and minimum angle  $\theta$  in the same order of magnitude. Phase shift is observed between both, which can be explained by higher drag coefficient in the experimental model due to nylon cord interaction with the fluid and sphere's surface imperfect finishing. This would also explain reduced swinging amplitude when compared to mathematical model result. Then, estimated  $C_D$  (for flow around a cylinder) data by proposed CFD model (solid red line) and obtained by empirical formula, equation (19) (dotted blue line) are plotted together, shown in Fig. 8.

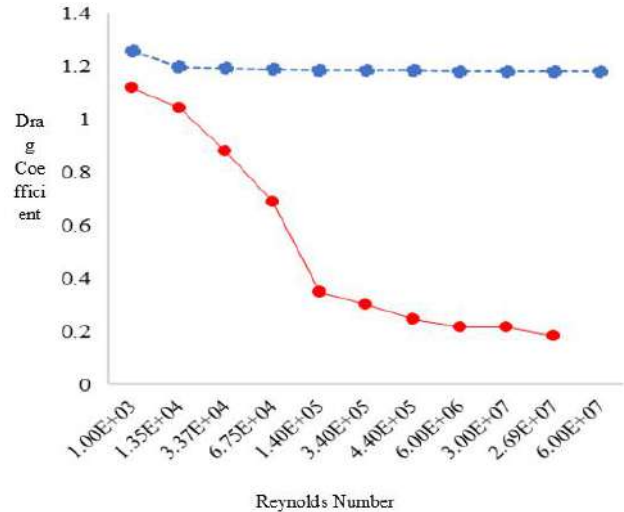


Fig. 8: Combined plot of drag coefficient estimates obtained by CFD and by empirical formula

It is noted that  $C_D$  values estimated by CFD have a more similar distribution to the empirical curve [15], shown in Fig. 7, than the values obtained by the empirical formula. Such result supports the choice of estimating  $C_D$  values by CFD, as the modeled event occurs at Reynolds number beyond the drag crisis.

Drag coefficients estimated by CFD for flow around a module are shown in Fig. 9:

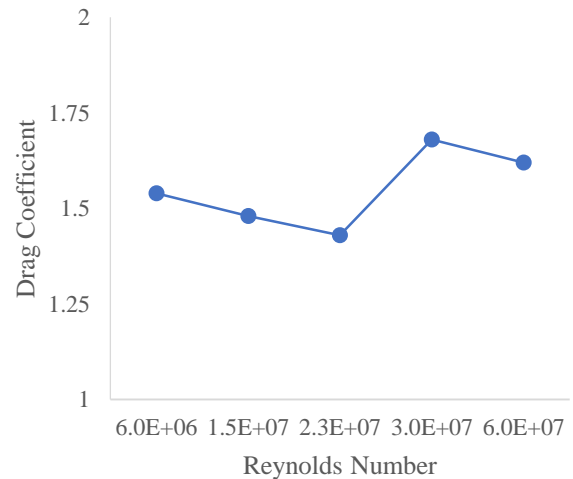


Fig.9: Module's drag coefficients

It can be observed that estimated  $C_D$  values are of the same order of magnitude as the ones in previous application [16], approximately at 2,0 for  $2 \times 10^4 \leq Re \leq 10^6$  for a flow around a square (aspect ratio of 1). Further, it is experimentally shown [17] that the higher the shape's aspect ratio perpendicular to the fluid flow, the lower is the  $C_D$ . This finding supports the lower estimated values (shown in Fig. 9) when compared to previous

application[16] as the module has a higher aspect ratio (1,1) than the square.

3.3. Wind Load Analysis

The horizontal displacement is calculated using the  $C_D$  values estimated by CFD. Fig. 10 shows the time response of  $\theta$  of the module once disturbed by wind gusts at 10, 15, 20 and 40m/s during 3 seconds.

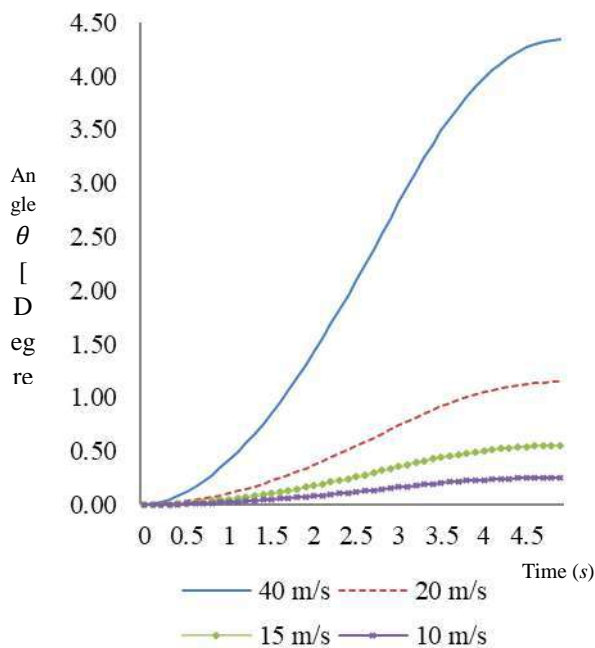


Fig.10: Time response of module when disturbed by wind velocities of 10, 15, 20 and 40m/s

Table 1 shows wind conditions of all four simulations, maximum angle  $\theta$ , maximum drag force obtained by equation (2), drag force obtained by methodology proposed by international standard [18] and maximum module horizontal displacement:

Table 1: Maximum Drag Forces and Horizontal Displacement

$v$ [m/s]	Max. $\theta$ [degrees]	$F_D$ [kN]	$F_D$ by API RP2A [kN]	Maximum horizontal displacement [m]
10	0,25	38,5	39	0,21
15	0,55	83,7	87,8	0,45
20	1,15	175	156,2	0,94
40	4,34	672,6	624,6	3,57

IV. CONCLUSIONS

It is observed that the maximum horizontal displacement values are consistent with field experience that large lifted bodies are subjected to pendulous displacement once disturbed by strong winds. Displacement amplitudes are large enough (0,94m) to hit nearby objects and people, as usually modules' lifting operations have small gaps to its landing targets and it is common practice to have operators nearby. It is also noted that such displacement occurs in a period of 4,5 seconds, which diminishes the ability to counter act and evacuate the affected area. Further, the simulated wind gusts have a duration of 3 seconds, if longer lasting gusts occur, there would be greater modules' displacement amplitude. Furthermore, at extreme wind conditions (40 m/s) such amplitudes can be greater than international standard [17] free space gap recommendation (3m). Although, at lower velocities, consistent with the ones experienced at Campos Basin, offshore Brazil, international standard 3-meter free space gap recommendation is sufficient to avoid collisions caused by wind induced displacement.

It is noted that aerodynamic forces applied to lifted body by wind conditions are great and it is also noted that the proposed methodology provides aerodynamic forces results in the same order of magnitude as the ones obtained applying API RP2A methodology.

Both observations lead to conclude that the proposed methodology is capable of estimating unwanted displacement caused by wind loads acting on lifted bodies. Further, it illustrates the importance of such evaluation prior to conducting a lifting operation to better manage the risks and avoid potential accidents as the displacement is significant and sudden.

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# Production of Non-Structural Concrete with Addition of Polyethylene Terephthalate Fiber (PET) in Porto Nacional - TO

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**Abstract**— Concrete is one of the most used materials in construction, due to its great versatility and high workability and can be molded in any way besides having high compressive strength, on the other hand the resources used for its manufacture are not from renewable sources. In order to search for new materials and to help the environment, as the number of improperly discarded PET bottles is huge, non-structure concrete was produced with the addition of polyethylene terephthalate (PET) fibers in order to improve its mechanical characteristics. Due to the widespread use of concrete in the world and the improper disposal of the PET bottle polluting the environment and causing various environmental problems. From these circumstances, fiber added to the concrete was produced in the following proportions (2%, 4% and 6%) instead of Portland cement, obtaining a 7 mm Slump Test. The specimens were submitted to a curing process (3, 7, 14, 21 and 28 days) in which an improvement in the resistance can be observed during the curing process. how many for resistance gain.

**Keywords**— Concrete, Concrete Fibers, Environment, Fibers and PET Bottle.

## I. INTRODUCTION

In Brazil and worldwide, when it comes to material used in construction, concrete is the most used, although not as strong as steel, this is due to its popularity created by factors such as: versatility (because concrete is a substance plastic being thus moldable, besides having easy production and handling.), durability, economy (being very cheap and commonly used worldwide) and high water resistance (MENESES, 2011).

The use of fibers in cement mixtures promotes significant improvements in their composition, which makes their mechanical characteristics improve. According to Metha and Monteiro (2008) the use of fibers industries, due to its versatility, high mechanical (impact) and chemical resistance.

Regarding sustainability, the use of materials such as active silica tailings and PET bottles in the manufacture of new materials presents a good alternative, if we consider that the improper disposal of Polyethylene Terephthalate (PET), presents a huge damage to nature, besides de represents 20% of the volume of waste disposed of in landfills (SILVEIRA, 2018). The production of concrete with the addition of this polymer would establish a new way of recycling this product and contribute to its reduction in nature.

occurs due to some limitations that conventional concrete has, such as low tensile strength which makes it susceptible to cracking, to minimize these limitations the fibers are used.

According to Metha and Monteiro (2008) the fibers are classified as short and long, while the short ones are used in mortar, reducing the cracks in a composite under load, while the long fibers are used in concrete to reduce cracks, their use reduces the workability. more increases its tensile strength. According to Cardoso, Liboni and Honda (2016) Polyethylene Terephthalate (PET), it is a polymer widely used in plastic bottle.

The work is characterized by the production of a non-structural concrete with the addition of polyethylene terephthalate (PET) fiber, for analysis of its mechanical characteristics, workability, and homogenization among others. In order to reduce the number of improperly disposed PET bottles in the Porto Nacional - TO region, a study experiment was carried out to evaluate the influence of partial addition (2%, 4% and 6%) of Polyethylene Terephthalate fibers (PET) on mechanical properties of concrete, aiming to evaluate and analyze their influence on the resistance to the uniaxial compression test, in order to verify their real feasibility of use in civil construction.

## II. METHODOLOGY

In order to produce non-structural concrete and reduce the number of PET bottles in the environment, a joint effort was made where the collection bottles were used to produce Polyethylene Terephthalate (PET) fibers, these bottles were collected by colleagues and friends in the

municipality of. Porto Nacional -TO, after washing and drying it in the open, the horizontal cuts were made manually using scissors and rulers for measurements, the fibers were manufactured in a 10 cm length by 5 mm width as shown. FIG. 1.

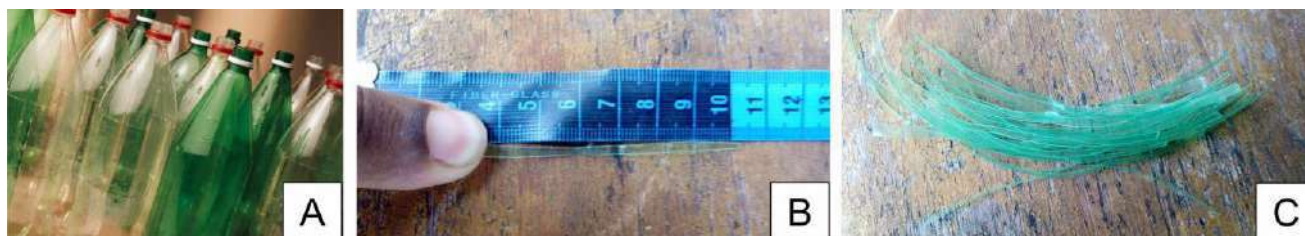


Fig.1: (A) PETS bottles used in fiber manufacture, (B) manual fiber measurement, (C) fibers already cut and ready for use.

The use of fibers in cementitious mixtures (concrete and mortar) has promoted an exponential improvement in the mechanical characteristics of these mixtures, with improved flexural toughness and impact fatigue strength (SALVADOR AND FIGUEIREDO, 2013). Observing Nunes (2006), it is said that the main function of fibers is to increase energy absorption through cracks because the current transfer bridged fibers reduce their propagation and expansion.

Another very important factor to take into account when using PET bottle fibers is that it does not absorb water, so you do not have to worry about water loss due to the absorption that natural fibers like bamboo have in the curing process. concrete (GERALDO, 2017).

The production of concrete consists of the composition of cement, aggregates and properly dosed water (RIBEIRO, 2013). For this study, the following materials were used:

- Small aggregate (Coarse Sand);
- Large aggregate (Gravel 1);
- Portland cement composed with slag CII F 32 TO;

- Water supplied by the supply company;
- Polyethylene Terephthalate fibers (PET).

The natural aggregate was collected on the Tocantins river, near the city of Palmas, Tocantins State, Brazil, and sorted by similarity of size ABNT NBR NM 7211:2005. Portland cement CII F 32 TO was used as a binder to obtain the concrete, according to ABNT NBR 5736: 1991 specifications. All raw materials used in the manufacture of the bodies of evidence, were weighed using a digital balance. The table 1 and 2 shows the proportions of materials consumed for each type of concrete studied and the levels of additions of dashes represented in percentage.

For the concrete trace, the following formulation was used: 1: 1.68 (cement: sand), 1: 2.68 (cement: crushed stone) and 1: 0.482 (cement: water) (ANTONIO et al., 2019), as there was a slight change from the amount of water ( $\pm$  600 ml). The table 2 shows the compositions characteristics of determination of trace of concrete with and without the addition of Polyethylene Terephthalate fibers (PET). Note - if the only change that occurred was between the cement and the addition of fibers.

Table.1: proportions of consumable materials for each type of concrete

Concrete	Cement (g)	Sand (g)	Gravel (g)	Water (ml)	Fiber (g)
0%	18000	30240	48240	8676	0
2%	17640	30240	48240	8676	360
4%	17280	30240	48240	8676	720
6%	16920	30240	48240	8676	1080

Table.2: Composition characteristics of determination of trace on the concrete

Betonadas	Dash (Kg)	Rupture
0% (Fiber)	18.00:30.24:48.24: 8.676	28 days
2% (Fiber) PET	17.64:30.24:48.24: 8.676	28 days
4% (Fiber) PET	17.28:30.24:48.24: 8.676	28 days
6% (Fiber) PET	16.92:30.24:48.24: 8.676	28 days

The concrete dosed to obtain the compressive strength of 20MPa fck, established by ABNT NBR 6118: 2003 at 28 days, using CII F 32 cement, without the use of additive. After weighing and characterization of the materials, the concrete was fabricated with the help of a stationary concrete mixer. After the preparation of the molds, the traces were made using PET bottle fibers with replacement content of 0% (conventional concrete), 2%, 4% and 6% in the binder (cement CII F 32). Concrete production follows the specifications of ABNT NBR 7215: 1996, in a dry place the materials were mixed in the order of coarse aggregate, fine aggregate and cement, then water was added, PET fibers were the last components to be added to mixture to form a consistent and homogeneous paste.

The concrete consistency of each composition was evaluated by the Slump test according to ABNT NBR NM 67: 1998. The concrete mixture was placed in the trunk of the three-layer cone metal mold, each layer also distributed received 25 blows. With the help of a legislator, the mold was slowly removed in the vertical direction to verify the final reduction of the concrete (difference between the height of the mold and the height of the concrete mix). After the Slump test was a test to verify the workability of concrete in which 10 beats were given around the mixture in order to verify its characteristic in order to avoid porosity, was still verified in the test of the spoon again the consistency of the concrete, as shown in following figure.



Fig.2: mixture characterization procedures, (A) Slump test performed on the trace, (B) workability verification test, (C) consistency test.

After performing the tests and once the proper consistency has been achieved, the specimens are molded. The concrete was placed in the molds with the help of a spatula and concrete compactor (AF 46 mm), to eliminate the voids of the dough, establishing its uniformity. For each composition 25 cylindrical samples were made in the

dimensions of  $\Phi 10 \times 20$ cm. After approximately 24 hours, the samples were removed from the cylinders and placed in a saturated water tank (hydration process) until they reached ages (3, 7, 14, 21 and 28) days of cure, ABNT NBR 5738: 2015, as shown in fig. 3.



Fig.3: PC molding and demolding process (A) formation of evidence bodies, (B) removal of evidence bodies, (C) hydration and cure of bodies of evidence.



Samples of each composition with and without fiber addition were evaluated by the uniaxial compression test to determine their compressive strength. The uniaxial compression test consists of determining the maximum value of rupture load supported by each specimen. The uniaxial compressive strength of concrete was determined by the compression test according to ABNT NBR 7215:

1996 specifications. Thus each sample was tested for each fiber portion (2%, 4% and 6%) and age (3 , 7, 14, 21 and 28) days of cure, having a total of one hundred (100) evidence bodies, subsequently allocated to each, strictly centralized mechanical bottom plate hydraulic press (EMIC DL 3000), illustrated in Fig. 4, Breakage and strength determination were performed automatically.

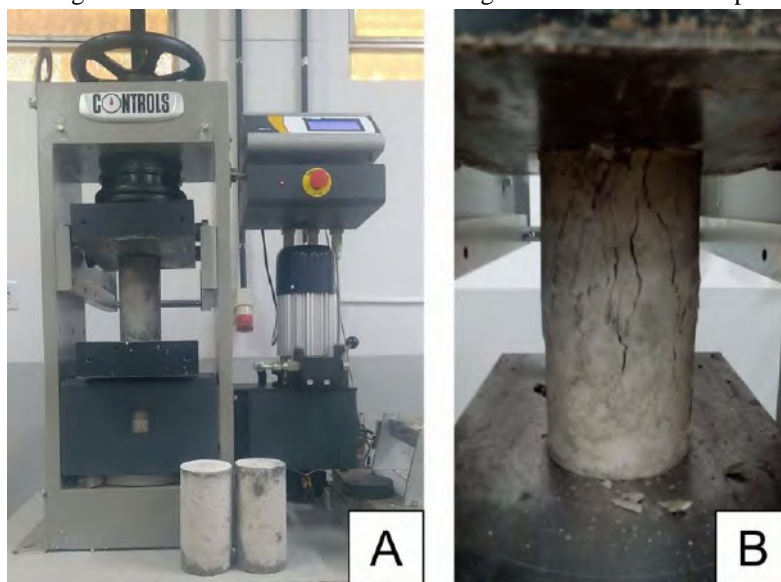


Fig.4: (A) Test of resistance to compression, (B) Uniaxial compression

### III. RESULTS AND DISCURSSIONS

In the reproduction of concrete using the trait 1: 1.68 (cement: sand), 1: 2.68 (cement: broken stone) and 1: 0.482 (cement: water) (ANTONIO et al., 2019), found that the Traces with 2% and 4% fiber addition had a satisfaction when compared to the conventional 70 mm and 60 mm, respectively, without drop test, having a good

workability already in samples with 6% fiber having a yield test. Unsatisfactory fall of 40 mm with its very difficult use, there was no water loss, since, as the fibers are not absorbed in water, as in the last sample shown porosity in some evidence bodies when drawing. Figure 5 shows the strength obtained in the uniaxial compression test.

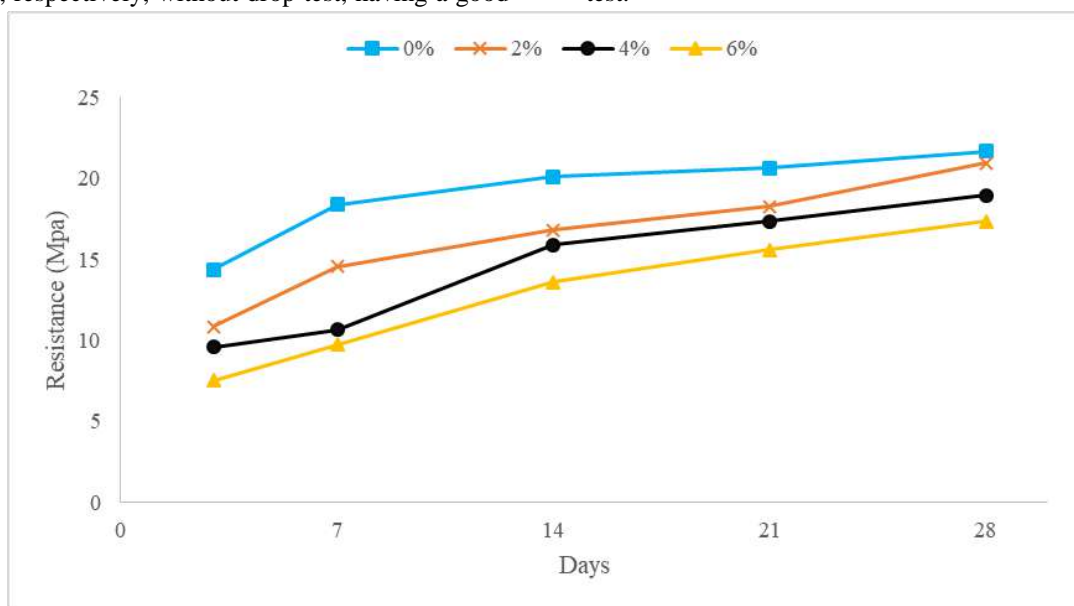


Figure 5: Graph of compressive strength gains after 3, 7, 14, 21 and 28 days with addition of 5 cm bamboo fiber concentration.



Fig. 5 shows the compression forces achieved (3 to 28) days, respectively, to determine uniaxial compressive strength. It can be verified that the lowest value of compressive strength occurred in the composition of 6% of PET fibers at 28 days and the highest value occurred in the concrete with the addition of 2% of PET fibers. With lower percentage of fibers the workability is much better than with higher percentage which gives a better distribution of fibers and filling of the evidence bodies. Figure 5: Graph of compressive strength gains after 3, 7, 14, 21 and 28 days with fiber addition of PET bottles. In Figure 6 it was observed that there is a significant

decrease in the compressive strength of both ages, in contrast to the conventional concrete (0% fiber addition) and the composition of 2% of fiber replacing the cement that came closest to compressive strength at 3 days of hydration and cure, yet far from the strength of conventional concrete.

Fig. 7 and 8, shows that there was a greater compressive strength gain in fiber compositions than in conventional concrete, with the sample with 2% PET fibers reaching the target of 20 Mpa, the 28 days of cure, and even Other compositions in achieving this goal their resistance gain was very satisfactory.

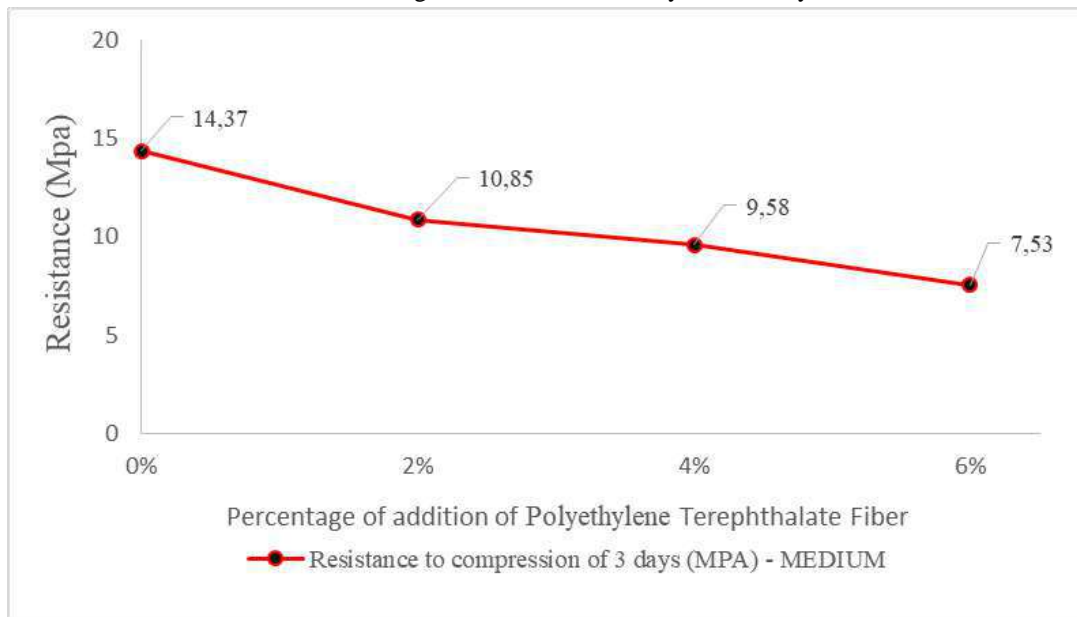


Fig.6: Graph of resistance to compression for 3 days.

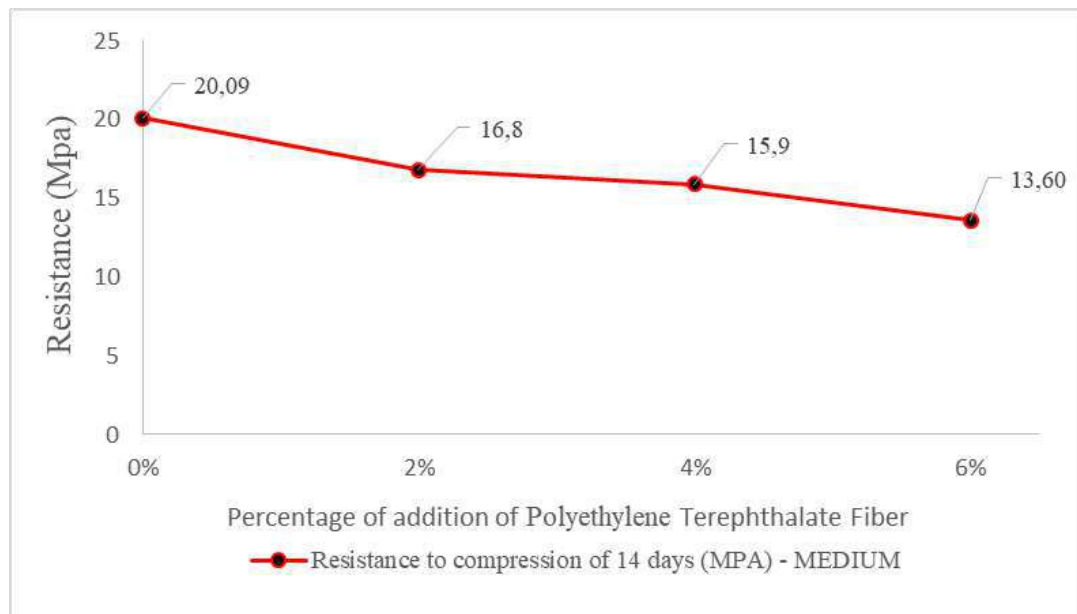


Fig.7: Graph of resistance to compression for 14 days.

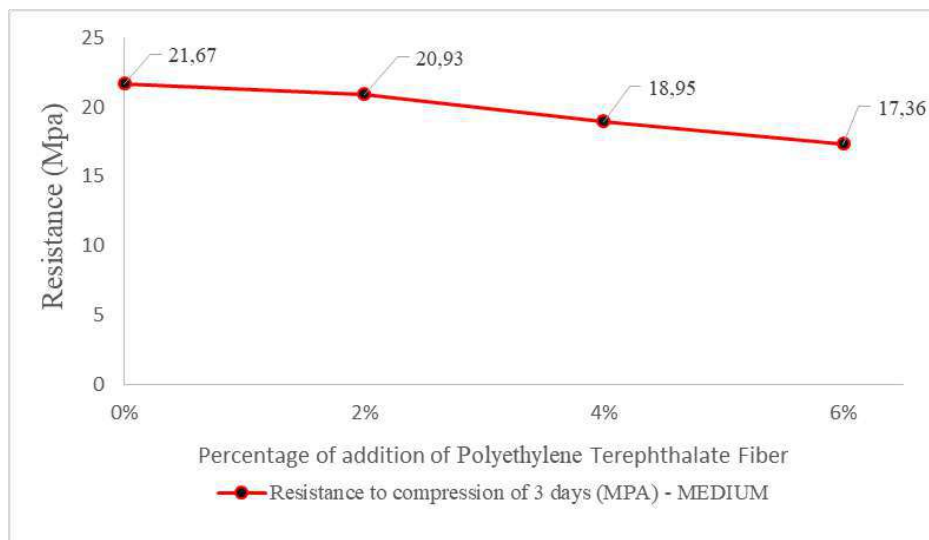


Fig.8: Graph of resistance to compression for 21 days.

After the analysis observed that the concrete with 2% of fibers in substitution to the cement obtained satisfactory resistance and being the concrete with 4% slightly below the target and 6% much below, according to ABNT NBR 6118: 2003, this make the use of PET fibers in concretes feasible.

#### IV. CONCLUSION

Concrete is the most used material after steel in construction because of its high compressive strength, the conventional concrete (0% fibers) manufactured for this project obtained a compressive strength of 21.67 Mpa at 28 days. curing, with the concrete with 4% and 6% content not reaching the desired resistance of 20 Mpa, being with 18.95 Mpa and 17.36 Mpa respectively, in view of this and the proximity to the resistance and the likely addition of some additive would help to achieve this resistance, and the composition of 2% for having a better workability than the other samples reached 20.93 Mpa at 28 days of cure. Therefore through the obtained results, it is possible to use Polyethylene Terephthalate (PET) fibers in concrete in order to improve sustainability in the construction industry.

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# An Analysis of Delay Causing Factors in Implementation of working construction Project (Case Study: Building of the Agriculture Office in Masohi City, Central Maluku Regency)

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**Abstract**— Agriculture Office Construction Project located in Masohi City, Central Maluku. In this agricultural office construction project the project owner worked together with the Office of Public Works and Spatial Planning in Central Maluku. The contractor is PT. Olovia Indah and her consultant is CV. Tricipta Consultant. Building level 2 with a size of 88m x 14m, contract value of Rp. 4.7221 billion ,the source of the funds is district budget. Central Maluku. The duration of work is 150 days, in working day reseacherbut the realization is more than 150 days.Based on this problem, the reseacher are interested in analyzing the factors causing delays in the implementation of construction project work.The method was Principal Component Analysis ( Principal Component Analysis ) is the analysis of multivariate transforming the variables of origin which are correlated into new variables that are not correlated with reducing the number of these variables so as to have smaller dimensions, but can be explained largely diversity of original variables. The data collection techniques in this study are the interview method, observation method and literature method.There were 26 respondents and 22 variables obtained 9 Main Components. The number of factors formed is seen in the Initial Eigen Values Total which is equal to or greater than one ( $\lambda \geq 1$ ). Component 1 (project resource factor) is the most influential component among the other components. This is indicated by the highest total component eigen value (factor) was 4,200 with variables: (Discipline of labor, Damage to materials in the workplace, storage place for materials / materials, Late payment by the owner). The least effect on the construction implementation, namely Component 9 (Surrounding environment), this component (factor) had a total eigen value of 1.083 with variables: (Surrounding environment).

**Keywords**— Delaying Factor, Principal Component Analysis, Eigen Value.

## I. INTRODUCTION BACKGROUND OF THE RESEACHER

The Agriculture Office Construction Project is located in Masohi City, Central Maluku. In this project the project owner works closely with the Office of Public Works and Spatial Planning in Central Maluku. The contractor is PT. Olovia Indah and her consultant are CV. Tricipta Consultant. Building level 2 with a size of 88m x 14m, contract value of Rp. 4.7221 billion , - the source of the funds the district budget. Central Maluku. The duration of work is 150 calendar days, but the realization is more than 150 calendar days. Based on this problem, the reseacher are interested in analyzing the factors causing delays in the implementation of construction project work.

## II. LITERATURE REVIEW

### A. Delaying Project

Delay in construction projects means increasing the time to carry out the planned completion and stated in the contract documents. Inadequate completion of work is a deficiency in the level of productivity and of course all of this will result in waste of funding, whether in the form of direct financing spent on government projects, or in the form of swelling investment and losses on private projects. The active role of management is one of the main keys to the success of project management. An assessment of the project schedule is needed to determine the fundamental change steps so that delays in project completion can be avoided or reduced.



## B. Delaying Construction Projects often experience delays.

It can even be said that almost 80% of projects have been delayed (Budisuanda, 2011). Project delay often repeats itself on the aspects that are affected as well as the factors that influence it. Frequent delays in the work of the planned schedule can be caused by several things, it could be due to internal factors namely;

### 1. Delaying due to Contractor's mistakes, including:

- a. Delay in starting project implementation.
- b. Workers and Executors lack experience.
- c. Too late to bring in equipment.
- d. The less active foreman.
- e. Poor work plan.

### 2. Delaying due to Owner error

- a. Late payment installments by the Contractor.
- b. Delay in land supply.
- c. Making a big job change.
- d. The owner assigns another contractor to work on the project.

And external factors namely;

### 3. Delaying caused by other than the two parties above, among others;

- a. As a result of fire that is not the fault of the contractor , consultant , owner.
- b. As a result of war, earthquake, flood, or other disasters.
- c. Monetary change.

A construction project is said to be successful if it can be completed in a timely manner as scheduled, according to the budget, according to the desired specifications and to obtain satisfaction from interested parties in it (Majid, 2006).

## C. The Causing Factors of Delay

Time is one of the constraints in project management in addition to cost and quality. Project delays will affect other aspects of the project. For example, increasing costs for efforts to speed up work and increase project costs. Another impact also often occurs is a decrease in quality because work is 'forced' to be done faster than it should so that it allows some technical things to be 'violated' in order to reduce project delays.

The factors that influence the project delay according to Suyatno , 2014 (thesis) are:

### 1. Material related delays.

In project implementation, there are often some materials prepared by the owner. Problems will occur if the owner is late in providing material to the contractor from the

scheduled time. The project cannot be continued, labor productivity is low due to unemployment, which results in project delays.

### 2. Delay in labor.

Lack of skills and expertise of workers can result in low labor productivity resulting in a long time in completing the project.

### 3. Slow resource mobilization

The mobilization referred to in this case is the movement of suppliers to project locations, between locations within the project, and from within the project site to outside the project site. This is strongly influenced by the provision of project roads and the time of delivery of tools or materials.

### 4. Improper planning.

delays cause loss of income from buildings that should have been able to be used or leased delays in the completion of the project due to increased overhead due to increased implementation time, so detrimental due to the possibility of rising prices due to inflation and rising labor costs, will also depend on contractor capital which is most likely to be used for another project.

### 5. Lack of technical personnel.

The amount of labor needed in each stage of project implementation varies , depending on the size and type of work. Planning that is not appropriate to the needs in the field can cause problems because labor is a resource that is not easily obtained and is very expensive.

## III. RESEARCH METHODOLOGY

### A. Research sites

Project for the Construction of the Agriculture Office of Masohi City, Central Maluku Regency. This Project Is Located To The Left Of The Masohi City Civil Registry Office JlnNamaelo, Masohi City, Central Maluku Regency, Maluku 97511.

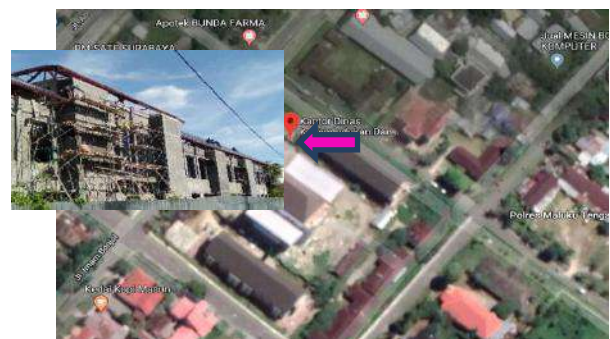


Fig.3.1 : Layout of the Masohi City Civil Registry Office ( Google maps source )

**B. Technique of data collection**

Technique of data collection are describe bellow :

**1. Interview (Interview)**

The interview is used as a collection technique and if the researcher wants to do a preliminary study to find the problem that needs to be investigated, and also if the researcher wants to obey things from the respondents in more depth.

**2. Observation**

In addition to the interview method, the observation method was carried out to complete the data needed and obtain a picture of an event or event to answer the research question.

**3. Questionnaire**

Data collection is done by way of giving a set of questions or a written statement to the respondent to answer. Questions or written statements to respondents to answer. Questionnaires are efficient data collection techniques if the researcher knows for sure the variables to be measured and knows what can be expected from the respondent .

**4. Literature**

Literature research is conducted to support the interview and observation methods that have been conducted. The collection of information needed is done by looking for references relating to the research conducted, references can be obtained from books or the internet.

**5. Data Type**

The types of data used in this paper are:

1. Primary Data, data that the reseacher can directly in the field in the form of: questionnaire and interview
2. Secondary Data, Data that the author can from the planning office / owner in the form: a project image and company history.

**C. Technique Of Data Analysis**

For processing the data the reseacher used principal component analysis by using of the SPSS 23 for windows program .

Principal Component Analysis ( *Principal Component Analysis* ) is the analysis of *multivariate* transforming origin variables are correlated into new variables that are not correlated with the reduction of the number of variables that have smaller dimensions but can explain most of the diversity of the original variables.

Suppose that you have p variables originating from X, namely  $X_1, X_2, X_3, \dots, X_p$ , where assumptions will be taken as follows:

$$X \sim Np (U, \Sigma) = (X_1, X_2, X_3, \dots, X_p)$$

$$E ( X ) = U, Cov(X) = \Sigma$$

The study was conducted on N individuals, where each individual will be investigated as many as p variables. These observations can be written as matix N Nx<sub>p</sub> as follows:

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1p} \\ X_{21} & X_{22} & \dots & X_{2p} \\ \dots & \dots & \dots & \dots \\ X_{N1} & X_{N2} & \dots & X_{Np} \end{bmatrix}$$

With the mean vector  $\mu$  and the variance matrix. From the variance matrix the covariance can be derived from the root characteristic, namely  $\lambda_1 \geq \lambda_2 \geq \lambda_3 \geq \dots \geq \lambda_p \geq 0$  with the equivalent feature vector, namely  $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_p$ .

Depreciation of the original variable X with the new variable Y can be formulated as follows:

$$Y = \alpha_{11} X_1 + \alpha_{12} X_2 + \dots + \alpha_{p1} X_p$$

$$Y = \alpha_{12} X_1 + \alpha_{22} X_2 + \dots + \alpha_{p2} X_p$$

$$\dots \dots \dots$$

$$Y = \alpha_{1p} X_1 + \alpha_{2p} X_2 + \dots + \alpha_{pp} X_p$$

The selection of  $\alpha$  is made so that  $Var (Y) = \alpha' \alpha = 1$  can be determined from the equation

$(\Sigma - \lambda I) \alpha = 0$ . To solve this problem the Lagrange function or the Langrange Multiplier Method is precisely used, and can be formulated as follows:

$$Y = \alpha' \Sigma \alpha - \lambda (\alpha' \alpha - 1)$$

By maximizing the above equation, the main component will be obtained.

The first main component is able to explain the greatest data variance so that  $Var( Y_1 ) = \lambda_1$  and the covariance between each major component = 0. This means that the main components do not correlate with each other. The first major component is a linear combination of origin-weighted variables which can account for the greatest diversity, and so on for the other main components. The total variance of data that can be emphasized by each major component is the proportion between the characteristic root ( $\lambda$ ) of the component to the number of characteristic roots or the covariance variance trace matrix which is formulated as follows:

$$Tr \Sigma = \lambda_1 + \lambda_2 + \dots + \lambda_p = \sum_{j=1}^p \lambda_j$$

Thus, the percentage of variance that can be explained by the jth major component is:

$$\frac{\lambda_j}{Tr\Sigma} \times 100\%$$

In the analysis of the main components, from the main components there are selected k main components that have been able to explain the diversity of data is quite high, for example around 80% - 90%. As an illustration, suppose that p is large and it is known that 80% - 90% of total diversity has been able to be explained by one, two, or three main components first, then the major components have been able to replace the p variable variables from the past rules, usually those can be used as a representative to explain diversity is the main component that has a root feature value ( $\lambda$ ) minimum = 1 or in other words  $\lambda \geq 1$ . With consideration, the main component has a root feature value below 1, the contribution in explaining the diversity of data is very small.

The number of main components formed is the same as the number of original variables. Reduction (simplification) of dimensions is carried out with the criteria for the percentage of diversity of data explained by the first few main components. If the first few main components have explained more than 75% of the diversity of the original data, then the analysis is sufficient to do up to the main components.

The reviewer also uses the Likers scale to determine the score on the questionnaire to be distributed to respondents, the **Likert Scale** is a psychometric scale that is commonly used in questionnaires and is the scale most used in research in the form of surveys. The name of this scale is taken from the name of RensisLikert, who published a report explaining its use. When responding to a question on a Likert scale, respondents determine their level of agreement with a statement by choosing one of the available choices. Usually there are five choices of scale with a format like this:

- a. For answers that have no effect given a score of 1
- b. For rather influential answers given a score of 2
- c. For influential answers given a score of 3
- d. For answers quite influential given a score of 4
- e. For very influential answers given a score of 5

This questionnaire was delivered directly by researchers to the intended location and provided explanations regarding matters relating to researchers. The completion of the questionnaire was distributed to respondents by means of being delivered directly by the researcher, with the intention of asking the respondent to fill out the questionnaire. If the respondent is busy enough, the researcher leaves the questionnaire, then requests that it be filled directly by the employee or staff working directly on the project being carried out and will be taken after a lapse of several days.

After all data obtained through the questionnaire is collected, then the next stage is held, namely data analysis. The analysis of this study uses the main component method, which is operated by using the SPSS 23 for windows program, to find some of the factors that are given influencing the delay in project implementation, as well as the factors that influence and determine the most based on the ranking order in each assessment of each company studied.

Broadly speaking the analysis of the data the author is doing as follows:

Table 3.1 The form of raw data matrix.

Variable \ Individual	1	2	3	4	5	.....	22
1							
2							
3							
4							
.							
.							
26							

1. After the raw data matrix has been compiled, extraction of these variables can be carried out. For this purpose, the researcher use the principal component analysis method. The number of variables formed can be seen from the number of *eigen values* in the *total variance table explained*.
2. Factors that are formed, in many cases do not adequately describe the differences between the factors that exist, so that the *factor rotation* process needs to be done. The purpose of rotation is to clarify the variables that fall into certain factors.
3. After the factors are completely formed, the process is continued by naming the existing factors.

**D. CONCEPTUAL FRAMEWORK OF THE RESEARCHER**

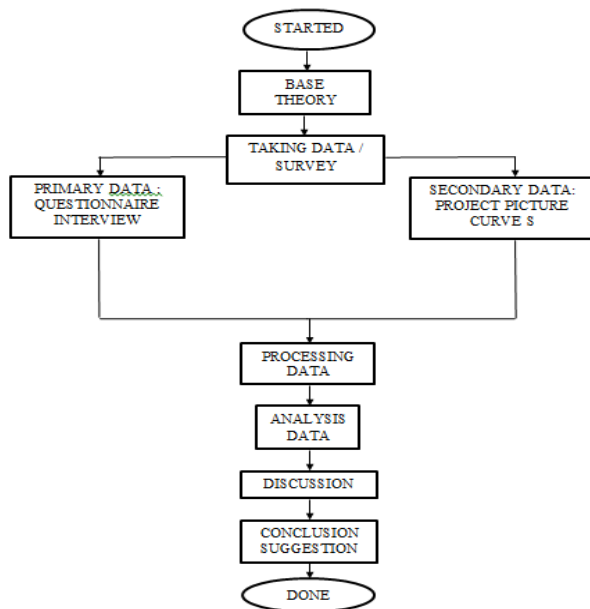


Fig.3.2: Conceptual Framework of the researcher

#### IV. DISCUSSION

##### A. Project Overview

The following data and specifications from the Masohi City Agriculture Office Construction Project:

SP (Contract ): NUMBER: 640.01 / BP / KPA / DPUPR-TR / APBD / VIII / 2018

Date : JULY 16, 2018

Job: Construction of the Agriculture Office

Volume : 1 (One) Package

Contract Value :Rp. 4,722,100,000

Location :Masohi City District

Source of Funds: District Budget. Central Maluku

Execution Time : 150 (One Hundred Fifty) Calendar Days

Fiscal Year : 2018

Implementing Contractor : PT. Olovia Beautiful

Supervisory Consultant : CV. Tricipta Consultant

##### B. Data Analysis

Based on the results obtained with Principal Component Analysis with the help of the SPSS program, 9 main components were formed (can be seen in the Appendix). The number of components known through the *initial eigenvalues*. *Initial Eigen Values* figures indicate the importance of the factors of each variable in calculating the overall variance of the analyzed variables. *Component* shows the number of factors or the number of variables. The number of factors formed is seen in the *Initial Eigen Values* numbers that are equal to or greater than one ( $\lambda \geq 1$ ).

Based on the results of the analysis with SPSS contained in the Appendix, for the total matrix visible main components formed up to the 9th component. It was concluded that 9 main components have been able to explain the diversity of data amounting to a cumulative percentage of 82.487%. Then obtained variables that clustered to form a factor. The *component matrix* table in the appendix shows the distribution of the variables on the 9 factors formed, but the results of this matrix need to be rotated first to clarify the variables that fall into certain factors.

In the matrix, the numbers listed in each column are called *factor loading*, which shows the correlation between a variable with each factor formed. Each variable is grouped into factors according to the largest *factor loading* number. For example, the variable "Number of Workers" has a loading factor : 0.119 (in component 1); 0.049 (in component 2); 0.320 (in component 3); 0.727 (in component 4); 0.023 (in component 5); 0,125 (in component 6); 0.070 (in component 7); 0.404 (in component 8); 0.269 (in component 9). The '-' sign only points to the direction of the correlation. So based on the *loading factor* number, the variable "Number of Workers" can be included in component 4. This method of grouping also applies to other variables.

After each of these variables are grouped into components (factors) based on the largest *loading factor* number, the final result is as follows:

Component 1, this component is the most influential component among other components. This is indicated by the *eigen value* of this component which is the highest at 4,200. Component (factor) 1 consists of variables:

1. Discipline of the workforce.
2. Material damage at work.
3. Material storage.
4. Late payment by the owner.

Based on the variables clustering in component 1, this factor can be called a project resource factor. The most dominant delay factor for the whole class with a large influence of 19.092%.

Component 2, is the second most influential component with an *eigen value* of 2.782 and consists of variables:

1. Lack of materials and materials.
2. Material changes in form, function and specifications.
3. Access to project sites.
4. Effect of rain on construction activities.

Based on the variables clustering in component 2, this factor can be called a material factor and a supporting project. The most dominant delay factor for the whole class with a large influence of 12.645%.



Component 3, this component has an *eigen value* of 2,216 and consists of variables:

1. Workforce expertise.
2. Shortage of labor.
3. Hold a job change.

Based on the variables clustered in component 3, this factor can be called the Labor factor. The most dominant delay factor for the whole class with a magnitude of 10,072%.

Component 4, this component has an *eigen value* of 1.902 and consists of variables:

1. Number of workers.
2. Poor quality of goods.
3. Equipment damage.

Based on the variables clustering in component 4, this factor can be called the Tool and material factor. The most dominant delay factor for the whole class with a large effect of 8.645%.

Component 5, this component has an *eigen value* of 1.774 and consists of variables:

1. Management of materials and materials that are less than optimal.
2. Delay in delivery / equipment provider.
3. Design changes by the owner.

Based on the variables clustering in component 5, this factor can be called Management. The most dominant delay factor for the whole class with a magnitude of influence is 8.062%.

Component 6, this component has an *eigen value* of 1.573 and consists of variables:

1. Material delivery delays.
2. Something unexpected happened.

Based on the variables clustered in component 6, this factor can be called a non-technical factor. The most dominant delay factor for the whole class with a magnitude of effect is 7,150%.

Component 7, this component has an *eigen value* of 1.426 and consists of one variable: There is less work added.

Based on the variables clustering in component 7, this factor can be called a plus less occupation factor. The most dominant delay factor for the whole class with a large influence of 6.480%.

Component 8, this component has an *eigen value* of 1.192 and consists of one variable, namely: Equipment productivity.

Based on the variables clustering in component 8, this factor can be called the equipment productivity factor. The most dominant delay factor for the whole class with a large influence of 5.417%.

Component 9, this component has an *eigen value* of 1.083 and consists of one environment variable .

Based on the variables clustering in component 9, this factor can be called an environmental factor. The least delay factor is the effect for the whole class with a large effect of 4.923%.

## V. CONCLUSION AND SUGGESTION

### A. CONCLUSION

From the results of the analysis and discussion it can be concluded that:

1. From the analysis results obtained 9 factors that influence the delay in building works at the Masohi City Agriculture Office, namely:

- a. Project Resource Factor.
- b. Material factors and project support.
- c. Labor Factor.
- d. Tool and material factors.
- e. Management Factor.
- f. Non-technical Factors.
- g. Work Factor added less.
- h. Equipment productivity factors, and
- i. Surrounding environmental factors.

From the test results of SPSS program, it is obtained that the project resource factor was the most influential factor among other factors. This is indicated by the highest *total eigen value* of this factor which was 4,200. And the smallest influence on the implementation of construction was the environmental factors around this factor has a *total eigen value* of 1.083.

2. The solutions for the late implementation of the project include:

- a. By way of replacing a less productive workforce with a more productive, the duration of the construction work is highly dependent on labor productivity.
- b. Workers must be careful when lifting the material in order to avoid damage.
- c. Request that the owner immediately make a payment, otherwise the project will experience delays and not in accordance with the progress of the work.

### B. SUGGESTION

Based on the results of this study it can be suggested:

- a. Construction service company that carry out the project should pay attention to labor discipline.
- b. For the elements that play a role in handling the problem of the construction service industry, these results can be

a significant input in relation to their duties and responsibilities.

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# Design for Real Temperature and Moisture Analysis on Battery Bank and Nobreak

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**Abstract**— Keeping track of the temperature and humidity of the nobreaks and battery bank locations helps to prevent loss of equipment life. Although equipment that makes measurements and controls on site is currently available, it is difficult to use techniques for temperature and humidity control in real time. This article implements and describes a temperature and humidity meter along with an automation system for real time verification of the nobreak and battery bank for industrial use. This design is used as an important tool in temperature monitoring with the purpose of avoiding the reduction of equipment life causing higher maintenance costs. Temperature and humidity meters were used to carry out the project, an arduino responsible for sending the data captured by the sensors to the database, and a web system that shows the data sent by the arduino in real time. The data obtained through the developed prototype were verified and compared in order to observe possible temperature changes in industrial environment. The measurements were compared to the temperatures indicated by the product manufacturer. With this it was attested that the prototype stored the temperature and humidity data and subsequently sent it to the web system correctly allowing thus a real time analysis of the temperature and humidity in which the equipment is submitted.

**Keywords**— Nobreaks; Automation; Battery Bank; Arduino.

## I. INTRODUCTION

In today's globalized economy, organizations are increasingly looking for methods that can improve process speed or continuous improvement. As a result, companies are increasingly looking for new management and monitoring tools to provide them with better quality and productivity of their products, processes and services [1].

Developing effective ways to test and manage battery temperatures and operations so that energy loss incidents can be reduced to prevent businesses from running out of power has been the subject of much research in recent years. [2].

Nobreaks has application in various industrial areas, such as data centers, transportation, metallurgical, hospital, to the area that needs a UPS will have met their need. UPS is used when a power outage is not possible because power outages can lead to losses such as downtime, lost data, incomplete services and even lives being lost due to power outages in hospital devices, according to upsbr [3].

Some nobreaks already have the function of indicating the temperature on their panel, however, often this equipment is in reserved rooms where you cannot easily access. As a result, a problem that does not lead to a power

outage may take time to resolve, thus causing a loss in the life of the company's assets or other equipment.

This article aims to provide a solution to the problems mentioned above, thus improving and speeding up the management of a company about its nobreaks and battery bank. Making Simple Problems. As a defect in air conditioning do not seriously affect expensive equipment such as nobreaks and batteries. Reducing your maintenance costs and possible loss of your asset.

## II. METHODS AND MATERIALS

The methodology applied in this scientific article were based on bibliographic references. The main objective of the research is to solve immediate and concrete problems or needs in a company that contains nobreaks and battery banks.

All companies and organizations that use an IT system are directly or indirectly related to processing centers. Environmental factors such as fire protection, electricity, heat and excessive humidity, debris, dirt or dust should be monitored and controlled through contingency planning to minimize the risk and unnecessary disruption of services and business. [4].

## 2.1 ARDUINO GSM SHIELD 2



Fig.1: Arduino GSM Shield 2  
 Source: Arduino store, (2018).

Arduino GSM Shield 2 allows an Arduino card to have internet access and to send text and make phone calls from an operator chip. [5] The GSM arduino uses a Quectel M10 radio modem. One of the communication methods and the AT commands. The GSM library has a large number of methods for communicating with arduino. The card requires the use of a network-registered operator chip to receive data or send commands over the network. [6]

Arduino GSM uses digital pins 2 and 3 for software serial communication with the M10. Pin 2 is connected to M10 TX pin and pin 3 to RX pin. PWRKEY pin is connected to Arduino pin 7. The M10 is a quadriband GSM / GPRS modem that uses the GSM850MHz, GSM900MHz, DCS1800MHz and PCS1900MHz frequencies. It uses TCP / UDP and HTTP protocols over a GPRS connection. The maximum downlink transfer speed and GPRS data transfer is 85.6 kbps.

## 2.2 DHT11 SENSOR



Fig.2: DHT11 Sensor  
 Source: Guangzhou Aosong Electronics, (2018).

The DHT11 Humidity and Temperature Sensor is a temperature and humidity sensor widely used in arduino projects for the most accurate reading for temperature ranges from 0 to 50 Celsius and humidity between 20 to 90%.

FEATURES:	
- Dimensions:	23mm x 12mm x 5mm (including terminals)
- Power supply:	3.3 to 5.5 VDC
- Current:	200uA to 500mA, in standby from 100uA to 150 uA
- Humidity measurement range:	20 to 90% RH
- Temperature measurement range:	0° to 50°C
- Measurement humidity accuracy:	± 5.0% RH
- Temperature measurement accuracy:	± 2.0 °C
- Response Time:	<5s

Fig.3: Sensor Features DHT11

Source: Authors, (2019).

The DHT11 sensor is an NTC thermistor and the Humidity sensor is HR202, the internal circuitry takes temperature readings through the sensors and communicates to a microcontroller via a one-way serial signal. [7]

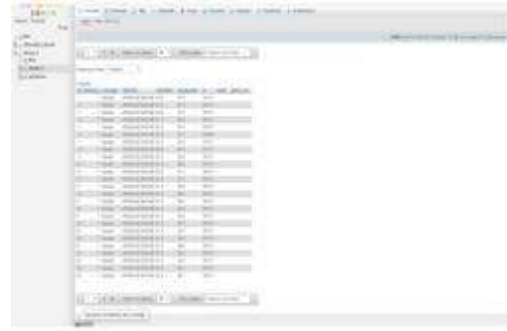


Fig.4: MySQL database.

Source: Authors, (2019).

For storing information sent by the prototype we use the MySQL database which is a relational code database management system used most of the time for free. The service uses the Structure Query Language (SQL).

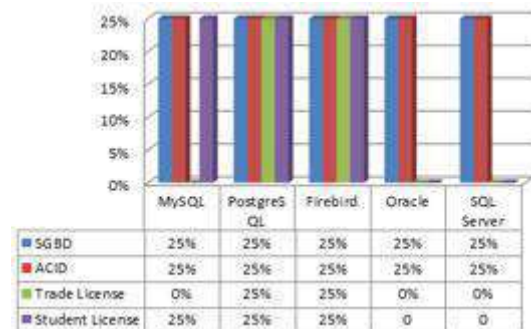


Fig.5: Top Databases

Source: Authors, (2019).

## III. DEVELOPMENT

In many companies today, it is essential to use equipment that can ensure stability in the network or that may eventually replace the power grid due to the lack of utility power, thus avoiding that sectors of the company stop causing a large prejudice [8].

That's why nobreaks, stabilizers and battery banks are used to ensure the full operation of the company, but like all electronic equipment, the nobreaks and battery banks have working temperature limits, and exceeding their limits or working life is compromised. [9] For example battery banks, in which manufacturers warn that batteries should be kept between 24 ° C and 33 ° C on average, and every 10 ° C above the limit the battery life may be longer. It is on average 4 years reduced by up to 50%, considering



that battery banks have from 1 to 90 batteries depending on customer needs, the damage is quite high.

The project measurement equipment consists of an Arduino GSM Shield, chip, antenna, temperature and humidity meter and VGA input connector.



Fig.6: Reading prototype.

Source: Authors, (2019).

The data when captured by the temperature and humidity meter will be sent and read by the arduino that will send to the project database. A website has been developed in which it will be possible to identify in real time the ambient temperature and humidity in which each equipment is located, on the website itself contains notifications if any UPS is outside the ideal temperature range, the block containing its main data is left with a red band informing the incident.



Fig.7: Reading prototype.

Source: Authors, (2019).

When the temperature is below 25 degrees Celsius and above 35 degrees Celsius, the system identifies and sends an email to the company's UPS manager and identifies it on our site's operations screen as shown in Figure 3. A In php programming, project phpmail will help you have better control from both the responsible company and the project manager. This often helps in identifying faults in the responsible company's network that could in the future damage the UPS or battery bank and thus not causing damage by downtime or data loss for example.

```

1 <?php
2 use "phpmailer/PHPMailerAutoload.php";
3 use PHPMailer/Exception;
4
5 require 'vendor/autoload.php';
6
7 $mail = new PHPMailer(true);
8 try {
9     //Configurações do servidor
10    $mail->SMTPDebug = 2;
11    $mail->isSMTP();
12    $mail->Host = 'smtp.gmail.com';
13    $mail->SMTPAuth = true;
14    $mail->Username = 'MILLER.reu.54@GMAIL.COM';
15    $mail->Password = '125463';
16    $mail->SMTPSecure = 'tls';
17    $mail->Port = 587;
18

```

Fig.8: phpmail image.

Source: Authors, (2019).

#### IV. CONCLUSION

This project aimed at the development of temperature control system in nobreaks and battery bank. The system will change the rudimentary view of the IT industry where this equipment is stored, the solution aims to monitor IT equipment such as UPS and batteries using hardware and software, making the actions of administrators more efficient in case of overheating avoiding industry downtime, as this technology supports critical sectors of an organization. The implementation of this project is important, as most companies do not use a computerized system to control the temperature of equipment in the Nobreaks room.

The results obtained through the project make the loss of information due to power outages due to problems with nobreaks and battery bank to be reduced dramatically. And with that, the organization and the critical parts that need it are always more connected to power.

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# Who was teaching whom? : flipping higher education

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**Abstract**— *The focus on increasingly student-centered methodological approaches is a current concern of all of those involved in educational contexts as they face the challenges of the 21st century. The present study, supported by the “Made by them to them: the students in the learning process” approach [1] and integrated within the scope of the IFITIC project (Innovate in Initial Training with ICT), focuses particularly on Higher Education and presents a reflection on the use of active methodologies in the didactic framing of languages and cultures at the undergraduate level.*

*Starting from the concept of “Made by them to them” in higher education (idem), we turned our attention to the curricular area of foreign languages and cultures having conducted a case study for this purpose. The students implemented strategies consistent with the concept, and data collection focused on reflections and field notes written by the Curricular Unit Teacher who accompanied the entire training process. Also, the analysis of contents and results was based on the categories of that same approach. It was concluded that in this specific context, “Made by them to them” promotes a way of learning to learn that drives the students to discover themselves and the world: not only individually in an informal context, but also collaboratively in a formal context where they integrate and share knowledge and skills in a more natural manner, meeting an innovative, enriching and meaningful teaching and learning experience. In this framework of active methodologies, teaching practice is enriched and students are prepared for the real work context, for their journey as individuals and citizens of the 21st century.*

**Keywords**— *Pedagogical innovation; 21st Century skills, active methodologies, flipped classroom.*

## I. THEORETICAL FRAMEWORK

The information era has thrown humanity into a new paradigm whose digitization, dematerialization, and connection have expanded storage and communication capabilities, overcoming spatial and temporal boundaries, favoring global integration and, consequently, the transformation of personal, professional and social aspects of our lives.

This framework implies changes in society in general and in education in particular, as stated by: changes in qualification, training, skills and knowledge, ethical attitudes and behaviors, relationships, organization and evaluation, in the curriculum, in all aspects of the educational phenomenon [2]. Therefore, there is a need to recreate the teaching-learning process by finding new active approaches that respond to students' interests and the challenges of a society increasingly organized around complex digital networks, as the misalignment of these vectors is a generating factor of demotivation among students [3, 4, 5, 6, 7.]

Active methods underlie the notion that all activity exercised in this context fosters the construction of

knowledge as a process, not linking it exclusively to the moment of discovery, of the final product. Thus, the student actively participates in the preparation of tasks and in the elaboration of knowledge, placing the emphasis, simultaneously, on their reflective and acting capacity.

Seeking to make this idea come to life in this study, we met the guiding principles of active methods as identified by Douglas Barnes [8], by creating relevant tasks for students, promoting opportunities for reflection and negotiation throughout the process, so that they could carry out tasks critically with relevance and connection to their day to day, to their professional future, responding to specific needs and questions of foreign languages and cultures, in an atmosphere of motivation, autonomy and commitment to individual learning and peer learning.

Studies such as "It's Not About Seat Time: Blending, Flipping, and Efficiency in Active Learning Classrooms" by Baepler, Walker, and Driessen [9], show us that active methodologies reduce the focus on the teacher within the classroom, increasing student autonomy and providing results as good or even better than those achieved in “traditional classes”. These authors also report that the

data show that these methodologies allow for better management of school spaces, time for all involved, giving learners a more positive overall perception of their own learning experience.

In addition to the focus on active methodologies, we cannot help but reflect on the theme of collaborative work, as we consider that it is precisely in line with our approach to active methodologies, namely because collaboration involves issues such as

listening to others, asking questions, expressing an opinion, settling disputes, and even being willing to change their minds, to the point of being able to evaluate different perspectives and detect stereotypes, prejudices, negotiate, make effective arguments based on evidence gathered, evidence, and accept differences of opinion (...). [10, p. 223]

We believe that the model followed in this study attempts to frame the four essential elements for effective learning, as pointed out by Osler and Starkey [11, p. 51], namely the acquisition of knowledge, the opportunities for reflection around cultures and identities, the experience of living in a democratic community and the development of the skills necessary for participation. It then became necessary to ensure that, in the design and implementation of the project, we were encompassing the requirements also listed in the work mentioned above, in view of the participatory aspect of the work.

Blumenfeld, Marx, Soloway and Krajcik [12] tell us that "Policymakers and researchers see small group work as a way to improve attitudes towards school, foster achievement, develop thinking skills, and promote interpersonal and intergroup relations". (p.37) However, they also warn us of the dangers of misuse of this strategy, as this may lead to stigmatization of students with greater difficulties or even special needs, opening a gap and creating a large separation between learners of a given class. Therefore, we seek to follow the idea that "the ways to overcome these problems must be adapted to the unique circumstances of the students, curriculum and context." [12, p.37], by looking at the specificity of higher education and the area of foreign language and culture teaching in a very particular way and implementing strategies consistent with that specificity, as we will further explain in the treatment of the methodology followed in this case study.

We would also like to mention the growth of formal, non-formal and informal paradigms of education as guarantee of inclusion in education and of equal opportunities in social participation. Knowing that the acquisition of digital competences, their critical and

responsible use, as well as mastery of other transversal skills, favor inclusion and progress in the light of empowerment, identity development and citizenship, we also intend to give prominence to that very same theme in this text. As the Council of Europe tells us,

In short, equipping learners with the competences specified (...) is an essential step which needs to be taken to empower them to choose and pursue their own goals within a context of respect for human rights and democratic processes. Equipping them with these competences through the educational system, alongside taking action to tackle structural disadvantages and inequalities, is crucial to ensure the future health of our culturally diverse democratic societies and the empowerment and nourishing of all young people who live within them [13, p. 66].

Having said that, and considering that the mere use of technology alone does not guarantee school success, we affirm that education professionals are needed to promote new pedagogical approaches as tools to improve education and make it increasingly inclusive [14].

Knowing that workers nowadays are valued for their creativity and emotional intelligence [15], for their value-creation skills, for how they are able to meet challenges with commitment and by "thinking outside the box", it is up to society to become increasingly concerned about the inclusion of all individuals, and aware of their rights and duties as citizens. This scenario imposes critical thinking, problem solving, collaboration, agility and adaptability, initiative and entrepreneurship skills, good oral and written communication, ability to access information and analyze it, curiosity and imagination, areas to be put to practice and stimulated from the earliest moments of school life [10], and throughout life as well.

This same inclusion theme deserves a prominent position in the theoretical and practical works in the field of education, and this framework strengthens the management of the curriculum in a flexible and contextualized manner [7], stresses the pillars of education [16] and creates a framework of reference for learners based on a humanist-based curriculum that advocates a people-centered society and human dignity as core values. Thus, it considers learning as the center of the educational process, inclusion as a requirement, and social contribution as a challenge that imposes an atmosphere that values freedom, knowledge, responsibility, and awareness of oneself and others [17].



For this reason, we consider it appropriate to address this issue also in the light of the present investigation. According to UNESCO [18], inclusive education

is a process that involves the transformation of schools and other centres of learning to cater for all children – including boys and girls, students from ethnic and linguistic minorities, rural populations, those affected by HIV and AIDS, and those with disabilities and difficulties in learning and to provide learning opportunities for all youth and adults as well. Its aim is to eliminate exclusion that is a consequence of negative attitudes and a lack of response to diversity in race, economic status, social class, ethnicity, language, religion, gender, sexual orientation and ability (p.4).

In 2018, the European Agency for Special Needs and Inclusive Education published a paper entitled “Evidence of the Link Between Inclusive Education and Social Inclusion: A Review of the Literature”, which helps us to develop this study given that the conclusions presented demonstrate that there is a close relationship between inclusive education and social inclusion in the areas of education, employment and community life, relevant contexts for this case study as it includes undergraduate students who are about to undertake internships in real and diverse work contexts within their learning pathway. Special needs contexts are usually correlated with low

academic and professional qualifications, employment in occupational activity centers, financial dependence, fewer opportunities to live independently, and insufficient social core after school completion. We believe that the use of active methodologies can help fight these inequalities and mitigate the negative effects normally associated with these same special contexts.

In this light, policy makers and teaching professionals can come up with ways of reformulating existing specific resources and supporting learning in inclusive education contexts [19, p. 6].

It is precisely in this context that we highlight the “Made by them to them: the students in the learning process” approach [1] for its perspective on the student as the main engine of their motivation and learning process, turning him into a producer as well as a direct consumer of his production. This process seeks to inspire students to reach their individual maximum potential, regardless of their characteristics or needs, their so-called functionality profiles, in an “inverted classroom” context, and at group level in the collaborative process, in an imminently inclusive spirit.

The “Made by them: the students in the learning process” approach [1] is based on the idea (Fig. 1) that the class should be prepared in advance with the participation of students, taking into account their characteristics, needs, motivations, so it takes support in the project methodology and learning by experience as means of achieving educational and professional integration.

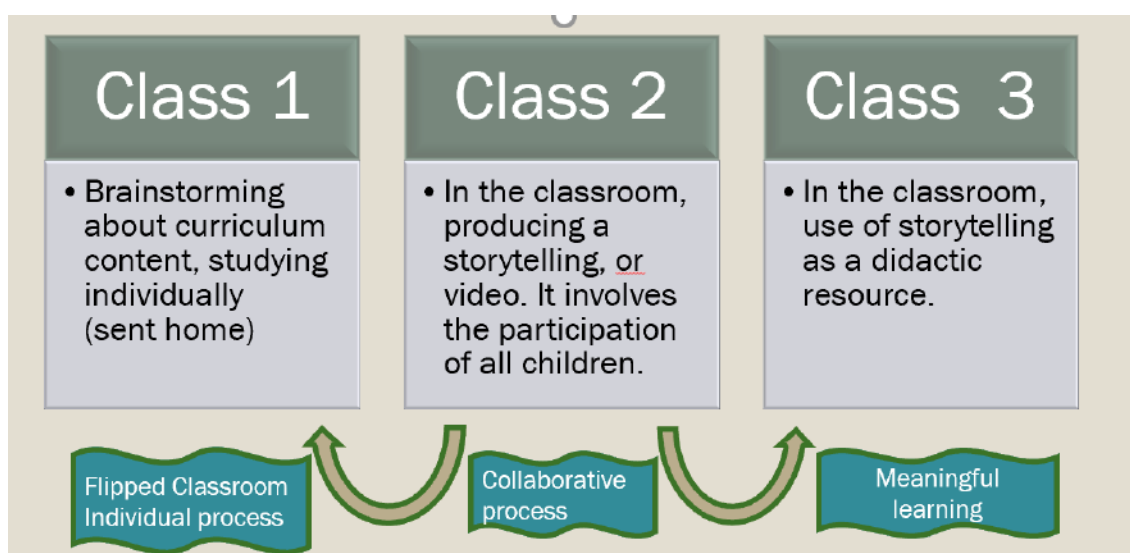


Fig. 1 –Made by them to them [1]

Although the framework presented mentions a working scenario with Primary School children, we consider that the design of the process, as well as the work stages, should be similar at other levels of education, even if it

implies adapting resources, tasks, and adjusting the challenge levels placed on students involved. We believe that the objectives of the “flipped classroom” should be clearly set and through a brainstorming process (what I

know, what I want to know, what is it for me to learn, how to learn, what to do and how I will use what I have learned), the steps should be defined according to the interests, abilities, motivations and needs of the students.

The experience presented by the authors in “Made by them to them: the students in the learning process” [1] was carried out in the context of mother tongue learning, under the premises of the “Flipped Classroom”, in which the students, outside school, individually, performed tasks to collect information with the purpose of using it to create fundamental didactic resources, to construct knowledge, according to the objectives of the class.

According to the authors, (Idem) the use of the resource produced by the students, or with their personal elements, such as their voice, (i) makes learning meaningful by captivating attention because it involves the student in a meaningful process, (ii) facilitates understanding as it includes prior and articulated knowledge in familiar contexts, (iii) stimulates effort by improving outcomes as everyone wants a good performance and (iv) promotes an inclusive and emotive school because everyone is eager to participate and does so with pleasure and satisfaction.

Thus, it is concluded that the “Made by them to them” approach activates crucial knowledge in the construction of new knowledge and articulates it in a natural way; involves the student in the learning process, from class preparation, promoting contact with curriculum materials and contents outside the classroom; helps the learning process to become more inclusive and challenging; promotes personal and group efforts to achieve better results; creates excitement and responsibility in the learning process.

Given these data, we wanted to broaden the scope of this approach and verify its application in Higher Education in the process of learning Foreign Languages and Cultures, namely French.

## II. METHODOLOGY

From a methodological point of view, we are dealing with a case study that aims to understand and describe events and pedagogical contexts [20] where the approach “Made by them to them: the students in the learning process” [1]. Having been undertaken in a real context, we see it as a true pedagogical resource [21], as the teacher reflected on a field research: observing in the natural environment, collecting data through field notes that were later analyzed and interpreted in the light of content analysis [22] to extract knowledge that will serve as a reference for new pedagogical experiences in an educational context. This is an exploratory field research as it seeks to find new applications for using the above mentioned approach at the

Higher Education level in the field of Foreign Languages and Cultures. As Sharan Merriam tells us, “Research is, after all, producing knowledge about the world — in our case, the world of educational practice” [23].

## III. FINDINGS

Regarding our study, the pedagogical experience focused on the teaching and learning process in the area of French Language and Culture in Higher Education, and the traditional learning process was “flipped”, as well as the educational practices in the field of languages and cultures, which are usually inspired by cognitive behavioral orientation and centered on the teacher's pedagogical activity.

Thirty students, aged between 20 and 23, participated in this study during a semester, more specifically, in a period of 60 hours of classroom teaching / learning experience.

Moving away from a traditional stance, we intend to create a paradigm that would give rise to a new way of looking at the teaching and learning process and that, without neglecting basic skills, would aim above all to educate the individual as a citizen, as language and culture constitutes a modeling semiotic system of the world, where each individual gives meaning to his perceptions within a cultural framework, and transmits them through his discourse, while revealing a way of life of a certain community, which he actively integrates and in which he actively intervenes [24]. It should be noted that life experiences have now become the central focus for the development of language skills and critical cultural awareness. Also, the acquisition of knowledge can now occur anywhere and anytime, inside or outside the classroom, so this scenario is extremely favorable to the possibility of each student making a change, improving their potential, their self-esteem and their self-concept. In this context, “each student is unique and learning is seen as a cyclical process made up of meaningful and lasting experiences” [25].

We believe that the “flipped school” provides more efficient use of classroom time, as students can delve deeper into the subjects of Language and Culture, learning for themselves, and showing greater motivation and involvement in learning.

In this context, students were previously, at an initial stage of this case study, given access to online information about the objectives of the course:

- Critically reflect on issues related to French culture through research and analysis of various documents, mutual exchange of knowledge and life experiences.

- Analyze the dynamics between linguistic, cultural and social relations from an intercultural point of view.
- Evaluate the French contribution to the creation of a European and global cultural heritage.
- Plan and create projects that require the appliance of knowledge and skills related to the subject in question.
- Reveal practices of critical thinking and cultural acceptance of others in order to promote personal and professional growth.

Given the specificity of the Curricular Unit and the target audience (adults), the model ceased to include only isolated classes, but was instead organized as a Teaching Unit around a theme, presupposing several face-to-face meetings.

At the first meeting, the students negotiated with the teacher the topics to be discussed under the theme “Geography of France / tourist sites”, having established individual points of connection and brainstormed ideas so that, outside school, each could develop his skills and knowledge. This moment was important because the students became aware of the way the learning process was organized and communicated in the target language about their researches, taking into account the rules of production and reception. This process acted as a stimulus for the promotion of autonomy and self-awareness.

At this stage, students were also organized according to the region / tourist destination of their choice. This pragmatic process that was developed promoted French-speaking discourse in communicative exchanges and favored the cohesion of the work groups. We believe this is very meaningful as speeches transfer the view of the world marked by the subjectivity of the speaker [24], but also his ability to argue and to influence the other for his decision, fundamental capabilities today.

Additionally, by email, students were made aware of other resource typologies (Tourist Sites, magazines, books, brochures, travel blogs, and others) and tasks they could access outside the classroom such as:

- Collection of different resources regarding the subject and typology of the itinerary chosen by the group
- Research: Collecting information by individual students, taking into account their interests, needs and experiences

- Online consultation of books on the subject, magazines and tourist brochures, travel blogs and other resources

Thus, outside the classroom, each student became increasingly committed to the group and gathered information and other relevant resources to address the topic. This process called for the involvement and accountability of each student, the self-regulation of the group about their own functioning as indispensable ingredients for the success of the group.

In the classroom context, it became evident that the mobilization of discursive language knowledge was fundamental in the transmission of collected information. Each group decided on the type of learning product / resource they would design to support the construction of more complex thinking, based on important reflections and syntheses on the cultural theme. In parallel, we followed a “Pedagogy of discourses” [24] which, according to the author cited, suggests that each individual takes on the role of producer and receptor-interpreter in a process in which the word is the resource that generates discovery and enjoyment of oneself, others and the world, and is also a condition for intervention in real life and in professional contexts.

It is important to point out that, throughout this process, the decisions were communicated to the teacher who ensured the diversity of pedagogical devices to be explored later on in the classroom. Given these circumstances, the teacher analyzed each project providing more precise indications for student guidance and to enhance their individual and collective performance.

In a second moment, imminently marked by the collaborative process, the students gathered the information and resources, discussed and analyzed them in order to create a tool that translated the knowledge built in accordance with the intended objectives. In this context, it was found that there are no limitations to the use of privileged tools for language development, as suggested in “Made by them to them”, bringing to the spotlight a diversification of resources clearly evident in the tasks developed by the students. :

- Photo gallery with descriptions and comments;
- Tourist brochures;
- Virtual tours with tour guides;
- Vacation schedule in a given region with different budgets;
- Design of detailed school exchange programs
- Visits and activities for different types of travelers;

- Role play in travel agencies;
- Video documentary for a contest to choose the best holiday destination in France.

It should also be noted that, in a collaborative way, the groups were dynamic and created different strategies during this second implementation stage, among them:

- Project design work of pedagogical devices as a way of presenting the information collected for reflection, synthesis of the topic and subsequent presentation of the final product.
- Division of tasks within the work group according to the information and knowledge already acquired (travel report collection, testimonials and real photos, collection of tourist brochures, audio and video documents, location of information relevant to the destination area on France...)
- Search for deeper and more detailed information about the content and the document or activity to be presented.
- Reformulations and readjustments related to the elaboration of the pedagogical project to be developed

The collaborative construction of knowledge and experience in the teaching and learning of French language and culture was based on the active participation of students and their emotional involvement in the learning process. It is known that the affective component has a great impact on the learning process, since emotions activate the self and help clarify the threats and opportunities of the individual in the context [26], which generate feelings, thoughts and behaviors, important elements in transformations, depending on abstract emotions: love, joy, sadness, anger, surprise, and fear [27]. We know that these emotions generate enthusiasm and involvement, but also despair, discouragement or disappointment. Thus, it is important to promote moments that foster collective proactivity, self-confidence, awareness of one's own formative process. We also aligned our research with Vygotsky's [28] inspirational theory, which focuses on learning from others in a social, cultural environment, since the interaction that each person establishes with a given environment, the so-called personal experience, is significant in a process of learning and learning to learn. Knowledge sharing increases the level of knowledge (through the scaffolding process) and develops the person and the group, stimulates the student to reach a level of understanding and skills not yet fully

mastered, enabling the acquisition of a new knowledge at a more demanding level of learning. Bloom's taxonomy is also strengthened [29] as group organization takes into account the specific domains of learners' cognitive and affective development, according to a gradual process that, according to the levels of its revised theory, consists of six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. Bloom's taxonomy provides a systematic way of describing how a learner's performance grows in complexity when mastering academic tasks. This context reveals the importance of pedagogical differentiation as learning differs from person to person, particularly when it regards the level of depth and abstraction of knowledge.

The "Made by them to them" approach [1] encompasses students' prior knowledge and skills, and respects previous organizers who make the necessary connections so that a given content can be understood and applied. In this sense, it gives the opportunity to build cognitive processes according to the complexity levels and objectives of cognitive development.

In the third moment of this study, based on the didactic resources built, the final products were presented and the process was debated and the results were evaluated at a more complex level, and a synthesis of the same was obtained. This approach effectively integrated the categories of the cognitive domain proposed by Bloom's Taxonomy (knowledge, comprehension, application, analysis, synthesis and evaluation).

In this context, in the classroom, students:

- Introduced the product built to the class, promoting discussion moments
- Subsequently recorded syntheses relevant to the understanding and assimilation of the topic;
- Ways of dissemination of products were considered

This step was effectively completed by evaluating the work of the various groups.

Thus, considering the categories of the "Made by them to them" approach and the reflections of the teacher and students, it can be said that

- a) "Made by them to them" activates previous knowledge:  
 "Promotes increased research capabilities"  
 "Helps students to become more able to acquire proactive knowledge and know-how"  
 "Involves students in their learning, perceived as project work done productively and meaningfully without 'boring' classes and the stress of testing."



"Raises interest in experiential intercultural learning, involving real tasks"

b) "Made by them to them" promotes personal and group efforts to achieve better results.

"This way of doing things has taken us much further in the acquisition of knowledge and skills" -

"We did a good job, very useful in future professional contexts"

c) "Made by them to them" creates an emotional bond in the learning process by engaging students, leading them to gain more knowledge of themselves and of others.

"I felt truly committed and responsible for learning"

We would like to point out that, regarding the results, the teacher mentions that

"By applying this new "flipped learning" methodology, I realized that students, critically and with great involvement and autonomy, were able to learn better on their own, improving knowledge and critical understanding of another culture. Each task was presented as a challenge to generate interest. Task effectiveness showed a significant improvement in autonomous learning and cooperation skills and objectives were achieved by taking into account different learning styles and profiles. The different types of tasks proposed were intended to contemplate different types of intelligence, as defined by Howard Gardner [30] in his theory of multiple intelligences."

Referring to the moment of self and hetero-evaluation performed orally in the classroom, the teacher concluded that

"They were interested in the experience of intercultural learning, involving practical tasks in real contexts, were proud to share the final products with their colleagues and carefully prepared the evaluation questionnaires about their presentation. Obviously, they were proud of the success of all groups in multitasking; They were aware that, in addition to the increased knowledge of the contents of French language and culture, they developed skills such as autonomy, creativity and decision-making as well as many social skills; They were also aware of the benefits of the "flipped class" model and felt as if they were "walking in the teacher's shoes".

We would like to conclude this part of our study by presenting the reflection and quoting the sentence said

by the teacher which effectively pinpoints our work in extremely a concise and meaningful manner: "Who was actually teaching who? The students were happy and the teacher came to the conclusion that teaching less and learning more is the key to innovation and success."

#### IV. CONCLUSIONS

The world is constantly evolving and School must find new answers to the new challenges of society. Technology has changed the world by promoting new ways of living, thinking and acting, by expanding horizons through globalization. The best part of the challenge of changing school systems is that it is impossible to perpetuate the same methodologies often used and enclosed in textbooks. There is no turning back, we are building the future today. We need to rethink our role as teachers, while adapting methodologies that meet the needs of our students, citizens of the world. Not only new forms of literacy and new educational policies are emerging, following new key competences for lifelong learning, but also new directions of research with pedagogical applications.

In this specific case study, we have reflected on how students can successfully learn foreign languages and cultures in school in order to live full and responsible citizenship locally and globally. "Made by them to them" is not a method or technique, but rather a pedagogical approach that aims to encourage proactive learning of all subjects. This way, it is possible to design different types of "flipped classrooms" for language and intercultural learning, with activities and strategies adapted to the students' age and linguistic level. There is no normative application or restricted model for this pedagogical option based on experiential and sensory approaches which are usually related to project pedagogy and task-based learning, always supported by the use of technology. Focused on student activity and responsibility for learning itself, this approach proved to be very effective for adults. Even though children have a natural appetite and are at ease while learning foreign languages and cultures, adult students have other advantages related to maturity, experience and autonomy in learning contexts. In a "flipped classroom", the role of the teacher should not be that of a mere content presenter, but rather one of a learning facilitator, assuming the role of knowledge mediator, organizer of learning processes, source of feedback and evaluation. By reversing the pedagogical process, different learning styles are taken into account and each student is able to control it to match his own interests and personal abilities.

It should be noted that the field of language teaching encompasses cross-cutting skills that are extremely

relevant for academic and professional purposes. Through language and culture learning, students can reach 21st century goals in areas such as critical thinking, problem solving, communication, and collaboration. The development of social skills has become a relevant formative dimension throughout the curriculum and much appreciated in professional contexts. It should also be noted that technological literacy is now an essential component for experiential communicative activities and students should be able to apply their knowledge in a practical way, whether in real or virtual contexts, using blogs, web quests and social networks, elements that are also part of their daily activities in their “real life”. School is not disconnected from the “real world” and cannot ignore the daily interests and activities of current students, the digital natives. The abolition of barriers of time and space through technology has changed the way we live, but also the way we teach and learn. The goal now is to empower students to take greater responsibility for managing their own learning by working collaboratively with teachers, other students, and people at local and global levels.

In an era of transition, renewal is important, in the sense of making things new, improving them. In Higher Education, students are not expected to acquire or memorize knowledge, but rather to learn to research, to think reflectively and critically in order to understand and intervene in the world in an intentional, responsible and creative way. The results show that the “Their for them” approach can be applied in a context of learning foreign languages and cultures. However, it is stressed that the product realized by students must be diversified.

We therefore conclude that this approach: (1) initially activates prior knowledge, fosters the personalization of teaching by individual student discovery in an informal context, and the development of personal and social skills (of others outside school); (2) at a later stage, fosters the development of personal and social skills with peers, and encourages student participation and pride in their performance; (3) finally, it promotes the mobilization of knowledge and the development of competences, as well as the awareness of the whole formative process and its benefits in the future.

The “flipped class” in educational practice enriched the learning process as it promotes representations of reality that are fundamental for the construction of knowledge schemes and to make learning meaningful. In addition, it allows students to carry their knowledge to class and share it with their classmates while building products that serve as didactic resources for learning with a higher degree of complexity.

Who was teaching whom? This process of learning to learn, with active methodology, guides the student in discovering himself and the world around him and promotes a positive attitude towards the curiosity of knowledge and the relationship with others and things.

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# Gamification as a strategy for promoting child involvement: A study on spatial orientation in the 1st CEB

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**Abstract**— We' are living in an era of strong change that misaligns offerings, processes and interests. In the field of education, it is urgent to find strategies that foster the revitalization of energies capable of triggering student involvement and thus improving efforts, skills and behaviours facing the challenge. Within the scope of initial teacher education, more specifically in Supervised Teaching Practice, this study was carried out with the purpose of evaluating gamification as a positive impact driver design in the involvement of children in a spatial orientation class, with effects on school outcomes. It was based on the Gamification Framework [7]. With a mixed methodological approach and a study case, we used disparate data collection instruments: participant observation of the trainee teacher who performed the pre-test, the post-test and the multimodal narratives, sustained in dialogues and interactions of the children recorded during the sessions, an interview with the teacher and, for a better understanding of the results, an interview with two specialists, one being an Internet Risk specialist and the other an Educational Technology expert. The project involved 21 1st grade children from a 1st CEB School. Among other results, there was an improvement in student involvement. Regarding spatial orientation, the promotion of lateralization ability and the ability to locate spaces were stood out, taking into consideration reference points and to identify the position of figures present in a grid through their coordinates. The analysis of the results raises some questions concerning the humanist paradigm.

**Keywords**— Gamification, Information and Communication Technologies, Motivation.

## I. INTRODUCTION

Answering to the statement in the Student Profile of Leaving Compulsory School presupposes the development of essential competences to the construction of a coherent and rewarding personal and social path [33, [41], capable of promoting a sense of self-fulfilment, a height of human needs [21].

In this context and knowing that every individual has the right to education [40], it should be focused on the person and their holistic formation[25, [37]. Thus, the teacher, as facilitator of learning environments [31], should promote learning to learn [24], through a humanistic view of the curriculum, as decreed by [43], which focuses on the person as a natural potential for learning, as self-awareness makes him / her responsible in the learning process. This makes the act more meaningful and therefore more lasting and comprehensive learning [31]. In this scenario, the teacher who facilitates learning, adopts attitudes of authenticity, acceptance, trust and understanding [30], but also assumes great responsibility in the process, as it defines learning objectives and finds the means to respond to the student and society. In this

endeavour, it should also provide the involvement of students in the process of defining their own goals so that it finds meaning in learning. It is in action that activity takes effect. Thus, the student involvement in the educational process should stimulate emotions and intellect, and, respecting the studies conducted by [6] regarding the dependent relationship between the presence of involvement and development, is defined involvement as "quality of human activity" [27, p. 25], observable through various indicators, such as concentration and persistence, motivation, energy expenditure, satisfaction and interest [27]. When the teacher emerges in an educational context strongly marked by the students' lack of involvement in their own learning process (absence of the above mentioned indicators), they may resort to active methodologies and resources more familiar to this digital generation [28].

This same reality was felt by the trainee teacher when she entered the educational context of the 1st CEB. Given the uniqueness of the class, particularly as regards interpersonal relationships and compliance with rules, students aspired for a teaching focused on personality [25].



It was these ideas that served as the motto for the research project - *Gamification as a strategy for promoting child involvement: a study on spatial orientation in the 1st CEB*, supported by a gamification approach, as a driving force for children's involvement when addressing promotion of spatial orientation.

In this scenario, and regarding the gamification approach, it assumes different definitions in the literature. However, it should be noted the providing by [10], which briefly defines it as the use of elements of games in non-gaming situations. In fact, one of the initial questions concerns with the distinction between the terms gamification and game. Although the "root" word gamification is based on an Anglo-Saxon foreignism - *game* -, adopted for practical reasons [14], these same concepts do not have a synonymous relationship, namely by the first idea highlighted: gamification occurs in non-game situations [10], although it resorts to certain elements of games: "mechanics, strategies, thoughts" [11, p. 1]. Not presenting itself as a specific methodology of education, it is possible to recognize, in this same area, great potentialities, such as the ability to provide playful, engaging and captivating learning environments. More intrinsically, it is able to assist in problem solving and to foster their own learning in an active way [11]. These potentialities occur, in large scale, simply because the approach is directed to the human being, namely at anthropological, sociological and psychological level, as emphasized by [12]. In this scenario, and given the magnitude that gamification increasingly acquires, there are several models that allow the design and evaluation of a gamified strategy [12]. For this project, we highlight the *Gamification Framework*, also known as *Octalysis*, developed by [7], pioneer and expert of the methodology in question. As a reference in the application of gamification in pedagogical practice, the *Gamification Framework* is composed by eight axes: *Core Drives* that should compose any gamified activity:

1. *Epic Meaning & Calling*, referring to the meaning that the activity may trigger in the student. For this same Core Drive, the plot is highlighted, while driving all the activity and its challenges;
2. *Development & Accomplishment*, where the core notion goes through the satisfaction that the subject feels when performing the activity;
3. *Empowerment of Creativity & Feedback*, which aims to promote creativity and feedback, ideally immediately provided;
4. *Ownership & Possession*, where it is defined that gamified activity should foster a sense of ownership. Creating an avatar illustrates this *Core Drive*, as the student / group admits the avatar as their own, as it is

designed through the tastes and preferences of the student (s);

5. *Social Influence & Relatedness*, which addresses the social component. Upon entering a gamified activity, the child also emerges in a need to communicate and interact;

6. *Scarcity & Impatience*, once motivated and predisposed to learn, a sense of impatience arouses in the student, whether in the face of rewards or in terms of the following challenges;

7. *Unpredictability & Curiosity*, which presupposes a gradual process of discovery of the activity, allowing to highlight its unpredictability;

8. *Loss & Avoidance*, since as in everyday life, you do not always win, and sometimes it is necessary to work more and more incessantly to achieve the goals [7], [12].

Thus, it is reinforced that gamification assumes innumerable and significant repercussions, not being associated, in education, to the act of playing [29]. Gamification is not meant to be fun, but rather a playful and active way of learning, sustained by real and contextualized goals, which makes sense in our project.

Regarding to spatial orientation, understood as spatial capacity [22], developed gradually and sequentially in space and with space, in body and body, it is a curriculum content to be developed in primary education, as stated in the Environment Study program, block 4 "Discovering the interrelationships between spaces", which can be articulated with the area of Mathematics, which is constant in the domain of Geometry and Measurement, given that the location and spatial orientation are assumed as the cornerstone of the geometry study. It is from the correct mobilization of their own vocabulary and language expressions that the child can communicate and perceive the world [4].

Trying to define the spatial orientation, one rescues a broader term: the spatial sense, also connoted as spatial capacity or spatial thinking. From the perspective of several authors, it occurs as the union of three components: spatial orientation, spatial visualization and geometric figures [4]. Being fostered from birth, spatial sense is responsible for the ability to respond to various daily tasks [26]. As mentioned by [15], spatial orientation and spatial visualization assumes a thin border with each other, since, to perform a spatial orientation task, it is often necessary to mobilize spatial visualization capabilities. Differentiating the two visual capacities, since they have a thin but existing boundary, spatial visualization refers to the individual's ability to understand their surroundings, occurring a mental movement of the object through the observer [15]. Regarding spatial orientation, it stands out as responsible for the appropriation of the "relative position of shapes and objects as well as the relativity of

their sizes” [5, p. 10], not requiring a mental movement of the object [36]. Thus, spatial orientation refers to the reading and construction of maps, plans and itineraries, as well as their reflection. At the same time, it allows the interrelation with geometric notions associated with coordinates, direction, distance and relative position [5].

In this study, we highlight a gradual and sequential course, namely from the use of terms that emerge from the stories selected by the teacher and the appropriation of notions of orientation (eg. right and left) [23] and also the concepts lateralization and laterality, given that lateralization corresponds to a preference for a body part, while laterality represents an advancement of this same ability, allowing to emphasize the notions of orientation according to the selected reference object [32]. In the age group in question, the relative position of a subject or object can be described from relative and subjective terms, namely regarding distance [5]. There may also be situations where the relative and subjective terms are not presented as sufficient solutions, requiring the use of coordinate systems and reference systems [5]. Thus, and as advocated in the Mathematics and Environmental Studies programs and highlighted in the present study, the promotion of spatial orientation occurs gradually, according to various concrete and practical experiences [34]. Thus, the investigative project assumed, as its central objective, the investigation of the influence of gamification as a propelling methodology of the positive impact on the involvement of children. Defined specific objectives: a) Identify children's knowledge regarding spatial orientation; b) Promote learning regarding spatial orientation; c) Identify the impact of the didactic proposal on learning; e) Foster children's involvement; f) Approach the proposed work with the work performed. In this sense, two research questions and their objectives were traced: 1) In what way is gamification suitable for working on spatial orientation? 2) What contributions can gamification bring to student involvement in learning?

## II. METHODOLOGY AND SAMPLE

Enhancing gamified educational activities presupposes the conception and development of a dynamic process by the teacher, able to respond to the singularities and needs of the context under analysis [16; 21;43], as well as the objectives listed. Given this same premise, was developed an investigation that followed the mixed methodological approach and a case study. Regarding the case study, it was decided to develop a short, time-centred and fully situational investigations [3]. Additionally, we sought to approach the Research - Action, assuming its phases towards the transformation of educational practice and professional improvement: observation, planning, action and reflection. Although the project was not again applied in the context under analysis, it served as a learning ground for future applications. Regarding to the mixed methodological approach, this emerged from the confluence of the use of quantitative and qualitative method techniques and strategies [1]. This approach, by mirroring reality [35], allows redirecting research to a full understanding of the case [9].

In this way, the data were collected through: (i) participant observation, which allowed the interaction between the trainee teacher and the students, as well as the collection of empirical data regarding their behaviors, interests and signs of involvement. It was used The Child Involvement Scale, developed by Laevers[27]. Although intended for preschool education, the same scale was used in order to ascertain the level of involvement of students when implementing the sessions scheduled to carry out the project. However, the scale implemented was adapted, as it changed from the original. Two of the most important changes were due to the number of existing levels, which decreased from five to four, so as not to influence the trainee teacher to fill in the middle column. Another change was based on focusing on only two signs of involvement: (a) concentration and (b) facial expression and posture. With these changes, the description of each level was adapted, as shown in Table 1.

Table 1. Description of each level of the adapted Child Engagement Scale

Levels	Description (concentration / facial expression and posture)
1 Absence of activity	- Distracts himself with space and peers. Does not exhibit any interest in the activity - Has an absent look and a passive attitude
2 Frequently interrupted activity	- Distracts himself with space and peers. Exercises activity, but without great concentration - Evidence of a disinterested posture
3 More or less continuous activity	- Distracts himself with some external stimuli. Concentrated and motivated in the activity - Committed attitude most of the time
4 Continuous activity with intense moments	- Hardly distracted. Very focused and involved in your activity - Posture and facial expression fully focused on activity

Regarding semi-structured interviews with the class teacher, an interview was conducted prior to the implementation of the project, in order to get to know the context in depth, and another subsequently, in order to ascertain the perspectives from the teacher regarding the repercussions of the project. For data collection, were performed categorical content analyzes[2]. In the final part of the project, in order to try to answer the questions raised regarding the analysis of the results, a semi-structured interview was conducted with Dr. Tito de Moraes, founder of the MiudosSegurosNa.Net project, and with Professor Manuel Area -Moreira, Full Professor at the University of La Laguna, located in the Canary Islands, Spain, together

with a content analysis. These experts were used because they are actively working in this area;

The dynamics of all sessions were organized and systematized into multimodal narratives that presented with “important epistemological value”[20, p. 28]and allowed to preserve their globality[8].

Our analysis was careful to triangulate the data.

In addition, the case study consisted of twenty-one 6-year-old students from the 23 who were part of the class because they were absent during the pre-test and post-test implementation sessions.

The project ran from February to May and was based on three major phases (Table 2).

Table 2. Research Project Schedule

Study Phases	Assignments
Cross to various tasks	1st Participating Observation
Early Stage	2nd Presentation of authorized consents: School Board and EE
	3rd Pilot test performance
	4th Conducting of EPT1
Implementation stage	5th pre-test application
	6th Groups formation
	7th Implementation of sessions and extensions
	8th Post-Test Application
Final stage	9th Conducting of EPT2
	10th Conducting the Expert Interview

Regarding the gamification approach, we retrieve the various *Core Drives*[7] and their presence in the project:

1. *Epic Meaning & Calling*, with the plot created and the cross poster posted in the room;
2. *Development & Accomplishment*, through gradually challenging levels and punctuation;
3. *Empowerment of Creativity & Feedback*, with motivating challenges framed by various iconic places to visit, group-designed avatars, multi-session extensions and immediate feedback;
4. *Ownership & Possession*, from the individual monsters in ClassDojo and the recurring rewards;

5. *Social Influence & Relatedness*/
6. *Scarcity & Impatience*, through award-winning collaborative work, successive exchange of representatives in groups, and the ability to visit places with families from Thinglink;

7. *Unpredictability & Curiosity*, based on curiosity about the following challenges;

8. *Loss & Avoidance*, with the extra challenges.

#### Presentation and discussion of results

For a better understanding of the results, Table 3 presents the spatial orientation capacities attended and the way they interrelated with the gamification approach, more specifically with the *Core Drives* [7].

Table 3. Path built during sessions

Sessions	Skills	Place to visit	Issue	Challenge	Extension
<b>Session 1st</b>	-Develop lateralization and laterality -Mobilize proper vocabulary of position relations of two objects	Avenida dos Aliados / Aliados Avenue	What indications can you give to overtake the maze without touching it?	-Motor coordination game -Overpassing a maze, adapted from the electric maze game, with the structure of the Porto City Hall (cf. Appendices 23.2. And 23.3.)	Online game based on questions prepared by the trainee teacher (see appendix 23.7)
<b>2nd Session:</b>	-Mobilize proper vocabulary of position relations of two objects -Represent, describe and compare itineraries linking the same points	São Bento Station	What indications can you give to overtake the maze without touching it?	-Construction, interpretation, description and comparison of several itineraries that connect two points (tourist and train) in grid and with several pieces constructed using magnetic paper. (see appendices 24.1 and 24.2)	Online games regarding the capacity in analysis (see appendix 24.6)
<b>Sessions 3rd and 4th</b>	- Identify the position of figures present in a grid with their coordinates -Locate spaces relative to a reference point	Bolhão Temporary Market	Which stand to choose and what information to give about its location?	- Selecting a branch by identifying the coordinates in a grid (see Appendix 25.1.) - Choose from a market stand to place the selected branch. - Creation of an avatar, through the Voki website, <sup>1</sup> recording the necessary indications in order to the other groups can locate the stand	Question-answer game using a digital resource developed by the trainee teacher (see Appendix 26.4)



It should be noted that the simple appropriation of various game elements in educational practices does not itself influence student involvement and self-realization. In contrast, a path was designed in order to meet the needs and motivations of the class [21], the educational objectives to be listed and the resources available. It was intended to involve students in the process by stimulating

connections that give meaning to what they learn. These preparation moments are fundamental in the application of game elements and the development of gamified activities [16]. In addition, we highlight the fact that each session was composed of several moments, as shown in Figure 1.

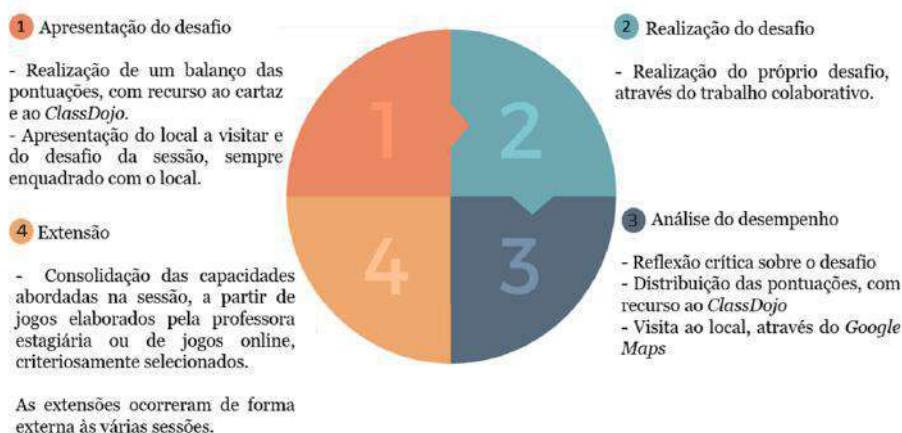


Fig.1: Session moments

Given this, in the present study several resources were mobilized to promote student involvement. An example, is the poster posted in the room (cf. Figure 2), allusive to the various levels (sessions), scores, final reward and observations made throughout the project, according to the *ClassDojo* parameters (cf. Figure 3) and the performance of each group.



Figure 1. Project poster



Fig.2. Selected ClassDojo Parameters

It has been found that students' visualization of the learning process makes it clear, decreases anxiety, and increases intrinsic synergies that are essential to learning. Although with simple but encouraging observations, given the age group, students resort to the poster when they needed to know what to do to improve or remember their score and level. Moreover, such an event allowed some autonomy to be stimulated, freeing the trainee teacher for other tasks. It was also found that it triggered the inclusion of digital resources (*ClassDojo*, *Google Maps*(<https://www.google.com/maps/@41.2609476,-8.7154688,15z>), *Thinglink*, *Voki*), which, associated with games, expanded the sessions and made the moments more playful, fostered the conception of learning how to learn through active, constructive and collaborative work [13]. It is noteworthy that the use of editing and display of graphic presentations allowed, in partnership with the visit diary, that students were motivated and assumed the various sessions as a continuum. Already in the second session all students recognized the tour guide (avatar) and were impatient to know what question the guide was going to ask and where they would take them (cf. Figure 4.)



Fig.4. PowerPoint slide

In the Child Engagement Scale it was found that students only reached level 3, which means that they were compromised most of the time, but reveal some distraction from external stimuli. Respecting the analysed signals - concentration and facial expression and posture - the obtained data was not analysed by session, but by moments. The time reserved for extensions is not present as it occurred externally. Figure 5 illustrates the level of student engagement. The shown values were converted to relative frequency, as a percentage rounded to units.

### Momento 1- Apresentação do desafio



### Momento 2- Realização do desafio



### Momento 3- Análise do desempenho

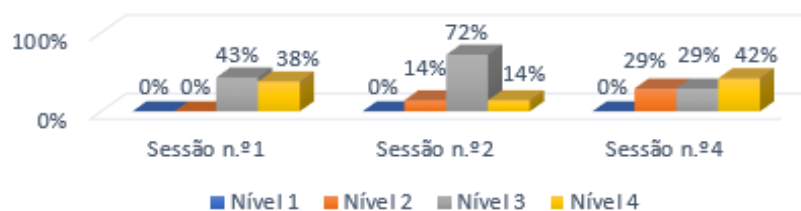


Fig.5: Comparison of involvement levels at various session times

Note: The first moment did not occur in session no. 4, just as the third moment did not occur in session no. 3, which meant that they didn't appear in the referred graphs.

To complement the information gathered from the graphs, we sought to highlight the voice of the full professor through the interviews provided (EPT1 and EPT2). Tables 4 and 5 show analyses of the EPT1 and EPT2, although Table 4 illustrates an excerpt. The purposes of each interview were the basis for the stipulation of analysis categories.

Table 4. EPT1 Review Excerpt

Category	Sub-category	Recording unit	Unit of context	Enumeration
Characterization of the class group	Behaviour	Serious emotional and behavioural problems	<i>There are children who have severe emotional and behavioural problems</i>	4
	Engagement	Interest in learning	<i>generally they show interest in learning</i>	1
	Attention Period	Difficulty staying motivated and diligent	<i>... Have a hard time staying motivated and diligent</i>	2
	Ability to deal with feelings of frustration and difficulties	Difficulty in feelings of frustration and difficulties	<i>(...) Have a hard time dealing with the frustration and difficulties founded</i>	1
	Interests	Practical, playful and exploratory activities;	<i>They are more interested in practical, playful and exploratory activities</i>	3
Classroom Mediation	Gamification as a strategy	Beneficial	<i>Would be beneficial</i>	2
	Programmatic Topic: Spatial orientation - Fullness	Crucial; Individual growth	<i>(...) Is central to individual growth</i>	1
	Programmatic topic: Spatial orientation - Difficulties	a) Yes b) No	<i>[a] Yes. [b] In general not</i>	
	a) Notions of orientation b) Capacity of distance, direction and position in space			1

The analysis of Table 4 shows that the full professor characterized the class as interested in learning, especially when presenting practical and playful activities, although ephemerally and with behavioural and emotional weaknesses. Given the problems and interests of the class, he considered the gamification approach a beneficial strategy.

Table 5 EPT2 analysis

Category	Sub-category	Recording unit	Unit of context	Enumeration
Perspectives on project repercussions	Adopted strategies	Positive ; New methodology	<i>Experience was very positive (...) the adopted strategies allowed them to get in touch with a new methodology</i>	1

Behaviour	Agitation and restlessness; Collaboration and interest	(...) It is natural that there was more agitation and restlessness, but they were always collaborating and interested.	2
Attention periods	Improvement; Good levels of interest and motivation	(...) the students have improved in this aspect, showing good levels of interest and motivation.	2
Ability to deal with feelings of frustration and difficulties	Awareness of the success stages; Do not give up; In some children, it remained	(...) encouraged them to comply with their demands, being aware that success is achieved in stages and that there should be an effort to achieve it (...) in children with very low levels of attention (...) the feeling of frustration over the difficulties remained	1
Interests	Arousing of the curiosity and interest	aroused curiosity and interest in the challenges presented in some students	2
Engagement - Child Engagement Scale	3 students at level 1; 3 students level 2; 7 students at level 3; 10 students at level 4	(...) For level 1, I identify three students. (...) Level 2, I identify three students. (...) Level three I identify 7 students (...) level four I identify 10 students.	1

The analysis of Table 5 supports the perspectives on the project's repercussions on the class and emphasizes that these, extrapolated student engagement. According to the teacher, significant improvements were felt in the dimensions: periods of attention, curiosity, interest, but also in the ability to deal with feelings of frustration and difficulties in most students. This result allows us to state that the gamification approach has effects mainly on the person who assimilates the process of change. When this occurs, according to [30] it can become threatening and individuals tend to resist, unless the experience reduces this threat, so gamification promotes a playful environment that does not shrink the student. In contrast, it incites you into action, involving you in the learning process. Thus, it also contributes to self-realization, the basis of personal growth, as stated by [21].

After this analysis and with regard to involvement it can be recognized that all data collection instruments point to an improvement. However and as shown in Figure 5, student engagement focused on level 3 - *More or Less Continuous Activity*. Thereby, was asked a question regarding the reason that did not allow most students to be at level 4- *Continuous activity with intense moments*. Given this question, and through a triangulation of data it

was possible to verify that, as referenced in EPT2 the sessions took place in the afternoon which, a priori, conditioned the results. However, at session no. 3, regarding the creation of an avatar, using a tablet / computer, the trainee teacher noted, in the observation field of the Child Engagement Scale, that "some students at the 2nd moment [achievement of the challenge] remained at a low level of involvement (level 2) as they intended to use tablets to play war games" (cf. Child Engagement Scale, session no. 2). Since it was assumed as a major underlying purpose of the project the implementation of a student-centred humanistic curriculum and its self-realization and integrity [38] plus a willingness of the future teacher to know his action sought to conduct an interview with Mr. Doctor Tito de Moraes and Professor Doctor Manuel Area-Moreira. With this, it was intended to ascertain what would have been the best position to be adopted by the trainee teacher: to allow the use of war games, although selected according to the educational purposes or not? These interviews were also used to ask questions related to the theme. An analysis of the interviews was conducted, which focused on the question-doubt theme: the educational environment and war games, as shown in Table 6.



Table 6. Excerpt from the analysis of the interviews with Doctor Tito de Morais and Professor Doctor Manuel Area-Moreira

Category	Sub-category	Recording unit	Unit of context	Enumeration
The educational environment and war games	Use of war games in pedagogical practices responding to the interests of some children	<u>Mr. Doctor Tito de Morais</u> Don't do all the wills	<i>Raising a child is not to do everything for her</i>	2
		<u>PhD Professor Manuel Area -Moreira</u> Not really	<i>In principle, I think that shouldn't be used</i>	1
	Justifiable situations for the use of war games	<u>Mr. Doctor Tito de Morais</u> Related topics	<i>The only situation that I see that this can be justified will be on the use of such games - carefully chosen - to teach subjects related to the theme</i>	2
		<u>PhD Professor Manuel Area -Moreira</u> Game Critical Analysis	<i>Only if we use these games to make the student perform a critical analysis of the games</i>	1
Learning disability and attention		<u>Mr. Doctor Tito de Morais</u> Gamification Strategy	<i>would recommend adopting a gamification strategy</i>	1
		<u>PhD Professor Manuel Area -Moreira</u> Interesting and technical quality game for the student	<i>game that has both audio-visual and graphic technical quality, which offers a straightforward challenge to the student</i>	1

Studying the analysis of the interviews allows us to recognize that the project was effective because it used a good strategy to intervene in a context / class with the behaviors and interests already explained. In fact, the results prove that gamification acted on the person, with effects on involvement and results, even if they did not reach the highest level, because the professional attitude of the trainee teacher also worked on the child's education.

After the four sessions implemented, the post-test was applied, which allowed to measure the promotion of spatial orientation compared to the pre-test initially applied. In Table 7 it is possible to recognize the results

obtained between the two applied tests. The values are converted to relative frequency, as a percentage rounded to units and absolute frequency. The answers obtained were not exposed to scores, since the most important was the acquisition of knowledge. Thus, each challenge was analysed through a graded table, constructed based on the answers obtained at both application times. Each type of answer obtained is named according to a code (R1, R2, R3,...). Since these are gradual tables, the R1 code corresponds to the totally correct answer, followed by the remaining codes that have failed or unanswered answers.

Table 7. Synopsis of pre-test and post-test data for each challenge

Capacity under study	Challenge	Percentage ...of answers with no failures (R1)	Absolute student frequency by answer code							Percentage ...of...evaluations o easy grade
			R1	R2	R3	R4	R5	R6	R7	
Mobilization of proper vocabulary of position relations of two objects	1 Pre-test	43%	9	3	3	3	0	3	0	90%
	Post-test	57%	12	4	0	2	1	1	1	90%
Location of	2 Pre-test	29%	6	11	2	2	0			76%

spaces, relative to reference points	Post-test	62%	13	5	1	1	1		85%
Analysis of itineraries	3 Pre-test	62%	13	6	2	0			86%
	Post-test	86%	18	2	1	0			90%
Building of itineraries	4 Pre-test	66%	14	2	3	2	0		95%
	Post-test	80%	17	2	2	0	0		90%
Identification of the figures position in a grid through their coordinates	5 Pre-test	24%	5	8	2	5	1		76%
	Post-test	57%	12	4	3	2	0		95%

Note: Shaded cells represent answers not counted in the respective challenge.

Regarding the mobilization of gamification in the promotion of spatial orientation, it is possible to recognize its adaptation, given the felt degree of learning between the pre-test and the post-test, once the results improved. As for the percentage of students who rated each challenge as easy, it is also possible to recognize an evolution. Moreover, this same adaptation was not only felt in the results obtained in the two tests applied, but also during the sessions. With the appropriation of various elements of the games and the creation of a cross-sectional plot and a sequential path focused on the students and the educational context, it was found that the approach allowed the learning to take place in an active way and through a trial-error method and immediate feedback [16].

In addition, the multimodal narratives of the pre-test and post-test implementation sessions were intersected in order to focus on the evolution felt when presenting the challenges. In general, the analysis of the results allowed us to conclude that the gamification approach is suitable for the promotion of spatial orientation. However, and through a triangulation of data between the percentages of easy grade, extracted from the two tests, and the multimodal narratives of the test application sessions, it is necessary to recognize a poor credibility of these same data. Many students marked the challenges as easy, although they did not understand and accomplish them, "Once again, and moving around the room, it was found in the vast majority of students that they considered the task easy, regardless of whether or not they did it" (multimodal narrative of the pre-test application session).

### III. CONCLUSION

The obtained results allow us to conclude that gamification is suitable to work the spatial orientation promoting moments of transdisciplinarity, so we highlight the eight axes *Core Drives*[7] and the strategies and resources used. We also concluded that gamification makes the classes more dynamic and that captivates the students, being involved with pleasure in the learning process. However, it was found that the use of digital games with educational intent is of interest to students, but not enough to engage with attention in the construction of knowledge, as it was found that some students were distracted by external stimuli. Trying to understand this result, it was found that some students preferred war games, so due to the educational game their attention level was not high. This dilemma raised the question of how the teacher should proceed. We conclude that, especially given the age group, it is necessary to educate to form critical and conscious and intervening citizens. Thus, we consider that gamification was the best pedagogical strategy to treat curricular content and to form according to the student profile for the 21st century.

In this follow-up, the gamification approach made it possible to understand, as a trainee teacher, that teaching to learn in contemporary times, in a pleasant environment that respects the student as a person and social being, brings to the teacher new postures, new knowledge and new processes from teaching to learning.

In short, this article, while presenting research limitations such as the short time frame in which it took place, recognizes the potential of gamification as a methodology for the positive impact on the involvement of children in Mathematics and Environmental Studies.

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**Legal documentation**

- [42] Decreto-Lei n.º 54/2018 de 6 de julho. Diário da República n.º 129 - I Série. Educação Lisboa.
- [43] Decreto-Lei n.º 55/2018 de 6 de julho. Diário da República n.º 129 - I Série. Educação Lisboa.



# Disposal of Automotive Oils - Evaluation of Environmental Management made by Public Transport Companies in the City of Manaus

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**Abstract**— The present work describes in detail the pattern adopted regarding the management model that are currently used by the collective transport companies of the city of Manaus-AM and reports what in fact these enterprises, has made important regarding the disposal of used/contaminated lubricating oil, residue generated during its exchange that according to the regulatory standard ABNT-NBR 10004/2004, are classified as dangerous class I. At first it was necessary to carry out a review bibliographic regarding the subject and after, field research (on-site visits) was carried out, which was designated in the application of a questionnaire to employees in the respective workplace. In view of this context it was found that the companies visited are always updating and improving this model that is considered extremely important to the environment.

**Keywords**— Lubricating oils; correct disposal; Environment.

## I. INTRODUCTION

Over the past 50 years, the exponential growth of cities accompanied by their urban expansion has been one of our society's main concerns about issues equated to the environment. Such growth has as a consequence the increase of its area of occupation by its respective inhabitants and, with this, a means of transport is necessary as a way of fast displacement and at the same time of comfort, starting from their respective zones residential for shopping, industrial, rural, etc.

As urban development of cities occurs rapidly, their area of forest deforestation in large concentrations increases in frantic rhythms leading to consequences the disappearance of species of flora and fauna, and due to urban pollution and generating the depletion of natural resources mainly affecting water resources such as rivers, lakes, seas, etc. Such anthropic actions are directly linked to the intensive consumption of non-renewable energy resources, which over the years have been adopted all over the world as a form of rampant economic model, which nowadays is already considered as Unsustainable.

Second Giucci (2004), the automobile was invented in Europe at the end of the 19th century and conquered several parts of the world invading cities which made it a protagonist of people's everyday life, becoming a dream of consumption since 1910. (BOZZA, 2016), reports

that around 1930, with the emergence of vehicle manufacturers, we saw the need to standardize the employability of lubricating oils as well as fuels (gasoline, alcohol, etc.) universally and from the first oil-based lubricating oils, there were great changes until it reached the present day, going through processes with greater sophistication and improving the attributes of this product, following the environmental standards in force in the country.

Currently, one of the biggest challenges encountered by society and environmental experts is precisely to find solutions and practices regarding the correct disposal of municipal and industrial waste contained in the National Solid Waste Policy (PNRS) Law No. 12.305/2010), within this context, however, arises the management of the disposal of used/contaminated lubricating oils known by the acronym (OLUC). These procedures are adopted by companies in the area of road, urban transport and by workshops and large or small commercial establishments allocated in cities. (NEGROMONTE, 2010), points out that incorrect management of this waste can lead to several environmental, sanitary, economic and social problems.

This project aims to research, the analysis on the management of the disposal of used/contaminated lubricating oils done correctly within the scope of current Brazilian environmental standards. Activities performed by

companies in the public transport sector that are currently allocated in several areas of the city of Manaus, capital of the State of Amazonas and explore this type of activity through concessions that are granted to it, operating their respective public transport lines with conventional buses and articulated vehicles, which after achieving mileage targets rounds, the exchange service lubricated oils of these respective vehicles is done.

Data collection was obtained through on-site visits in the premises of the companies, to which they were consulted through the permission of their managers and directors, accompanied by a questionnaire that was prepared through bibliographic research, observing since the exchange, handling, storage and the final destination of this waste considered as dangerous class I, according to standards of ABNT-NBR, no. 1.0004/2004.

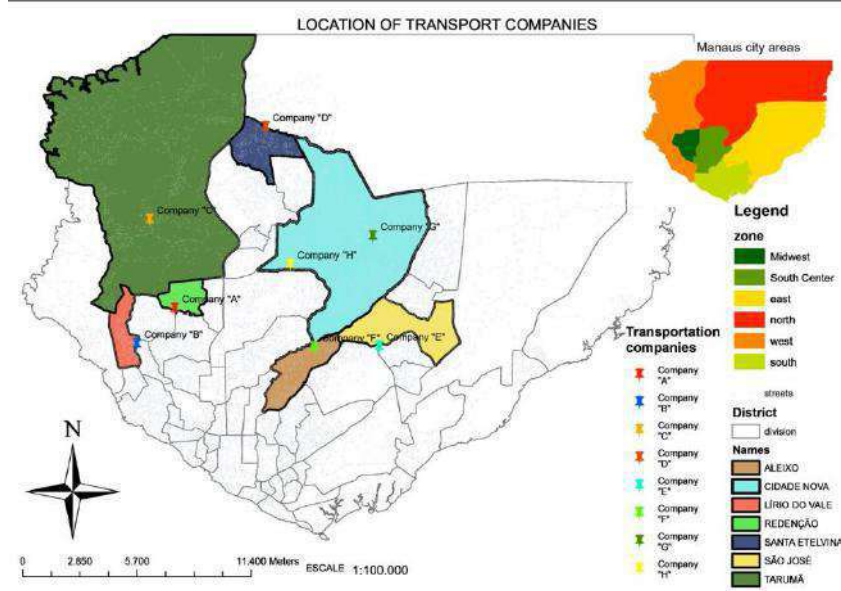


Fig.1: Location of transport companies used in the study.

## II. METHODOLOGY

In the present work, qualitative approaches were applied, which Richardson (2008), shows that this approach is the attempt to understand the nature of the problem to be studied, understanding the observation and description without having to use the experimental procedures and statistics of this subject. The object of study was selected as the object of study, the public transport companies that are currently allocated in the Metropolitan region of Manaus/AM, in areas different from that city. The aim of the study was to understand the way in which the management of the disposal of lubricating oils is performed after the exchange. The location of the companies is shown in Figure 1.

During the development of this work, seven large companies were visited, which have a fleet of at least around one hundred vehicles. Therefore, a very significant sampling if we take into account that the city presents a total of nine companies that run the public transport service (collective) in the capital and are in full activity, operating 24 hours a day. companies, five samples were selected to obtain satisfactory results for this research.

It is important to highlight that all analysis happened through the interview method and were carried

out in the environment and working hours of each local enterprise to which a responsible employee (in charge) was made available by the exchange sector of oil so that, in fact, the application of the questionnaire containing questions related to the theme in question.

## III. RESULTS

The results of the collections occurred during august and september 2019. It was verified that all the companies studied are intended for waste correctly, complying with the standards of ABNT-NBR No. 12,235/1992. In addition, they hire the services of outsourced companies or legal entities, licensed by the National Petroleum Agency according to their resolution No. 20/2009, for the collection of oil waste generated by exchanges in automotive vehicles (Table 1).

At the same time, it was noticed that waste is stored for disposal differently, i.e. companies 2, 3 and 5 collect in metal-protected resistant plastic tanks with the ability to store up to five hundred liters, while companies 1 and 4 they store in metal Toneis that are able to store up to a thousand liters of that residue where no other form of storage such as drums, containers, etc. has been found. Although oil residues are disposed of correctly, the material

to which the Tanks that store the residue until their respective collection are not adequate, as these are made plastic material. This material may deteriorate in the future and leaks may occur, which would directly affect the environment.

In addition, the questionnaires applied during the visit helped in understanding the dynamics of operation of each company (Table 1). Although the five companies analyzed have a contract for the disposal of the product periodicity is not the same, with companies 2, 3 and 5 fortnightly and weekly in the other.

Table 1: Data obtained contained in this tab.

Activities	Company 1	Company 2	Company 3	Company 4	Company 5
Storage	Vat	Tank	Tank	Vat	Tank
Correct destination	Yes	Yes	Yes	Yes	Yes
Authorized Collection Company	Yes	Yes	Yes	Yes	Yes
Collection Frequency	Biweekly	Weekly	Weekly	Biweekly	Weekly
Supervision of environmental agencies	Yes	Yes	Yes	Yes	Yes
Understanding of the final destination	Yes	Yes	Yes	Yes	Yes
Use of PPE's during handling	Yes	No	Yes	Yes	No

Given the results presented in the table above, it is possible to understand that companies adopt safety procedures, and over time improve and adapt when regarding the handling, storage and final destination of OLUC. In order not to occur any non-compliance and in the future, that companies will not suffer penalties in the face of inspections by specialized environmental bodies.

When companies are questioned whether they adopt safety procedures both at the time of oil exchange and in their handling, 2/5 of the sample answered that they do not perform in their entirety, that is, it can happen from the absence of some type of PPE, such as glove, face mask among others.

Moreover, the results collected showed that all companies have already undergone supervision by environmental agencies and that none of them have been fined or fined for such non-compliance, these actions are frequent and are used as a form of prevention avoiding thus damage to the environment.

Another part of the results collected show that companies are aware of the importance of correct disposal of waste generated in their dependencies, thus avoiding any kind of friction by environmental management bodies both at the state level and Municipal.

The volume of oil used/contaminated in enterprise dependencies consists of the exchange and storage process, as shown in the table below:

Figure 1 shows that companies 1 and 4 generate a larger amount of used/contaminated lubricating oil, while companies 2, 3 and 5 on the other hand, a smaller volume. Nevertheless, this quantity is still significant when annual averages are extracted. Compared to the work of Mendonça (2015), the results showed a volume of waste generated by motor vehicle concessionaires in the city of Caruaru-PE very high and evident. In addition, the author mentions that there is an impact in the face of the dynamics applied at national levels and making it an even bigger problem when there is no control over the disposal of the used oil.

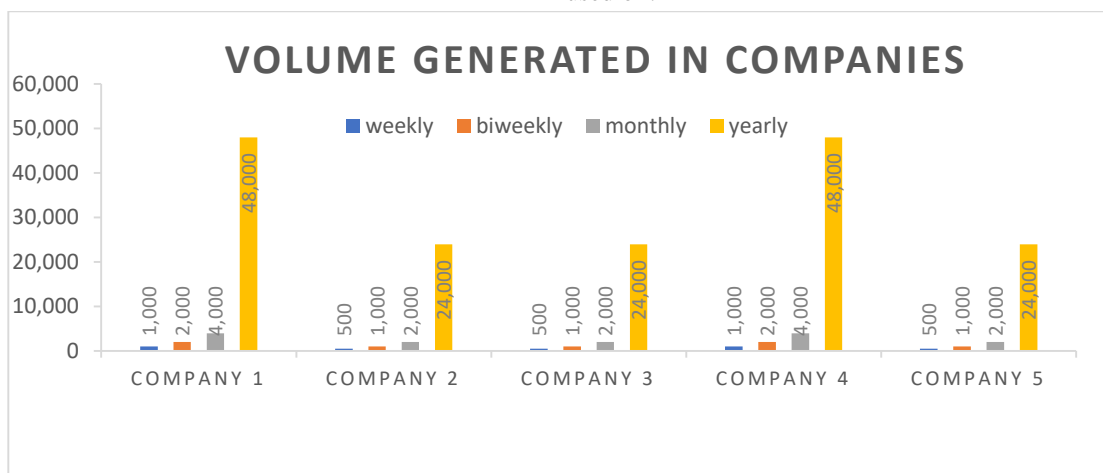


Fig.2: Volume of used oil generated, in the premises of each company.

The information in Table 2 shows that companies 1, 4 and 5 have a fleet of vehicles higher than companies 2 and 3, which generates an even larger volume of used oil, which generates an even more significant

volume of used oil. However, all analyzed companies perform oil exchange through channels, and separator boxes. The latter is used after the end of the service, when cleaning the work environment is carried out.

Table 2: Information acquired and included in this tab

Activities	Company 1	Company 2	Company 3	Company 4	Company 5
<b>Fleet/vehicles</b>	465	160	120	354	210
<b>Correct disposal of packaging</b>	Yes	Yes	Yes	Yes	Yes
<b>Correct disposal of filters</b>	No	No	No	No	No
<b>Environmental cleaning material</b>	Wash	Tow	Tow	Wash	Wash
<b>Channels for exchange</b>	Yes	Yes	Yes	Yes	Yes
<b>Separator boxes</b>	Yes	Yes	Yes	Yes	Yes

Table 2 above shows that companies 2 and 3 use the stopper as a cleaning method, while companies 1, 4 and 5 that have the largest fleets use washing as hygiene in the exchange sector. All of them discard plastic packaging for recycling companies.

The filters used from vehicles is still a problem to be discussed, as they have no forms of reverse logistics for it and are still discarded normally in the controlled landfill of the city, after going through the drying process.

#### IV. FINAL CONSIDERATIONS

During the research carried out in the premises of oil exchange companies, the evolution of the procedures adopted regarding the handling, storage and final destination of used/contaminated lubricating oil and the importance of applying these daily procedures for the proper functioning of activities during its course was notorious.

Thus, it was possible to further study the oil exchange processes used, from its handling to its final destination. In addition, some risk points were identified that still persist during the process, such as missing some items of ppe as appropriate gloves. The correct destination of the filters used are not disposed of correctly and/or have a destination, being posted to the local controlled landfill. Unlike plastic packaging, which are intended for plastic recycling companies.

Finally, it was found that the public transport companies of the city of Manaus-AM, allocate their waste from oil exchanges properly. It is worth mentioning the lack of incentive programs for waste collection in various establishments such as small workshops. Furthermore, the lack of supervision by environmental-oriented bodies more effectively.

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# Destination of Organic Waste Produced at Manaus Free Fairs

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**Abstract**— Free fairs have always been the target of many regulars, which leads to producing tons of organic waste, but do not always have an efficient destination mechanism for organic waste. A correct disposal of waste is of paramount importance, as it prevents them from going into the process of decomposition in inappropriate places. In this phase, the release of slurry occurs, liquid that can contaminate soil and groundwater. The work aimed to point out the visible problems caused by organic waste, map and make comparisons between the main free fairs of Manaus, besides promoting a correct destination for organic waste produced in them. It was possible to analyze that the healthiness of free fairs are going unnoticed, with this it is clear that the disposal of organic waste is not receiving due attention. Through the questionnaire applied to fairs, consumers and waste pickers, a negative result was obtained regarding the infrastructure of free fairs.

**Keywords**— *Manaus Open Market, Organic Waste.*

## I. INTRODUCTION

Free fairs were born from the simplest marketing mechanism, the exchange, which over the years became recurrent. The fairs in Brazil were an inheritance of the Portuguese colonizer, due to the need for supply (PINTOR et. al., 2011). In Guimarães (2010) show that the records point to the year 1914 the creation of the first Free Fair in the state of São Paulo. From that moment on free fairs have become common place across the country.

The free fair in Brazil is a type of outdoor retail market modality, of weekly periodicity, organized as a utility service by the municipality and focused on the local distribution of foodstuffs and basic products (MASCARENHAS,2008).

In Brazil, 60% of food production is discarded before reaching the dish. This represents a total of 39,000 tons of food converted into garbage per day, which could feed 19 million people or 1.3 billion tons per year, considering the three meals a day (CREUS, 2018).

Also, Sampaio (2017) presents in his study that thousands of tons of fruits, vegetables and vegetables that could go to the Brazilian dish, will end up right in the trash. In addition to waste, in free fairs of Manaus, organic waste causes aesthetic and environmental disorder, because organic waste in general that are accumulated, cause disgust to consumers, who in certain situations stop buying, opting to go into big markets (SOARES et. al., 2013).

The accelerated growth of the population is directly proportional to the level of waste, and uncontrolled consumption causes pollution and environmental impacts increasingly present in our society, causing more areas to be deforested to meet the man's needs. The accelerated growth of the population is directly proportional to the level of waste, and uncontrolled consumption causes pollution and environmental impacts increasingly present in our society, causing more areas to be deforested to meet the man's needs (BACKES, 2007). The slurry the dark-looking liquid, which is formed during the decomposition of organic waste, can pollute the soil and reach the groundwater i.e. leading to water pollution. With an adequate destination of organic waste, the impact can be mitigated (SERAFIM et. al., 2003).

Thus, this research aimed to analyze the treatment of organic waste from Manaus free fairs and how waste is generated, map the main free fairs of the city and its characteristics. In addition, obtain information on the disposal and treatment procedure of waste generated at free fairs and develop an appropriate disposal procedure.

## II. METHODOLOGY

Located in the northern region of Brazil, the municipality of Manaus/AM currently has a population of 2.1 million inhabitants. The 45 free fairs in the city are controlled and administered by the Municipal Department of Public Cleaning (Semulsp) (MARRECO, 2019). To

carry out the case study, the five main free fairs of the city of Manaus were selected: Rural Producer Fair, *Banana*

Fair, *Panair* Fair, *Sepror* Fair and the Free Fair of the Coroado.

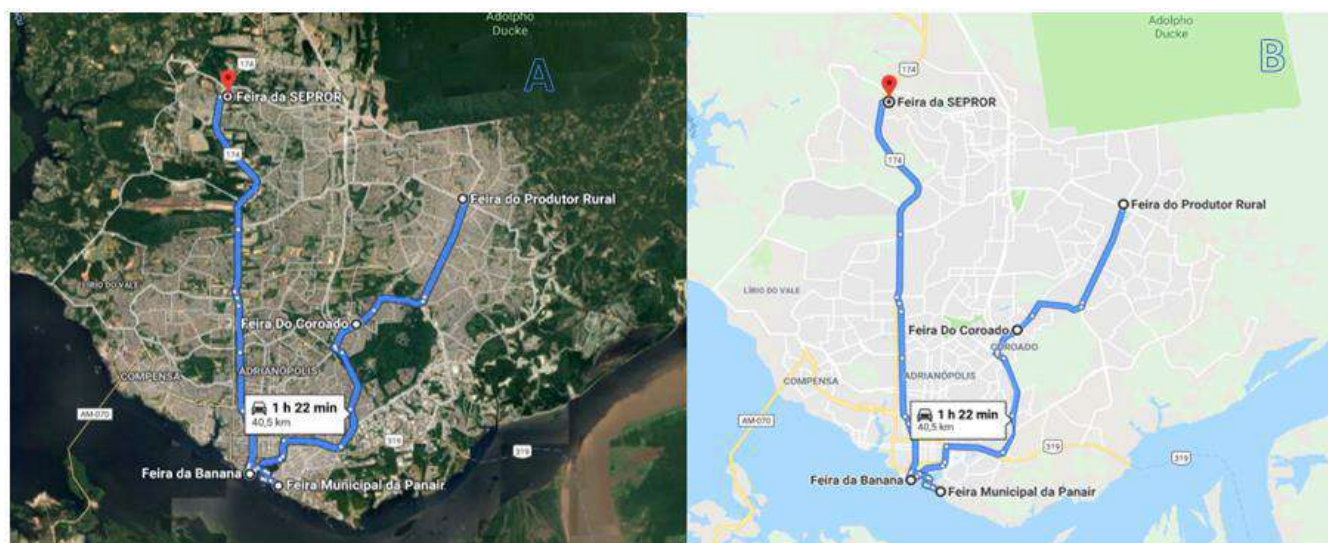


Fig.1: a) actual location of the five free fairs; b) fixed location of the five free fairs  
Source: Maps Google



Fig.2: Localização das distancias entre as feiras  
Fonte: Maps Google

The methods covered in this project are qualitative, being developed through on-site visit, interview, photographic records, observation and bibliographic searches. The purpose of the visit to the site was to analyze the production of organic waste, disposal, map the main free fairs of Manaus, make the comparison between the main free fairs, and the destination of organic waste.

First, a study was conducted for the characteristic of the five main free fairs of Manaus, which assisted the field research from March to September 2019. The information collection technique was possible through the application of questionnaires of easy understanding

(SANTOS, 1999), where the intention was to evaluate the perception of the interviewees about the accelerated production of waste at the fairs. The questionnaires were applied with fairs, consumers and homeless people. In total, 10 questions were elaborated, where three of them were directed to 75 fairs, four to 100 consumers and three to 50 homeless people, totaling 225 people.

Subsequently, the main weaknesses of the fairs were detected, and with the information obtained, the project of "Portable Compost separator" was developed. The compost separator was manufactured from PVC buckets with a capacity of 20 liters, in addition, were tested at only two free fairs belonging to the study. In



parallel with the project, explanatory booklets were developed on the use of the "Portable Compost separator".

### III. RESULTS

Through on-site visits, visual analyses, and application of questionnaires with fairs, consumers and residents, it was possible to understand the logistics of free fairs in Manaus. At first, it was clear that the exaggerated disposal of organic waste found at the end of activities at the fair, cause disorders such as, visual, smelly, proliferation of rodents, as well as cockroaches, pompoms, worms and vultures.

However, with the application of the questionnaires it was possible to observe that fairs, consumers and waste pickers, are unaware of the destination of tons of waste that are generated every day at the fairs. In addition, most fairgoers interviewed showed

no concern in possible solutions to the quantitative easing of waste generated. On the other hand, consumers have described as regrettable the waste situation, as there are many people who are experiencing precariousness.

According to the administrator of the Coroado fair, an awareness is made with fairs wore at their respective sales stand, to separate organic waste and non-organic waste, thus the destination could be directed in places Differentiated. Contrary to what happens today, where waste is deposited in the same garbage truck and thus taken to the controlled landfill of the city. The street dwellers interviewed showed that they remove discarded food in good condition for consumption.

The five free fairs analyzed presented the same deficiencies/ and or problems in relation to the loss of the organic waste generated, an example of the form of disposal can be observed in Figure 3.



Fig.3: a) Deposition of waste at the Coroado free fair; b) Storage of foods that are donated- Coroado Fair

Although the fairs did not present a correct form of disposal, the Coroado fair did not show a high number of disposals of organic waste. The reduction in waste is due to the existence of a Venezuelan refugee shelter, which collect part of the discarded usable waste. In addition, fairs wore donate those foods that are not in standard for sale, but can be consumed, this are deposit in cardboard boxes until the residents of the shelter collect.

It was possible to verify that the higher production of waste comes from the kiosk's restaurants,

which sell food at low cost. The residues generated by these kiosks are vegetable and fruit peel, fat and animal viscera, which are discarded directly to the garbage truck along with the other solid waste of the fair.

The free fairs in the Amazon have a peculiarity that is the sale of fresh fish, which generates considerable volume of viscera that are discarded. But unlike plant residues, the viscera are cast in the open to feed vultures.





Fig.4: a) Disposal of waste from the Rural Producer's fair; b): Accumulation of organic waste after the end of the fair

At the Rural Producer's fair, the disposal is carried out through the rotation of four employees of the fair who constantly carry out the collection. Unfortunately, fairs and employees who perform the collection do not care to perform the separation between organic and non-organic waste. In addition, they do not separate products that although not saleable are in good condition for consumption. This waste is taken directly to the collector truck, serving the fairs wore for 12 hours. One point analyzed is the lack of environmental awareness on the part of the fairs wore, the fair at many points has very disordered aspect, shells and stems of organic waste are present at all times at the fair.

Despite the absence of a process of separation of organic waste, and food in good condition or not, employees allow homeless people to collect the waste. Also, at the Producer's fair there is a mechanism for the donation of organic waste, but fairs donate to small producers to serve as food to animals. However, there are no garbage trucks collectors, given that the waste collector truck is available to the fairs wore until the closing of the fair.

Located in the historic part of the city of Manaus, the *Panair* fair has undergone renovations since its creation. Among some positive characteristics at the fair, we highlight the cleaning, organization of the stands for the sale of products, but the structure of waste still causes problems. It was found that the fairs wore were highly aware both in the area of waste generated and in the cleaning of the site. Waste in good condition is donated Fridays to NGOs, and groups that assist homeless people and refugees in the production of soups that are distributed in hospitals and to homeless people. During the period from Monday to Friday the disposal procedure is the same as used at the Coroado Fair, regardless of the type and state of the waste are discarded in garbage trucks.

Despite this, the greatest fragility at the fair refers to fish sellers. There is a portion of the sellers who donate the waste to the feed manufacturers. But not all sellers await the collection of fish waste by manufacturers and end up discarding directly into the river, causing serious environmental impacts on water body banks.



Fig.5: Cleaning process at Panair fair.

For many years the Banana fair and the Manaus Moderna fair occupied the same physical space. But during the technical visits for this study, it was verified that the two fairs had been separated, both in relation to administration, and physically, through the use of wire fences. Despite the physical separation between them, the Banana fair still produces a considerable amount of waste, reaching daily averages around 6 tons.

However, the Banana fair is among the most organized fairs when it comes to waste. Disposals are

taken by employees to a waste disposal truck, which was also verified at Panair. In addition, a project called "Zero Hunger" is developed, which waste is transformed into meals such as soup, cake, bread, sweet and others. Meals are donated to homeless people, refugees, and or those who need it. But on the other hand, the only downside of the fair is the lack of security of the place that this subject the assaults constantly. This problem was not verified in the other fairs analyzed.



Fig.6: Separation of banana residues at banana fair.

The last fair analyzed was the Sepror fair. This fair is one of the most recent as to the period of operation. Therefore, a more modern physical infrastructure and a greater awareness of the environment than in the other fairs analyzed were observed. Nevertheless, as for the disposal of waste generated garbage trucks, which are

collected by urban cleaning once a day. Despite having a more modern structure than the others, the waste is not donated, but are reused by the fairs wore themselves. Yes, Sepror fair 95% of traders produce their product for sale, and so waste is used from food for their animals.



Fig.7: Disposal of waste from the Sepror fair.

Among the five fairs analyzed, four of them opted for a collection system, to which the fair's employees

collect and discard the waste in buckets or trucks collect trucks. For this, each sales stand pays the \$5.00 fee for the



trade fair association, responsible for cleaning and disposal of waste, at an average periodicity of 20 times/day, starting the schedule at 8am until 6pm. It was also observed that employees in addition to being exposed to the sun for a long time, do not use PPE during waste management. Another point observed was the poor state of the instruments used to transport the waste, many of them are adapted. As mentioned above, the *Sepror* fair does not offer these services, the fairs wore themselves are responsible for the disposal of waste generated.

In general, the company responsible for the collection of waste performs the service from 6am to 12:00 pm and 1pm to 6pm, transporting an average of 4 to 10 tons/day. This variation depends on the day of the week, verifying that from Monday to Thursday the average is 6 tons, while from Friday to Sunday the average quantity is 10 tons /day. The final destination is the controlled landfill of Manaus, located at the beginning of the state bus AM-10.



Fig.8: a) form of transport and collection of waste from the pits of the fairs; b) collector containers in each stand.

In addition to technical visits to the analysis of waste logistics, questionnaires were applied in the period of 1 week, to obtain the opinion of the regulars. Among fairs, consumers and waste pickers, a total of 225 people were interviewed at the five fairs, totaling ten questions, where: three questions were aimed at fairs, three to consumers and staff to waste pickers.

The questionnaires show that 70% of traders do not have knowledge about the final destination of waste generated by them. Only 30% of them demonstrate that it would be feasible to implement environmental education practices for fair trades, as shown in Table 1.

The results of the questionnaire applied to the regulars of the five fairs analyzed. It is noted that 80% of

consumers are shown to feel bad about the waste of waste generated at the fair. Only 20% of consumers presented waste disposal solutions such as fertilizer, fish feed from waste discarded at fairs. Waste pickers, 90% feel shocked by traders throwing so many products in good quality, every day tons go to the truck, 30% also say they could donate before the waste reaches the trucks.

With the application of the questionnaire, it is clear that there are no investments in EA in free fairs. And also, during the application of the questionnaires, the traders expressed the need to obtain more information on the subject through mini courses on AS, and also the creation of a space for donation waste collectors, and the importance of composting, or make fairs more sustainable.

Table 1: Result of the questionnaire, applied to fairs, consumers and homeless people.

Stallholders	Coroado	Rural Producer	Panair	Banana	SEPROR
Know the destination of waste	70%	80%	45%	80%	10%
Apply EA	30%	20%	55%	20	90%
They are satisfied	8	8	6	8	3
Consumers	Coroado	Rural Producer	Panair	Banana	SEPROR
Concerned about fate	70%	90%	60%	80%	10%
They knew the donation system	30%	20%	20%	20%	20%
They are satisfied	3	4	2	3	5
Pickers	Coroado	Rural Producer	Panair	Banana	SEPROR
Concerned about fate	50%	90%	60%	80%	10%
They knew the donation system	70%	30%	70%	20%	30%
They are satisfied	2	1	2	1	1

During the study, the deficiencies and weaknesses of each fair were noticed. And so, it was possible to create a project for the implementation of bucket compost separator at *Sepror* fairs and *Coroado* fair analyzed. The choice of traders was made according to the type of food marketed, that is, which can be used in the composting process. In addition, at the *Coroado* fair the products are brought from all over the state of Amazonas, that is, traders do not produce the products marketed, while at the *Sepror* fair 95% of the products marketed by the fairs.

Although the bucket Compost separator project presented a good acceptance before the fairs wore, there was a fragility at the *Coroado* fair, which was the theft of bucket compost separator during the evening period.

Because the opening hours of the fairs wore, they only cover their stands, and the place does not have a security such as fences or gates. Thus, the work of the Compost separator was not completed.

At the same time, although the project is applied only in a stand at the *Sepror* fair, excellent results. After a small explanation and delivery of the explanatory leaflet (Figure 10). The fairs wore showed familiarized to the process of the bucket Compost separator, taking advantage on average that 0.25 tons/day of organic waste per stand that would be destined to the landfill of the city, but if it were applied to more stands would considerably reduce the disposal in the landfill, which today is of the order of 4 ton/day.



Fig.9: a) Installation and production of the sepror fertilizing process; b): Return 20 days after the installation of the Bucket Compost separator, decomposition of waste, and the formation of slurry.



Fig.9: Primer delivered to fairs wore showing the assembly of the portable Compost separator, step by step.



#### IV. CONCLUSION

This work shows the results of a study on the five main free fairs in relation to the theme of the disposal of organic waste generated during its operation. The results showed that the analyzed produce a huge organic residue, on average these fairs generate 6 to 10 tons per day. sensitize them about the practices of EA. For, by encouraging by associating the fairs wore, they will feel more encouraged to participate in mini courses, and dynamics of EA.

From the results, a portable Compost separator system for individual use of each fair was developed, called a bucket Compost separator. The compost separator was tested at two fairs showing that: at the *Coroado* fair the project did not have good results due to the theft of the compost separator during the night, time that the fair is not in operation. On the other hand, at *Sepror's* fair the project had excellent results.

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# Influence of Granulometry of the Small Aggregate on the Permeability of Wall Cement Coating

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**Abstract**— The performance of the vertical sealing elements is determined by the level of protection to which they are subjected. Construction processes are changing and cementitious coatings are increasingly taking place among current construction options. On the other hand, the weather has its increasingly aggressive and more evident incidence. The performance standard sets the guidelines for seal manufacturers to meet expected quality standards. Given the above comes the importance of evaluating the best particle size composition to obtain the ideal mortar manufacture. Water transport mechanisms are the actors in this permeability process with the effective participation of diffusion and capillarity. The present study proposes observations about the water absorption of cementitious coatings manufactured with three sand granulometry (fine aggregate). The mixture containing the fine sand obtained the lowest absorption while the mixture with the highest grain size presented the highest absorption and the highest flow rates.

**Keywords**— Particle size, permeability and performance.

## I. INTRODUCTION

Masonry, like all building systems, plays the important role of building protection. The external environment is endowed with weather such as solar radiation, wind, rain and noise that generate various pathologies in the building affecting its integrity, therefore its durability. Therefore, the function of masonry, mentioned above, is to provide sufficient isolation of buildings with the external environment, to ensure the comfort and safety of its users.

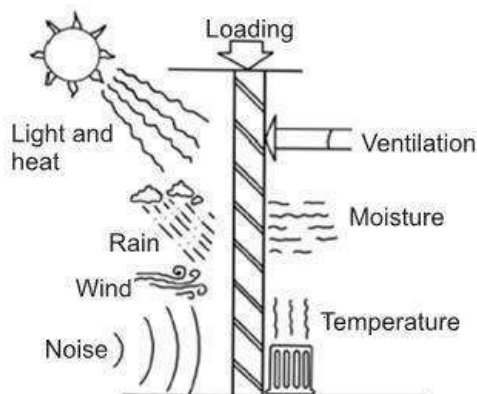


Fig.1: Protective behavior of masonry

Source: Polisseni

One of the biggest problems with buildings is the pathological manifestations caused by moisture. The

humidification of masonry can be manifested from rising ground source, rainwater absorption and penetration, condensation, due to hygroscopicity of materials and accidental. Among these sources, the most frequent sources are soil ascension and rainwater absorption and penetration (1).

Masonry is a building system with subsystems. The structure of the masonry is composed by the ceramic block materials and the mortar that has the function of bonding and gluing the blocks. Over this subsystem is installed the slat subsystem which has the function of creating a porous surface to serve as a bond to the plaster. The function of the plaster is to realize the protection of the entire system as well as confer aesthetics.

Plaster is an element made of mortar. Mortars are cementitious compounds made from binder (cement), fine aggregate (sand), water and additions. Because it is heterogeneous material its characterization is difficult and its structure is complex. Each of its materials has specific characteristics and properties that combine to give the product different properties (2).

One of these properties we can cite is permeability. The present term is used to characterize the conductivity of a porous medium with respect to penetration by a Newtonian fluid, considering that this flux has laminar characteristic (3). For such observation the permeability is

essentially dependent on the fluid properties and the permeation mechanism.

With the permeability evaluation it is possible to obtain some indicators such as: porosity, particle packing, pore moisture, mechanical resistance, cracking and others. The porosity of the coating is intrinsically related to its composition, its execution procedure and the curing process. Responsible for openings that allow water to penetrate, it directly interferes with the durability of the coating.

The porosity of mortars and consequently their performance is affected by the characteristics of the components used. The type of binder, the mineralogical nature and the grain size of the sands and any additions are some of these characteristics that should be observed in mortars.

The performance standard has the necessary prerequisites to guarantee the durability of the elements of a building. Not unlike this, the durability of masonry is evaluated on its aspects. Among such aspects, this standard recommends the sealing of the sealing elements, giving the coatings the ability to be more or less leakproof (4).

Understanding that porosity is influenced by, among other factors, the fine particle size (sand) particle size, the present work intends to analyze the influence of the fine size particle size that constitute the masonry mortar.

Among the various methods used by researchers, the burette method was chosen to be used. This method consists of the use of a hermetically sealed wall box with sufficient insulation and a graduated glass bar at the top. The function performed in the system is to ensure uniform pressure, showing fluid displacement. Such a methodology is suggested by the performance standard in Annex C of Part 4.

In order to achieve the objective thus set, considering the chosen methodology, the specific objectives were listed. The first objective was to model the different types of coatings for the analysis. For these coatings will be considered three particle sizes: thin, medium and coarse. The coatings were applied on an external masonry that is influenced by the weather.

The second was to build the burette box suggested by the details of NBR 15575/2008. This objective has a high degree of importance and determinant for the results, as it is not a material that was acquired ready, requiring to be made.

The third is to perform the simulations and record the data provided by the burette. The simulations were performed at time intervals: 1h, 2h, 3h, 4h, 5h, 6h, 7h and 8h.

The fourth objective was to analyze the data obtained with comparisons between the different types of coatings. In order to determine the real effect was applied variance analysis where it is possible to evaluate by the effect and residual graph the influence.

## II. BIBLIOGRAPHIC REFERENCE

### 2.1 Performance Standard

Performance standard NBR 15.554-4 of 2013 (4) seeks to foster concerns with the expected life, performance, efficiency, sustainability and maintenance of housing buildings. In summary we can say that it is the quality factor of the building delivered to the user that is in question.

This standard presents user requirements that must be met to promote safety, livability and sustainability. In safety the standard exhibits structural safety, fire safety and safety in use and operation. For habitability are presented items of weathertightness, thermal performance, acoustic performance, lighting performance, health, hygiene and air quality, functionality and accessibility, tactile and anthropodynamic comfort. In terms of sustainability, the keys to be observed are durability, maintainability and environmental impact.

For the Standard, in VUP (design lifetime) definitions, three key concepts are worked on: defects in system or element performance failure; ease of maintenance and repair in the event of performance failure; the cost of correcting the failure, including the cost of correcting other affected subsystems.

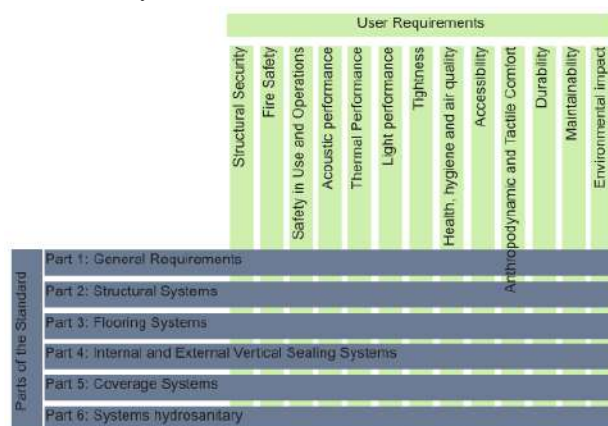


Fig.2: Standard Matrix.

Source: Own Author

Interior and exterior vertical fence systems (SVVIE) are defined by the standard as parts of the housing building that vertically limit the building and its environments, such as facades, walls or internal partitions. Therefore, for vertical seals the prerequisites and guidelines are presented

in Part 4: SVVIE Internal and External Vertical Sealing Systems.

The standard sets out in part 4, item 10, the requirements for water infiltration into sealing systems. As a main recommendation the standard makes it clear that fences must be watertight from rain or other sources. The standard goes on to explain that the seals should not have infiltrations on their inner surfaces that provide sprinkling or dripping or formation of adherent water droplets, and classifies the test conditions according to the regions of Brazil.

### 2.2 Moisture in buildings

The action of water is responsible for many damages found in buildings, often presenting itself as the main driver of some deterioration mechanisms. Sometimes only moisture causes damage, but in other cases it is combined with potentializing factors (5) (6).

The presence of water in buildings, for Solomon (7), is from the beginning of its construction work until the moisture generated by rainwater that penetrates through the building elements, through the absorption moisture and capillarity of the water present in the soil. Two other classifications punctuated by the author are condensation humidity caused by water vapors and accidental humidity generated by leaks.

The pathological events are the result of rainwater actions combined with the characteristics of the materials used in vertical fence systems. Observing the materials on a microscopic scale, one can see defects exploited by the waters. These pathologies that sealing systems present due to the presence of water shorten the service life and thus the minimum required performance.

The waters are pushed through the façade openings by forces resulting from the kinetic energy of raindrops, capillary rising forces, gravitational forces, and wind pressure forces (5). Rain is explained by the author as the most common agent to cause moisture because its main factors include direction, wind speed and intensity of precipitation.

Winds are also presented by Rodrigues (8) as the main agent of rainwater penetration in buildings. And it states that without the winds the rains would happen vertically, wetting the facades little. After taking an approach on the types of precipitation, Rodrigues explains that the wind puts pressure on the facades and generates water films on the surface of materials.

Bauer (9), describes that raindrops are deflected by variable air currents, i.e. winds, in order to change the downward trajectory and being inclined arrive at the vertical face of the buildings. The factor that determines

whether the drops are more or less deflected is their size, the author explains.

For Solomon (7), cementitious materials have small voids called pores. For Hattge (10), it is necessary for materials to have accessible pores for water molecules to penetrate, or cracks in the surface.

Solomon (7) explains that the interconnected pores form an internal network allowing water to pass through. Also, according to the author, they are hygroscopic and attract air humidity meaning moisture content. Thus, in addition to the pores the moisture content depends on the relative humidity of the ambient air. This relative air humidity, the author explains, is the ratio between air pressure and air saturation vapor pressure at the same temperature.

### 2.3 External forces and water transport mechanisms

The external forces are directly linked with the transport mechanisms since they are naturally the generators of large amount of moisture. The external forces acting on the façades are mostly and most significant from nature, that is, with or without the help of man will be present subjecting the cementitious coatings to various water transport characteristics.

The external forces to which the façades of buildings are exposed. The action of the wind that casts rainwater on the façades of buildings and the gravity that acts on surface water runoff are pointed by the author as external force agents (1). The author also argues that, when finding a crack or crack in the façade, water penetrates. Thus, to allow water to penetrate a building, the author presents three basic conditions: water on the surface; openings such as cracks and cracks; forces that push water through these openings. He goes on to comment that there are four forces pushing water: forces resulting from the kinetic energy of raindrops; capillary aspiration forces; forces of gravity; and wind pressure forces.

Studying the mechanisms of water transport in masonry, Monticelo (5) verifies water vapor diffusion, convection and capillarity. All observed mechanisms have two important actors: microscopic interstices in the material, i.e., failures in the microstructure of the material and the pressure caused by external forces.

Whereas for Sentone (11), water transport can occur by three phenomena: diffusion, capillarity and permeability. These phenomena, according to the author are determined by the porous structure of the materials and their driving forces.

### 2.4 Diffusion

Diffusion is the pursuit of equalizing the difference of two concentrations between two components. The



diffusion of water vapor is presented with a classic example, since it has happened between two gas mixtures: dry air and water vapor. When they come in contact there will be the transport of molecules that will happen until the concentration differences disappear (8).

The concept of diffusion in materials. Setting the definition, the author infers that there is a natural tendency for molecules to migrate from regions of higher concentration to smaller ones in order for equilibrium to occur. And it remembers that for the destination to succeed successfully it must be empty and in the migrating atoms there must be enough energy to break the bonds with the neighbors and generate the dragging movement (11).

And, it continues to define the factors influencing diffusion, as the phenomenon occurs in greater intensity for some materials than others. Temperature is pointed by him as the major influence on the process because it is able to provide activation energy for the process to be started (11).

Hygroscopicity is commented on as the property is related, by the author, to diffusion. He explains that hygroscopic humidity is a consequence of the diffusion of moisture in the air that passes into the material through the pores. However, the author distinguishes that humidity occurring in a short period of time, such as that occasionally found in bathrooms, has little influence on the humidity of the material. The author also recommends that, in order not to have problems with mold or mold in the materials, one should limit the relative humidity inside the buildings or be careful not to remain high for long periods (1).

### 2.5 Convection

Convection is characterized by the passage of water vapor molecules through the fluid carried by the relative movement of the particles of that fluid itself. When it comes to masonry, the author explains that it is a phenomenon that occurs mainly in hollow walls and that if the inner faces enclosing the air layer are at different temperatures, convection currents will arise that will carry water vapor to the surface. colder (8).

### 2.6 Capillarity

Rodrigues (8) explains that capillary absorption acts to suck water from the surface to the interior. After complete saturation the only way to continue transporting the liquid into the material is by differential force such as gravity and wind pressure. According to the author, the volume of suction water depends on the absorption force and pore size, so thin capillary pores suction little water with a high absorption force.

Whereas, the force exerted on the pores of the hydrophilic material is strong, i.e. the material is easily

wetted. The opposite of this is when the material has a weak water adhesion force, so it is more difficult for water to penetrate. This capillary absorption force, is commented by the author, as a result of the combined action between the surface tension of water and the adhesion force of water molecules on the pore walls. Finally, the author simplifies in his text saying that this adhesion force between water molecules and pore cavities are simple molecular attractions that normally the walls of materials exert (9).

### 2.7 Porous structure of mortars

The definition of porous structure, important for our study. For the author, a porous material is defined as one that contains interstitial spaces not filled by solid matter (pores), distributed in the solid or semi-solid matrix, or is defined as being permeable to the flow of various fluids, adopting the definition of porous material. permeable (3).

The author goes further by explaining that the porous structure of a mortar can be classified according to chemical, mineralogical and morphological aspects. And that such characteristics are dependent on the manufacturing process and the kneading process, the materials, the trace, the amount of water and the type of cure performed. Besides these commented points, for the author two other factors play particular relevance: the support and the application process, thus two mortars produced equally, will give rise to distinct hardened materials in function of these two variables.

In the work of Rato (3), a division of properties is still presented that separate the water movement conditions inside the mortars. For the author the properties are divided into macroscopic and microscopic. The macroscopic properties are porosity, the specific surface area, related to the intrinsic property of the material, and the permeability and diffusivity, related to the transport properties, already discussed in this paper. The microscopic properties are the porometry that relates to the pore grouping, and the porous network geometry that relates to the shape of the pores and the way they interconnect.

For the development of this work, it is important to be well defined that the property to be observed will be macroscopic, because it is related to porosity and is simple to measure, since the microscopic properties are more difficult to observe, need appropriate equipment. difficult to acquire.

## III. MATERIALS AND METHODS

### 3.1 Materials

#### 3.1.1 Cement

The cement used in the formulations of mortar cloths was Portland, named CP IV-32, manufactured by the company MIZU, widely traded in Manaus / AM. The cement was fractionated and stored in small quantities in a dry environment, besides being used within the expiration date.

### 3.1.2 Aggregate

The aggregate used in the production of mortars is mineral in nature and sold in Manaus / AM. The sand used as fine aggregate was taken from the natural dry land deposit acquired at the Arco Íris deposit.

As characterization of this material, the grain size test was performed to verify the distribution of the sand grain size, unit mass and specific mass. All tests will follow the procedures recommended by NBR NM 248/2003 (12); NBR NM 45/2007 (13); and NBR 9776/1987 (14), respectively.

For the preparation of mortars, the granulometric separation of the fine aggregate was performed in three strips by simple sieving. The fine particle size range of 4.8 mm to 0.05 mm shall be broken down into coarse sand (4.8 to 1.2 mm), medium sand (1.2 to 0.3 mm) and fine sand (0.3 to 0.05). The classification and decomposition of fine particle size was performed according to NBR 248/2003 (12)

### 3.1.3 Production of cementitious coatings

Mortar production followed the procedures described in NBR 7200: 1998 (15). Mortars with 1: 3 mass traits were produced for the plaster and 1: 5 for the plaster, considering the same a / c factor of 0.40.

The materials were mixed in an inclined shaft mixer with a capacity of 150 liters of mortar. So that there was no need to control the humidity of the small aggregates, they were put in the oven and dried for later weighing.

After the mortar manufacturing process, the masonry ceramic block coatings were placed in the external area, weathered and covered with roughcast. The fabric made of coverings has 105 x 135 cm and thickness for plaster 15 mm and plaster 20 mm.

### 3.1.4 Testing Equipment

The permeability test consists of subjecting a certain section of the wall to the presence of water under constant pressure, with the aid of a coupled camera.

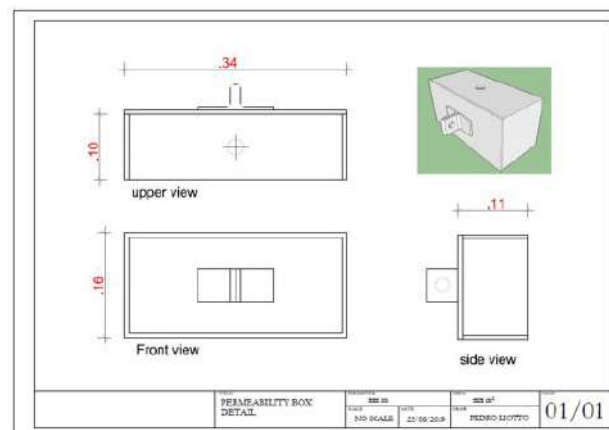


Fig.3 - Detail of the glass box for the test.

Source: Author

Annex C of Part IV of the Performance Standard sets out apparatus. The standard determines which flat dimensions, for example 34 x 16 cm, but because it is a box does not make clear the depth dimension. Therefore, it was adopted 11 cm with 8 mm glass plates. The material used for sealing between glass and the glass / mortar contact surface is silicone glue.

In the upper part of the box was made a hole of 11 mm in diameter that aims to fit and fix the graduated beaker. The box detail can be seen in the following figure.

### 3.1.5 Performance of the test

After the coatings were performed, the equipment was fixed to the face of the coating with the aid of silicone glue and pedestal. The curing time of the silicone glue was respected so that the box was perfectly sealed to the wall.

Then water was added to the system and introduced by the graduated pipette. The volume of water was determined by the volume of the box plus the pipette-formed water column to the 5 ml mark.

Pipette water column measurements, as stated above, were performed every hour from the first hour of the test: 1h, 2h, 3h, 4h, 5h, 6h, 7h and 8h. The assay was repeated three times, thus obtaining 24 results from each coating cloth. In order to prevent each trial from interfering with the one performed previously, an interval between each three-day repetition was determined.

## IV. RESULTS AND DISCUSSION

### 4.1 Characteristics of materials

The following figure shows the particle size distribution curve of the sand fractions. It is possible to observe that the sand well graded and without discontinuities has the largest portion of the grains between 0.2 to 1 mm.

Table 01 sets the values of specific mass and unit mass. It can be verified that the acquired sand is within the

acceptable normative limits. These data show the degree of importance of the study, because from the data are traced the traces and the determining factor for the manufacture of mortars is the paste content.

Table.1 - Test of specific and unit mass of minute aggregate.

Feature. (kg/dm <sup>3</sup> )	Test Method	Fine aggregate (natural sand)
Specific Mass	NBR 9776	2,60
Unitary Mass	NBR 7251	2,49

Source: Author

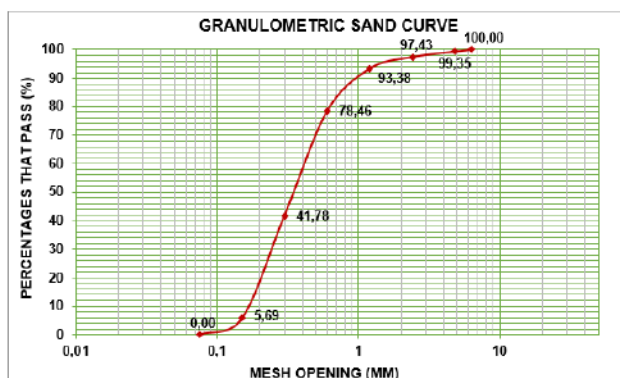


Fig.4 – Granulometric Sand Curve.

Source: Author

#### 4.2 Absorption

The average results of the absorption measurements are expressed in Figure 04. This shows the variation of the absorption in the different mortar productions. The measurements made on mortars made of fine sand are represented in the blue curve and triangular markers. The orange curve with square markers represents the average curve of mortars made from medium sand. Point markers represent the means of absorption that the coarse sand mortar obtained in the test.

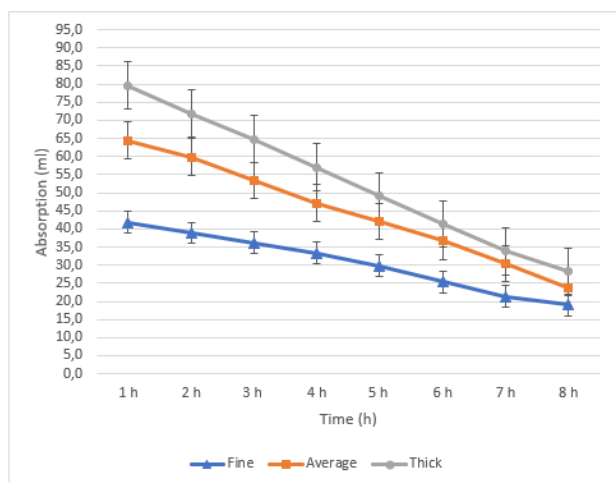


Fig.5 - Mean absorption measurements

Source: Author

The first observation to be made from figure 05 is the absorption of mortars with fine sand. These obtained lower absorption rates, thus being indicated with the best absorption results and therefore better masonry protection against water permeations. It is also possible to infer that the absorption rate is being reduced over the hours, this effect occurs because the coatings over time become saturated. Slight variations between absorption rates are notable. It can be observed that between the hours 5 and 6 was registered the largest variation displacement in the water column, being of the order of 4.5 ml / h. Explained by the transport mechanisms, because imagining the pores as conduits for transport, it is observed that as they are infiltrated, other pores are reached giving different flow rates. Mortars made with medium sand during 8 hours absorbed 22.83 ml.

By analyzing the average absorption curve of the mortars manufactured with medium sand, as shown in figure 05, we can observe, in general, that the absorption was higher than in the fine sand curve. The medium sand mortars had total absorption during the 8 hours of 40.83 ml. Also, the absorption rate is decreasing over the hours and it is possible to notice small variations in the absorption differences, being remarkable that there is no constancy in the absorption. An important factor to note is the amount of total flow absorbed. The average sand mortar curve has a higher flow than the fine sand mortar. This is due to the fact that it has a larger porosity allowing greater water flow through the transport mechanisms.

Figure 05 also shows the curve of mortars made of coarse sand presents characteristics similar to the other curves. However, it is possible to notice by observing the differences between the hours that there is a smaller variation than the others. This can be explained by the difficulty that water has to saturate the pores left in these mortars. Parallel to this the observed flow is the largest of all types of mortars. The highest peak flow recorded was on the order of 8 ml / h and occurred between the 4th and 5th hour.

Figure 06 shows the Pareto Global Average graph. The tendency that the isolated averages already represent is the tendency to decrease the absorption over time. It can also be seen from the graph that the 50% portion of water absorption happens on average at 3 o'clock, i.e. just before half the time.

Figure 07 shows the curves of mortar averages and also the global average. It can then be observed that the global average is very close to the curve of mortars manufactured with medium sand.

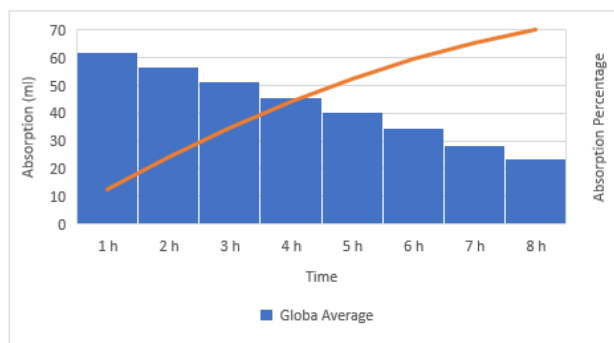


Fig.6 - Global Average Pareto Chart

Source: Author

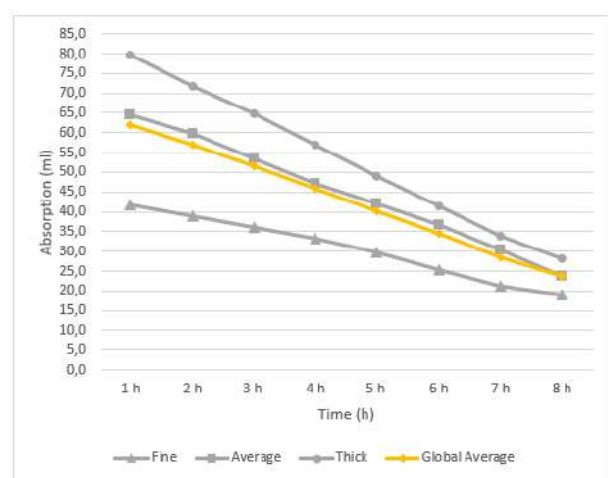


Fig.7 - Global mean absorption

Source: Author

## V. CONCLUSION

The tests were carried out with maximum control and the results found clearly convey the effect that fine particle size exerts on mortar production and in particular on porosity. It is clear that the coarser sand produces more pores than fine sand and that these pores more continuously allow larger water flows through the mortars.

The different flow rates observed in mortars are directly related to the transport mechanisms, with highlights for diffusion and capillarity. Diffusion can be pointed as a determinant for more constant flow in coarse sand mortars. The capillarity generally present in all is more evident in the fine sand mortar.

The present work contributes to the clarification of the importance that mortars have in the protection of the vertical protection systems of buildings. However, further work is needed to continue the study.

The mortar porosity test is a very important test that must be developed to be added to the knowledge acquired with the present.

## ACKNOWLEDGEMENTS

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# Creative Art as a Door and Window for Children's Expression

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**Abstract**— This study aims to understand the creative art for the development of children's expression of a socio-educational institution of Itajaí-SC. This is a research of qualitative approach, with methodological proposal in phenomenological hermeneutics, and it was developed in 10 workshops about creative art, in the educational institution Lar Fabiano de Cristo, located in Itajaí-SC.; the research subjects were 30 children, between 8 and 10 years old. As for the comprehension of the results, it was evident that in the creative art children broadened the sensitive and understanding look at life, education, health and nature. Theoretical-practical interactions occurred with expansion of creation, lovingness, self-esteem, respect, perception of self and others in cultural connection and social belonging.

**Keywords**— Creative art. Expression. Children. Fabiano de Cristo Home. Itajaí.

## I. INTRODUCTION

Creative art is an expressive activity that reveals the subjectivity and objectivity of emotions and thoughts in various languages of body communication, in different artistic expressions of drawing, painting, modeling, among others. Its potential is the ability to create different objects and perceptions in the inventive process in which the subject recreates his/her world of understanding.

In the art of drawing (image 1), expressed by children, the door and window are two metaphorical structures that represent the opening of imaginary expression for sensibility and rational thinking development, considering, according to Maturana and Verden-Zöller (2011), that the human being lives in learning experiences in the intertwining of language and emotion, that configures the conversation and that goes beyond the oral language itself.

Reinforcing this argument Maturana and Verden-Zöller (2011) state that creative thinking occurs in learning to learn, in human being's autopoietic process in which emotion, sensation and reason do not separate. When we talk about metaphors, it is possible to create images with meanings in the child's life, for example, the door and the window that are symbolic images related to the dwelling house of being as a body in action in time and space of the movement of its consciousness.



Picture 1: Door and express window

Experiences of this order provoke organizational and relational processes to broaden the look at oneself, at the other, at culture and nature. We correlate with a structure that enables different openings, such as the movement of human being's organization in its cognitive vital process, which expands the transcendence of skills in different dimensions and educational contexts. It is also possible to favor conditions that are determinants to health, such as access to formal education, leisure, habits and interpersonal relationships ways.

The sensitivity stimulated in art sought to favor countless sensations and perceptions of the world in child's consciousness development. In the individual and collective movement, we interfere in the historical, social,

cultural and spiritual context in which various expressive and creative practices are promoted. The contact with art favored the passage from creation to recreation in the search for understanding coexistence and desires to live in social and personal harmony.

The experiences lived by the children mobilized the artistic conscience for the critical, reflexive and creative action seeking for transformations and extensions of the focus of action in the educational environments. The practical proposals involved transdisciplinarity as “an interactive and dialogical look at reality, which manifests itself in multiple forms and levels, based on the observer's understanding and intentionality.” (TORRE; PUJOL; MORAES, 2008, p. 13-14).

In this theoretical-practical study, in the phenomenological approach, we aim to understand human action as a door and window for opening and expanding human relations, the look, the feeling and the expression. Proposals made in the dynamics of a dissertation study that allowed deepening scientific studies and transcending human structural and biological aspects, developing conscious action for expressiveness and creative capacity.

Art has been involved in practice as a skill and product of human creativity that explores techniques, styles or personal skills. Through it we seek to mobilize the creative act and the perception of the world. From ancient times, artistic expressions correspond to the psychic expression of the community and, particularly, of each individual. Consider the importance of cave paintings for communication between men. Art “communicates its relationship with itself, with the group to which it belongs, with nature and with the Divine in an integral way” (ESPINDOLA e DITTRICH, 2015, p.19).

The perceptive opening movement instigated the organization of knowledge and the creation, reflection and expressiveness to redefine the perspectives, dreams and goals that children had. Initiating this movement, by opening the doors and windows, participants expressed a desire to broaden their daily gaze and understanding of the world. Contacts were desired for social life and the search for reflection of their capacity and responsibility in their projects' implementation.

## II. METHODOLOGY

Qualitative approach research, theoretical-practical, with methodological proposal in phenomenological hermeneutics for data comprehension. The investigation took place through the holding of creative art workshops at the Lar Fabiano de Cristo socio-educational institution, located in Itajaí-SC. The research subjects were 30 children, between 8 and 12 years old,

participants of the project. Within this investigative proposal the data collection was done in 10 (ten) theoretical-practical workshops.

In order to activate the imaginary and the real, two activities were offered to represent the future. The first activity was the representation of a door and a window; the window represented the look and desire for the far future, and the door represented what they expected for the near future. At the same time, the construction of the “book of the future” occurred with the records of future visions correlating with the present world.

The activities involved contact with artistic resources and creative expression with clay, free design, folding and collage. They were organized in the Transdisciplinary Circle of Integral Health - CiTranSi, a technology mentioned in the procedural methodological organization in Dittrich, Bernardo and Barreta (2012); Dittrich, Meller and Giorgi (2013).]

The methodological organization of the workshops was supported by Dittrich et al. (2016, p. 178-179), which present the three organizational movements: **1) Environment Preparation:** The environment was energetically prepared to receive the participants with a welcoming purpose of loving life, with the symbolic organization of the objects arranged in a circular way in the “Wheel of Health”. Poems, songs, visual messages, aromas and expressions in different languages were chosen. **2) Preparation of the transdisciplinary team:** Concentration and energizing activities of the cognitive vital processes of the transdisciplinary team (teachers and students) were carried out through dialogue. Attention and awareness in the purpose of work and expression were stimulated, with body movements to reinforce concentration, individual awareness and interactivity of all those involved in educational actions, for welcoming listening and possible interventions. **3) Circular movement of integral health:** The participants/children were welcomed with everything the team prepared. Transdisciplinary educational actions were carried out with several integrated practices, expanding the creative, reflective and problematizing being. Involved: – **Children's reception:** The dialogue took place with a loving welcoming posture and all sit in a circle forming a symbol of a integrative and complex, creative and intelligent vital-cognitive unity, in their different personal knowledge and feelings. Dynamics involving expressiveness and various forms of body language are performed.; - **Specific theme presentation:** activities that mobilize the access to knowledge, the vibrational interactive reflection of the specific activities in the creative art and the involved knowledge that each one

presents. Subjects related to the human being, life, health, science were involved, aiming at self-reflection for health education, the elevation of self-esteem and discovery of meaning of life. There was the exploration of various resources in painting, drawing, sculpture, writing in order to mobilize the perception of the space of belonging in the group relationship and creative potential in educational practices that provide knowledge, attitudes in thinking and living together.; – **Reunion of integral being in health:** This happens in the resumption and continuation of “Wheel of Health” dynamics when everyone in a circle expresses the resignification of the thematic knowledge involved. The purpose of this final activity involved the energetic flow harmonization of the psychobiological, psychic, spiritual and social dimensions, aiming at the awareness of the being and its condition, awakening to the creation and deepening of social ties, affective and knowledge about reality, but that can bring meaning to life. (emphasis added).

### III. DISCUSSION OF THE DATA

In creative art expression practices, freedom was an element for interaction and autonomy involved in different languages. Children expressed with diverse resources, in their singularities and desires, constructions in different contexts. There were practices aimed at the relations to the self with the other in culture and its deepest layers of expression, in a proximity of respect and love to life.

At the first moment, in disposition to draw the door and window, children exerted an action of “themselves”, of their desires, transcending to a collective and social action. They participated in the organization, thus acquiring a feeling of being a designer, with belonging and protagonism of their desires to live history, as subjects of their own existence. This projecting for the future, for widening the opening of the door and window, and looking in different directions, favored children’s attitude of to see and perceive the world. The child’s speech (1) expressed the meaning of the created image: *“I made the window really big because I want to see things out there”*. The personal entry into the house, the feeling of the body that establishes actions of opening and expansion of its capacities allowed to recognize the organization and construction can favor personal potentials and access.

In the contact and connection with the real and imaginary world, the enigma of visibility was greatly favored in observation and learning, with creative actions of artistic expression, of the artist mixed with his art, in the potential of self-creation, because

The pictorial depth (as well as the height and the painted width) comes, it is not known from where, to stand, to germinate on the support. The painter’s view is no longer the look on an outside, merely “physical-optical” relationship with the world. The world is no longer before him by representation: it is rather the painter who is born in things as by concentration and coming to himself from the visible. [...] (MERLEAU-PONTY, 2004, p.37).

To stimulate the artistic movement of attention and openness to the real and desired world, the workshop called “Present and Future - Door and Window” focused on the purpose of attention to the present/near future, in the figure of the door, and for tomorrow/farther future, in the window picture. The activities promoted the recording of perceptions, worldview and the recognition of reality, re-signifying existing perspectives and dreams that can be achieved individually and collectively. For, “[...] early or late, spontaneous or formed in the museum, his vision in any case only learns by seeing, only learns by itself. The eye sees the world, and what the world lacks to be a picture, and what the frame lacks to be itself [...] (MERLEAU-PONTY, 2004, p. 19)”. In the field of human vision, as potential for registration and meanings, picture and world become intertwined.

In the door and window illustrated subject and object mingle in the work, the feeling and thinking were recorded and dimensioned the possibilities of seeing and thinking life, care, real goals and symbolic potential to desire. The body is connected to the world in the interaction and dynamics of perceptual phenomena. In painting, desires and thoughts expressed, the subject and object established fusion, the perceptions that were recorded and triggered others evidenced that in perceiving the world I also perceive myself. There are processes of self-organization and self-care.

Heidegger (1995) names the “being” of man as a care, referring to the self-protection that is always exerting on his own existence and that of his world. It is not a controllable attitude, but the result of understanding and transformative action. Care involves reception, support, recognition, attunement and the search for senses and meanings involved in the health and life situation. In the wishing words of a participant child (1) we hear: “[...] *more love in the heart*”. This was a personal and collective desire for coexistence that involves care.

The importance of love, peace and respect in living together has been expressed for nowadays. Among the real understandings presented, we can mention the

relationships of self-care, love of neighbor, health, education and the dialogue established between children and educators. The love that creates and lovingly recreates everything and everyone becomes vital for the practice of care, as for Dittrich (2010, p. 163) is it that:

Dignifies the human being in his way of being in front of the other. It makes the child-body recognize itself as human in its uniqueness and subjectivity towards the other. This experience develops a way of understanding the other as a child-loving being capable of establishing the most diverse relationships and unpredictable changes in existence.

Contact with art and looking at life tenses existential and desiring being, expressions through drawing involved actions and feelings that when registered became personal and social goals. For Espíndola and Dittrich (2015), art, besides fulfilling its social function, also fulfills a therapeutic-scientific function by flowing the creativity of the human being. Pain (2009, p. 47) highlights that "the goal of therapy through art is to restore to the body the right to emotion and to feel the world, to become the subject of passion". In art, human beings find the space they need to positively express their dreams, projects and personal desires.

In creative art it was possible to perceive the expression of a child (2), with his wishes for the near future "[...] to be a model, to have a boyfriend". And your dreams and projects for your farther future "[...] work, have a child and a husband". These were desire relationships that involved cultural patterns and that required reflection in order to review the experiences and desires of being a child that needed to be resumed and valued. The notions of productivity-focused life goals are early understood by our children. We have not heard expressions of actions consistent with the ages and purposes of living childhood as the near future.

It was possible to identify that human life has a profound significance, but today is hardly a lived experience. The human being needs to make sense of his/her life, and it is this ability that makes him/her different from other beings, but consciousness projects little to the here and now as an existential condition. Faced with these difficulties, expressions through the art of drawing have tensioned this more present and existing look of the human being. For Jung (1991) when "artistic techniques" such as painting, modeling, composition, drawing, collage, literature are used, they provide the effusion of creativity that, by making artistic, promotes the

production of symbols. It revitalizes and rearranges the consciousness of the individual, that is, the way he/she experiences his/her inner and outer world. "The creative process consists (as far as we can follow it) in an unconscious activation of the archetype and an elaboration and formalization of the finished work" (JUNG, 1991, p. 71).

\*Several meanings and senses have been manifested which, for Giovanetti (2002, p. 98), "can be expressed through the meaning given to an action, or through the direction, the direction given to life". Given this, another child's speech (3) made reference to life and the near future: "*I wanted to be a dancer*". To the farther future: "*I wanted a 15th Birthday Part, dance and have a child*". To the child (4) "[...] *I will be a soccer player, I will study, have good thoughts, good nutrition, exercises, love others, love myself and good companions*". These were desires that involved expressions in their purpose of being, having and living, and which were broadened to social, educational and cultural values. For Morin (2000, p. 93) "the properly spiritual mission of education: to teach understanding among people as a condition and guarantee of intellectual and moral solidarity of humanity."

At first, the children in their creative artistic expressions, evidenced the evolution of a look more focused on material and consumer goods and advanced to a greater achievement of personal fulfillment and educational formation for health, human values, acceptance and belonging.

Promoting expression through illustrations was an opportunity to activate human sensitivity to their living conditions and desires to be and live. The appreciation of conditioning factors for well-being and health became evident in relationships with food and self-care, and the love involved in peace. As a relevant factor, the attitude of overcoming was broadened with emphasis on "*I will be*" and "*I will do*".

The relationship between the intentionality of being, creative thinking and the images expressed in the works qualified relations of the child's creative thinking. The imagination expanded and was strengthened in the intersubjectivity of the creator-work-world relationship. "In children, creativity manifests itself in all its loose, diffuse, spontaneous, imaginative making, playing, dreaming, associating, symbolizing, pretending to reality and which is basically nothing but the real. To create is to live for children (OSTROWER, 2014, p.127)".

In the manifestations are the growing appreciation and awareness of being vital, healthy, values, positive social attitudes, social inclusion, lovingness in individual and collective attitudes, which can be observed in speech



and creative expressions. In this sense, Souza (2012, p. 35) points out that “this same conscience gives you the perception of social, cultural and moral values, among others, which condition and, at the same time, give meaning to your way of living”.

Sensitivity in creative art is raised to a deeper look at the child's being and living together. For Ostrower (2014, p. 12) sensitivity "represents a constant openness to the world and connects us immediately as it happens around us." It was possible to identify that the sensitization and awareness of being a child in their weaknesses and creative capacities is fundamental. Desires and attitudes start to compose the look at oneself and the other, favoring confidence in expressive potentialities, alterity in relationships, with a notion and respect for differences.

The perception of adopting tasks in contact with the nature and care of it was an advance over the limited desires in consumer products. Humanizing habits and understandings were possible because "at any given moment in our lives, creativity seems to flow almost on its own and endow our imagination with a power to immediately grasp new relationships and possible meanings." (OSTROWER, 2014, p. 55).

The ecoformative connection was a great advance in the relations that humans establish with nature. In this sense Suanno (2014, p. 175) highlights that:

Ecoforming is seeking to promote, build education for sustainable development associated with an education of solidarity, of commitment to the planet and all its inhabitants. Developing an environmental education, it also pays attention to human rights and peace. An education that promotes interactions between the environment, social progress and economic development. This means thinking about the preservation of life and providing adequate conditions for everyone, creating a healthy, welcoming and preserved environment. It is supposed an educational work based on interrelations, aiming at the attainment of three objectives: economic development, social progress and environmental protection for all living beings and the development of humanity.

The future is a projection of the creative imagination that involves desires, life goals and vital feelings that strengthen the desire to live fully. Establishing body contact in art was a fusion of human with nature, expanding the desire for contact and living.

It was possible to identify through the children's speech how “[...] the goals, values or ideals express the direction given to life. All life must have a course, which upholds the meanings of the acts I do every day” (GIOVANETTI, 2002, p.98). It is possible to see in creative expressions the awareness of their capacity, the decision to turn their lives around, looking at existence as a constant projection of goals. Giving meaning to existence with the construction of a life project involves an authentic reframing, especially the strengthening of social relations.

By strengthening the meaning of life, we also favor health, in this context Meller et al (2016, p. 152) advocate that:

When the proposal is to promote health, strengthening the self-regulation dynamics of human beings in their interactions with themselves, society and nature, it is necessary to consider the construction of ways of thinking and acting that favor qualitative actions for the languages perceptions of blossoming with meanings pointing possibilities for choices involving mainly lifestyles for good healthy living.

In the narratives of their happiness projects and for the future, children had as reference the lived experiences and values that positively guide the construction of their health conception. Both conceptions of health and the happiness horizons helped so that personal projects were conceived, valued and recognized. With that, the participants re-signified the meaning of their existence. Heidegger's (1995) existential ontology manifests the expression “care” to refer to the relationships between projects and human ways of being with the ways they understand themselves and their world, as well as their ways of acting and interacting. .

It was the construction of existential projects instigated in creative art that allowed children to establish a link between their way of being, living and their health. They began to employ connected meanings in doing, looking at their doubts and questions about life. Expressions such as: “*take care of love, love with you, love your neighbor*”; “*Take care of yourself*”; “*take care of health*”; “*Love yourself*”; “*Happiness*” and “*happiness for all*”. These records led to the understanding of their life projects elucidation and their resignifications.

Open doors and windows in the involvement of the whole being demanded life force and expanded the creative processes and the sense of living,

In the process of creating the artwork, child love manifests itself in the biopsychological as an integrating force of vitality for the child body to be; have the courage to create and express the feelings, emotions, imaginations and reasons that he/her often does not know what they are and why they manifest in the child's body. Vitality, in the full sense of the word, is human because human being has intentionality. (DITTRICH, 2010, p. 191-192).

During life, listening, silences, gestures, looks and touches can say a lot. The human being is in need of listening and dialogues involving diversity and expressiveness. Experiences in art have made it possible to broaden the worldview and many challenges have been required in activities with children opening doors and windows as fields of view of the world.

#### IV. ART FAVORING PERCEPTION

Artistic practices guided a broader view of human being and society, with links outlined in human ecology and other issues related to life. In the continuous exchange of knowledge, many fields of vision have been expanded, because for Merleau-Ponty (2004) vision is dependent on movement, since without any eye movement, vision would be limited.

Enabling the look to today and the future with the understanding of the purposes of living art was the mobilizing force to open doors and windows. For Merleau-Ponty (2004, p. 16) "[...] it is necessary to rediscover the operating and acting body, that which is not a portion of space, a bundle of functions, which is a twist of vision and movement".

It was by mobilizing the expression of the possible art in the creative body that the look at the world was expanded and favored the social, emotional and intellectual development, seeking the cultural and human understanding that guaranteed the reflection on the meaning of life, values, rights and duties. Favoring the visibility and giving voice to the children allowed the expression and valued their desires and realities.

The children's expressions showed lived and practical relationships with many ecoformative meanings, the art that presents life was modeled.



Picture 2: Art with clay.

Source: Authors Personal Archive.

In the hands that express life, consciousness presents dynamics, redefining the doings and learning. One activity that children developed was the planting of vegetables and teas in the garden, in a mandala format, and this practice was represented in the expressive art of the lived experiences, when it was modeled in clay (image 2). Evidencing the methodological proposal, expressed by Dittrich, Meller and Giorgi (2013), it is a search for integration of vital processes and broader vision of human being and society, understanding that thinking and acting is in the complexity of relationships, with the rescue of citizenship.

In the planning of creative art workshops, a path was conceived to involve children in a movement of opening consciousness with a broad dimension of feeling and knowing in the experience. Espindola and Dittrich (2015, p. 19) consider that spontaneous art has the characteristic of giving real existence to the objective and the subjective of the creator and the contemplator. This can occur consciously or unconsciously, "intentionally or spontaneously, engendering the enjoyment of flows of feelings, emotions, learning, concrete and/or virtual experiences that belong to it."

Art is part of life as a way of expressing internal and external processes. It is also the oldest form of mankind's language. In art is the connection of the inner world with the outer world of the subject, and the path to this connection is the dimension of the symbols and the senses of the inexplicable poetry of life. When art is combined with creativity, which Ostrower (2014) defines as a "potential inherent in man", the act of creating shaping something new that stimulates the imagination and the development of new relationships arises. Art also

promotes new meanings about experiences and their contents, enhancing the ability to understand the world and allows us to visualize things in a new way and helps in the construction of new interpretations and conclusions.

In this purpose, creative art was promoted with children to raise awareness in human relations. Children's creativity emerged in interaction and greater freedom of action. As pointed out by Dittrich and Dittrich (2017, p. 210) "through art, expression of creativity, human beings release their emotions from internal conflicts and images [...]". Art gives vent to the manifestation of its own subjectivity and in this sense, "the creative act therefore encompasses the capacity to understand; and this, in turn, is to relate, order, configure, mean". (OSTROWER, 2014, p. 9)

Stimulating creativity requires complexity of thinking to see beyond the objects offered and their possibilities. Through art arises the opportunity for social acceptance to create, recreate, do, undo, start over, as an integrated act of human living, for "In fact, creating and living are interconnected". (OSTROWER, 2014, p. 5).

Creative art was a space for art production, socialization, artistic being and self-care expression. It was possible to conceive a learning space in a broad sense, involving daily life and existence as essential in human formation.

During the reading and presentation of the works it was observed that the activities resulted in a process of building a project of life and happiness. For Suanno (2013), as a support for facing the external reality, one must first work to face the internal reality, where are the scares, concerns, fears and weaknesses. It is necessary to accept, favor and desire for internal changes to happen.

The search for understanding about being and doing directed children to an experience full of desires and achievements. Both the door and the window were full of meanings and senses, as they have visual, acoustic and topological functions to unite or isolate environments. The same room or environment can be isolated, calm or shy, with the door and window closed. However, when they are open, the room becomes accessible, circulating, noisy, energized ... The choice between one and the other means movement, that is, acting on the environment, acting on themselves, their historical context, cultural, social and spiritual. These aspects were aggregated and revitalized in the practices performed.

The encouragement not to passively admit to the environment was important, as children began to intervene in their daily life, with transformative capacity, creating a variety of pleasant climates and situations. They became

resilient, became aware of their body and the importance of present and future different fields of vision.

## V. FINAL CONSIDERATIONS

Many doors and windows have been enlarged and opened in the imaginary taking of the consciousness of each child involved in the meaning of their existence, in the learning and development promoted in lived experience. In the mobilizing practices of creative art it was possible to broaden the symbolic and real relations of the desires and constitutions of life, expanding the affective and constructive relationships for interpersonal life. Children artistically included, became more active and expressive in creation and committed to the principles of harmonious coexistence in expressive actions.

Practices provided the opportunity to open up knowledge in a continuous way that was strategically planned for the creative art expressiveness. In the driving force of this dynamic opening doors and windows, that is, projecting themselves into the future, children have established connections between space and time. They created perspectives of diverse interests, uncovered enclosed spaces and shared freely. This possibility of freedom and participation broadened and reinforced the sense of autonomy and responsibility towards their doing and living, recognizing the truthfulness of our own experience.

It was looks and perceptions that strengthened future purposes, and the importance of being cared for and welcomed, as well as caring for and welcoming others. This form of care was sustained by the expanded vision of education and also human health, both views focused on the integrality of being.

It was possible to identify the evolution of an entire human being in constant metamorphosis of its essence, with flexibility, confidence, tolerance, empathy, positivism and respect for the self/others/culture/nature. This evolution took place through movements of exchange and construction of knowledge, in a dynamic process of opening. Attention to care in creative art as a therapeutic process was consolidated as a driver of this dynamic strengthening. It was outlined as an important way for the development of children's health care and for the consolidation of a more humane and fraternal society.

The experiences enable relationships to understand the symbolic languages expressed in various representations created through art. Psychic energies go through a conscious opening movement and materialize in symbolic images. In creative art, possibilities were offered for children to show their uniqueness and creative dimension, expanding their ecoformative knowledge. This

has resulted in human formation focused on the relations of the self with the other, the self with culture and the self with nature, since human formation inhabits between the subject and its deepest layers of expression, in a proximity of respect and love to life.

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# Evaluation of Tropospheric Ozone concentration in two Urban Roads of Manaus - Am

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**Abstract**— This main objective is to evaluate the concentration of Ozone (O<sub>3</sub>) in the low troposphere of two main urban roads of Manaus, thus identifying the possible impacts of this element on human health and the environment. For this work, weekly data were collected in September, a period characterized as dry in the region. The data were treated according to the hourly average of the concentrations that were established from 10 to 15h UTC, based on the values collected by RESOLUTION CONAMA 491/2018 that presents the criteria of air quality standards. The results demonstrated high peaks in the ozone concentration, but were within compliance, since in most of the monitoring time the concentrations were in accordance with the legislation in force.

**Keywords**— Tropospheric ozone, air pollution, air quality.

## I. INTRODUCTION

Population growth contributes directly and indirectly to increased air pollution through ozone (FERNANDES, 2017). In recent years with the intensity of anthropic activities the air quality in large cities has become a problem, because fleets of vehicles in circulation on the streets of cities have multiplied, causing concern about the issuance of pollutants launched into the atmosphere, the gases generated by industries and the burning of fossil fuel by automotive vehicles has been causing damage to public health (SILVA 2014; PAZZAGNOLO 2013).

Costa (2015), describes that tropospheric ozone is a secondary pollutant formed in the atmosphere and naturally developed in the stratosphere by the photochemical action of ultraviolet rays on oxygen molecules, the gases that combine for this process are nitrogen oxides and carbon. For Pazzagnolo (2013), the formation of ozone from the burning of fossil fuels, gases emitted by industries and fires, forms caused by anthropic actions, but has the natural means of emitting gases such as natural fires and volcanic activities.

Ozone is a gas that has multiple functions in the atmosphere according to the altitude at its time, in the stratosphere is considered a beneficial gas because it filters ultraviolet radiation of type B (UV-B) that are harmful to living beings (PACHECO J., 2018). However in the troposphere ozone loses its protective utility and converts into a polluting gas in which it is responsible for increasing surface temperature, grouped with carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (BRANCO et. al., 2013).

Vehicles and industries launch into the atmosphere a large amount of carbon monoxide, which alone is not such a dangerous pollutant to human health, but on the other hand, when interacting with solar radiation, a photochemical reaction occurs occurring in transformation for tropospheric ozone (COSTA, 2015; PAZZAGNOLO, 2013; SANTOS et. al., 2016). This interaction was shown in Alabarse (2016), which states that ozone is a very harmful pollutant to the health of the population, while Silva (2017), presents ozone as the main pollutant causing respiratory disease problems. According to the Ministry of Health diseases such as: bronchitis, asthma, allergic rhinitis, lung cancer, ischemic diseases that cause the infarction have grown as well as exposure to O<sub>3</sub> throughout the country especially in urban centers and states where it has a high rate of Burned (OMS, 2018).

Due to the probable effects of ozone on health, Silva's (2019) and Silveira (2019) studies showed an evaluation of ozone concentration based on CONAMA Resolution No. 481/2018, where limits are determined in relation to exposure to O<sub>3</sub>, both considered the importance of the values established in this.

According to CONAMA Resolution No. 481/2018 establishes values for ozone concentration that is 140 µg/m<sup>3</sup> at an average of eight hours per day, for world health organization (WHO) the defined value is 100 µg/m<sup>3</sup>.

This article will show a study in which evaluated the concentration of O<sub>3</sub> in two avenues of great circulation of vehicles in the city of Manaus / AM, presenting differences in the afforestation of them. At the

same time, it was possible to analyze the impact of vegetation on the concentration of pollutants.

## II. MATERIALS AND METHODS

For the realization of this research, two urban roads of Manaus / AM were selected, in which both have a greater flow of vehicles in circulation. Avenida Brasil where data was collected near the Children's Emergency Room that will be called study area 1, this has a variety of vegetation as shown in Figure 1, and Constantino Nery Avenue that was collected in front of fametro college characterized as unit 3, called study area 2.



Fig.1 – Study area 1, Avenida Brasil.

Source: Google Earth, 2019.



Fig.2 - Study area 2, Constantino Nery.

Source: Google Earth, 2019.

Data were collected on days 09, 12, 16, 19, 23, 26 and 30/09, with the exception of day 03/10, which occurred precipitation record which made it impossible to measure. Thus, the measurements were carried out during four weeks during Mondays on Avenida Brasil and Thursdays at Constantino Nery Avenue, at the time of 10 to 15h UTC. Measurements were performed 10 minutes before and after full hour, in an interval of 2 minutes. Additionally, the measurements were performed at a predetermined fixed point on the two avenues where there is a greater flow of

motor vehicles, this regime occurred during all the days when the collections took place. Two equipment was used, the Term – Hygrometer used to measure humidity and temperature along with the pom portable meter (Personal Ozone Monitor) this measured the concentration of tropospheric ozone and pressure on both avenues. The Term – Hygrometer is an equipment that has the following features, LCD display, dimensions 130 x 7 x 18mm, power 1 AAA battery, weight 150g, a cable that measured approximately one meter and function °C and °F.

The POM device has dimensions of 4x3 x 1.5 inches and passes only 0.8 Ib/ 1.0 Ib without/ battery (360g/ 450g). The POM was established by the U.S. EPA as a federal equivalent method (EmF) for O<sub>3</sub>. The mechanism used was the same for the two equipment, the POM and term were connected – hygrometer these were connected for 1 minute for self-calibration past the minute began measurements. First the POM was used after the Term - Hygrometer, this process lasted on average 2 minutes for each device.

The collected data were recorded in a table covering items such as date, time, O<sub>3</sub> values, temperature, relative air humidity and pressure. After finishing field collections, the data set obtained began to be scanned in Excel for the comparison of information, in which it will be analyzed cautiously and thus begin to build the results of this work.

The city of Manaus/AM has a peculiar feature of providing services of autonomous street vendors such as snack suppliers and breakfast that are directly exposed to air pollution over a long period of time and at times of greater circulation of cars and incidence of solar radiation. Thus, the choice of taking measures at a fixed point allowed to obtain an overview of the degree of exposure of inhabitants who are exposed daily to air pollution.

## III. RESULTS AND DISCUSSIONS

Figure 3 shows the average records of the surface ozone concentration (O<sub>3</sub>) on 09, 12, 16, 23, 26 and 30 at times from 10 to 15h UTC. It was observed that there is a growth in the values of concentrations during the period of 12 and 15h, a time with a higher incidence of solar radiation which contributes to the formation of O<sub>3</sub> on the surface. These results agree to those presented by Costa (2015) and Alves and Alves (2019) in their analyses in the city of Manaus and Lamarão do Passé - Bahia, respectively.

Figure 3 also shows that on days 09, 12, 16 and 19/09 the pollutant concentration presented lower values in relation to the other days analyzed, which ranged from 3 to 17 ppb, succeeding at times between 10 and 13h. On the other hand, on 12/09, a strong increase in concentration was recorded around 38 ppb at 3:00 p.m., which was not noticed

in the other days analyzed. This increase in training at 3 pm may have a strong influence of high temperature during this time, unlike the relative humidity of the lower air, as shown in Figure 4 (WALLACE AND ROBBS, 2006) .

Maximum ozone concentrations were recorded during the days 23, 26 and 30/09 in the period from 12 to 15h, presenting concentrations around 41ppb. Despite the high registration, the concentrations did not exceed what was established by CONAMA Resolution No. 491/2018 which is 140 µg/m3 (71.4 ppb) and the defenid by who which is 100 µg/m3. However, in Alves and Alves (2019)

concentrations exceeded 51 ppb, as the hours of the day advance, increase the temperature records, around 35°C while humidity 53%, which caused interference in the concentration of pollutant.

According to Figure 3, on 26/09 between 14 and 15h due to rain, no records were made, which decreased to zero the concentration of the pollutant. Nevertheless, it was found that before the occurrence of rain the concentration increased rapidly, presenting a higher concentration value of ozone around 41ppb, the atmosphere was stable thus affecting the results.

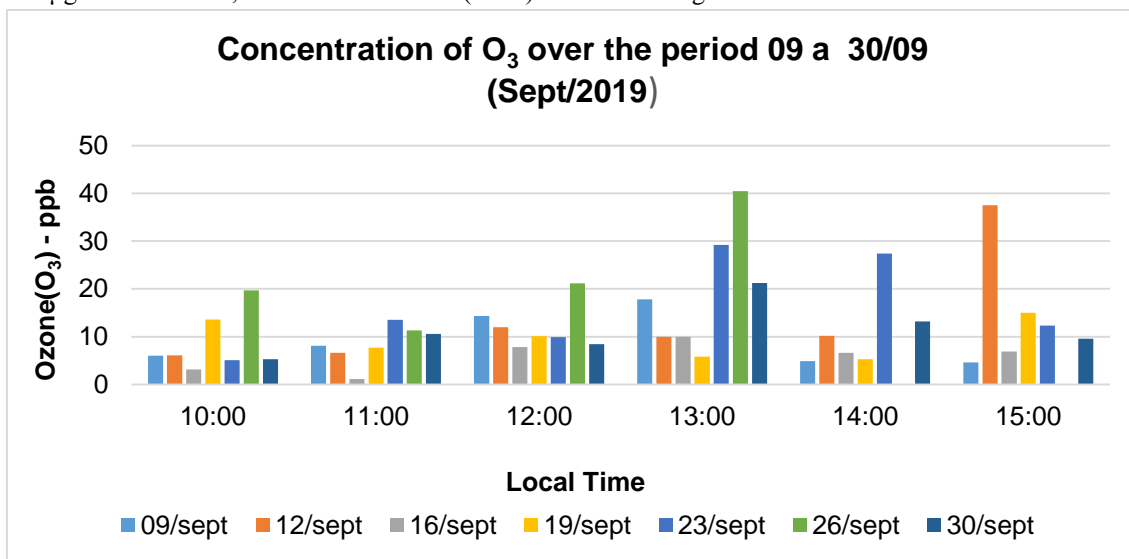


Fig.3 - Concentration of the average O3 for the month of September.

Analyzing Figure 4, it is observed that this period of September was very dry, presenting high temperatures, and the relative humidity of the air becomes lower and varies as the temperature increases. On the other hand, Dutra (2012) showed that in the period from July to

September are the months defined as the driest in the region. Thus, the temperature and humidity averages for data collection days is notorious that temperature has high values and added to the intense flow of vehicles thus promotes ozone formation (Figure 4).

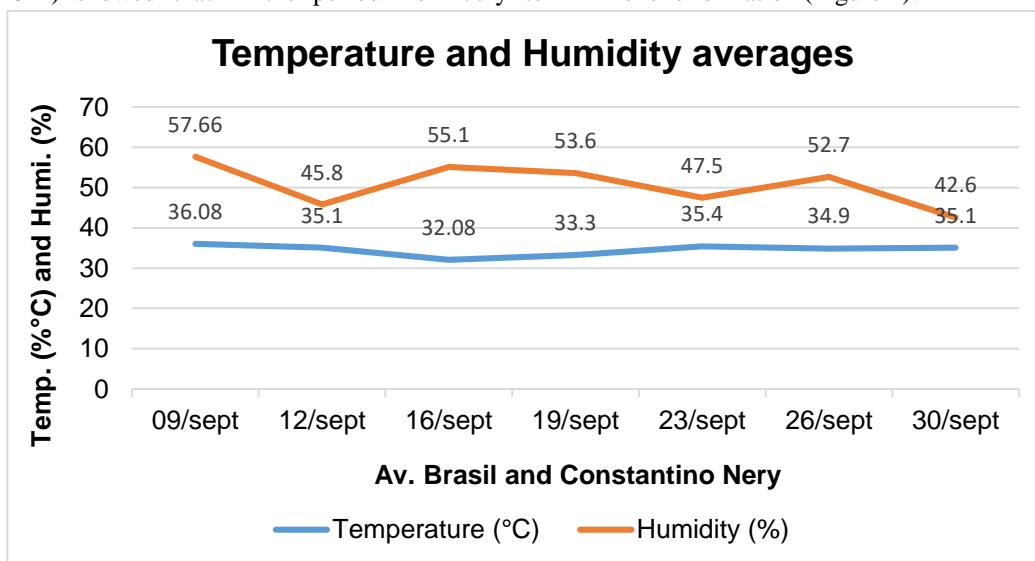


Fig.4 - Temperature and Humidity Averages for the month of September.

There were lower ozone concentrations on Avenida Brasil ranging from 1 to 29 ppb in relation to the records shown in Figure 6. This fact may be related to existing vegetation on site. These results agree those aprees in the study by Delabio and Sobage (2013) and Moura et al. (2004) who report that vegetation has a strong absorption of pollutants in the atmosphere, softening the concentrations launched.

Still, during the day 16/09 there was a decrease in the concentration of ozone around 1 ppb at 11am in the morning. This was due to precipitation records by inmet (National Institute of Meteorology) during the period of 9 mm accordingly, which plays the role of "washing the atmosphere", decreasing the concentration in the low

atmosphere, especially CO<sub>2</sub>, which associated with oxidized solar radiation, generating ozone.

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This avenue has a high flow of vehicles, due to its strategic location of access to the bridge over the Rio Negro, connects the capital of Amazonas the satellite cities, in addition, this route presents a great movement of street walkers.

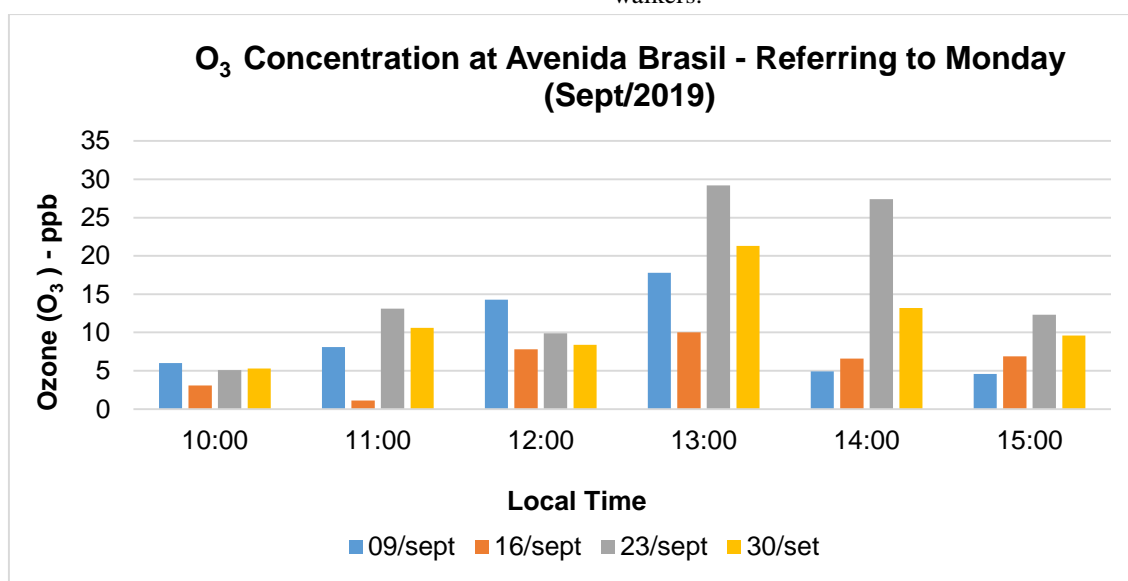


Fig.5 - Concentration of O<sub>3</sub> Avenida Brasil.

Figure 6 shows high concentrations, but which on the other hand did not exceed what was allowed by CONAMA Resolution 481/2018 and who. The highest record was around 40.5 ppb on 9/26, within the required standards. However, Constantino Nery Avenue presents a large flow of motor vehicles in circulation which contributes to the high concentrations of pollutant, when compared to Avenida Brasil.

On 12/09 had a high in the concentration of ozone 37ppb at 15h, the temperature at 36°C and low humidity, this high concentration occurred at the time of highest flow vehicles. It is noteworthy that in this period of collection Constantino Nery Avenue was under construction which caused slower and congested traffic of vehicles. Likewise, Freitas (2012) states that intense flows of cars emit pollutants into the atmosphere and thus contributing to the formation of ozone. At the same time, Costa (2015) and Calderaro (2016) report in their studies that the month of

September in Manaus which was conducted this study is characterized in the region being as the warmest period, with the highest solar incidence, due to these photochemical specificities of ozone, its production multiplies at this time because the solar incidence is high.

The burning of fuel fosséis of vehicles and industries are still the main precursors of ozone formation in Curitiba and São Paulo (ANTUNES, 2008 and POLLI, 2011). These results do not differ much from Manaus, already in this study was used the two of the main avenues of the city, where it has an intense vehicle traffic and consequently a higher concentration of ozone is obtained.

Also, Figure 6 shows that on 9/26 ozone obtained its highest peak value (40.5 ppb) at 1pm, although ozone is quite high still does not cause any danger to human health, because according to RESOLUTION CONAMA 481/2018, this high would only be harmful to salute when exposure to pollutant is eight hours.



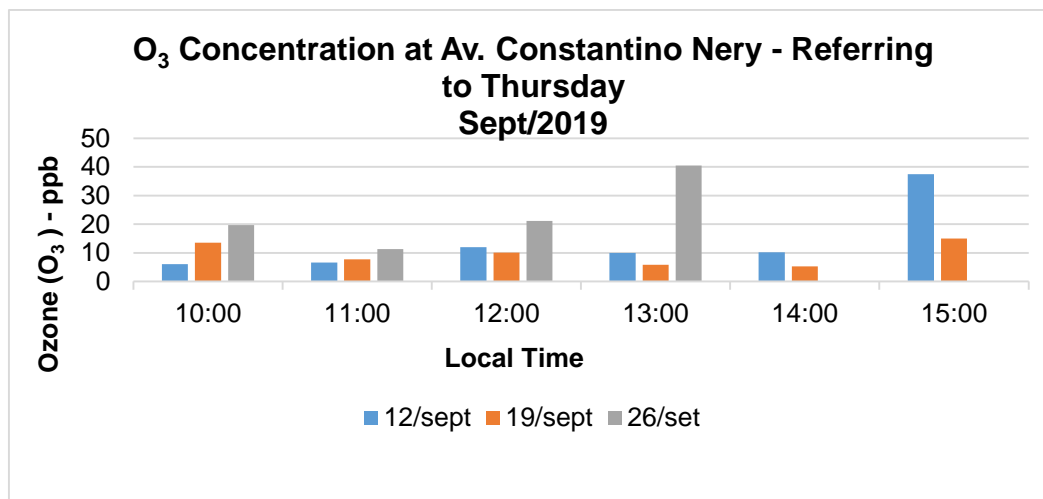


Fig.6 - Concentration of O<sub>3</sub> Constantino Nery Avenue.

#### IV. FINAL CONSIDERATIONS

This work showed a punctual study of the concentration of O<sub>3</sub> in two urban roads of intense flow of vehicles in the city of Manaus / AM. The city has a large number of services performed by self-employed street vendors such as snack suppliers and breakfast that are directly exposed to air pollution over a long period of time and at times of greater circulation of cars and incidence of solar radiation.

The maximum concentrations were recorded between 10 and 15h, a period in which solar radiation was intense, even because the month of September is characterized as a dry month in the region. According to CONAMA Resolution No. 491/2018 and the World Health Organization (WHO) the results of ozone concentrations did not violate the limits established, although maximum ozone values have remained as required in the legislation in force.

Although the values obtained have been within compliance, it is important that this pollutant be monitored because when launched into the atmosphere it is harmful to human health. Being exposed daily for a short period of time, they can affect the health of people who are exposed to pollutants, especially street vendors. However, monitoring this pollutant is extremely relevant to society, because ozone can generate more respiratory diseases, thus compromising air quality.

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# Analysis of the Concentration of Carbon Dioxide (CO<sub>2</sub>), Ozone (O<sub>3</sub>), Nitrogen Oxides (NO<sub>x</sub>) and Particulate materials (PM) in the Environment in the city of Manacapuru

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**Abstract**— The polluting gases carbon dioxide, ozone, nitrogen oxides and particulate materials in the environment are among the main causes of air pollution in Brazil and in the world, in the region of Manacapuru/AM, this type of pollution has been intensifying in dry periods, due to the increase of motor vehicles. The objective of this article was to analyze the concentrations of the pollutants studied and to relate to the precipitation levels, for results indicating interference with the environment on human health. The data obtained were from the Green Ocean Amazon Project (GoAmazon), where it was possible to analyze the monthly concentration of the transition period between the dry and rainy season. Through the percentage of vehicle fleet increase of the last years it was possible to analyze the impacts caused. In addition, a study of the influence of pollutants on the environment was conducted. The results showed that in the dry season the concentration levels are higher compared to the beginning of the rainy season and that what contributes to this concentration increase is the increase of vehicle fleets, causing impacts on the environment.

**Keywords**— Atmospheric pollution, Particulate material, Environment, Automobiles, polluting gases.

## I. INTRODUCTION

With the industrial revolution, emissions to the atmosphere of particulate matter generated by burning fossil fuels, biomass burning and vehicular emissions increased, thus changing their physical and chemical characteristics (DERÍSIO, 2012). These emissions bring impacts to the environment and consequently to human health, thus, the presence of polluting gases, for example, some gases, bring difficulties for the passage of oxygen in the breathing process, which can lead to death. Little is perceived what polluting gases can bring to health, but can lead to cardiovascular diseases, increase the risk of pneumonia, among other problems, so it can be perceived that it goes from simpler diseases, to more severe cases (CENZI, 2018).

High carbon dioxide (CO<sub>2</sub>) temperatures cause overheating, which result in impacts on the environment, which in their study showed reduced soil respiration rates (SILVA, 2014). What can lead to, in loss of microorganisms

that act and glued to the growth of species.

Júnior, Oliveira and Andrade (2008) Ozone (O<sub>3</sub>) in relation to other air pollutants, in the ozone layer plays a different role from the lower layer of the atmosphere, in his study it was observed that at the end of weeks the concentration rate is much higher, this may occur due to the largest traffic of vehicles, and because O<sub>3</sub> is a secondary pollutant gas, it takes place through atmospheric fusions with other gases that are emitted from mobile sources.

Nitrogen oxides (NO<sub>x</sub>) are mainly in a large amount of concentration in developed or developing regions, because they are urbanized areas, they receive a higher incidence of solar radiation (SILVA et al., 2003). When there is no presence of tree species in a balanced quantity, it happens in these ambient problems, which ends up further damaging the environment in which one lives, in addition to diseases.

The presence of particulate matter in the atmosphere has been the great cause of increased hospitalizations with

health problems related to difficulty in breathing. The smaller particles, which measure 2.5 micrometers ( $\mu\text{m}$ ), are considered responsible for these health problems, because they are smaller, easily enter the respiratory tract, causing diseases (SILVA et al., 2013). For Carmo et al. (2010) the concentration of particulate matter caused by fires in the Amazon has a direct influence on the increase in cases of respiratory diseases, as analyses were made where days with higher material concentration result particulate matter, there were also the days with the highest occurrences in hospitals of people with respiratory diseases.

Isaksson (2010) believes that air pollution can cause stress in terrestrial animals, because just like humans and vegetation, they are living beings and have the breathing process. And through its results, it was able to obtain data that proves that animals exposed to a higher concentration of pollutant strain has a greater stress than animals living in a balanced environment. While Ribeiro (2011) raises the question that the fusion of secondary pollutants causes acid rains, responsible for the deterioration of civil construction materials and historical monuments of cities. It may seem that this problem is not due to pollution, but when it is analyzed that acid rains occur due to air pollution, it can be understood that pollutants are the major causes, where it has been noted, that the main organic compounds volatile (VOC's) are emitted by burning fuels.

The presence of particulate materials in the atmosphere is worrisome when there is concentration at a given point. For Stern (2015) the chemical composition of aerosols in the Amazon is 78% organic, that is, it is the one that prevails, but this occurs in the dry season, which is when concentrations tend to increase. Particles differ both in size and in their chemical composition. And depending on their chemical composition, these particles may become larger over time (SANTOS et al., 2016).

According to Signoretti (2008), vehicular fleets reach 10% of global CO<sub>2</sub> emissions. Dutra (2018) believes that chemical fusions among pollutants have become more dangerous due to high consumption. And that these emissions from motor vehicles add up largely to the changes caused in the environment over time.

The present work is based on data taken from the Green Ocean Amazon (GoAmazon) project where it was possible to perceive the increase in concentrations of air pollution in periods of drought in the years 2014 and 2015. GoAmazon is a program that aims to analyze the interactions

between the environment and air pollution, showing how the dispersion of pollutants can significantly impact the environment in which one lives. The project was through the installation of experimental sites, located in the city of Manaus and Manacapuru, observing very specific characteristics of these two locations (COSTA, 2015).

The studied area is located in experimental sites in the city of Manacapuru in the state of Amazonas. In the years in which data were collected, the periods chosen were the transition between the dry and rainy period, which contributed to increased concentrations of pollutants in the atmosphere, as well as the increase in the flow of motor vehicles. In order to this problem, it is necessary to analyze the consequences of pollution in the city of Manacapuru/AM.

## II. METHODOLOGY

The study was carried out in the city of Manacapuru located in the state of Amazonas whose coordinates are: LATITUDE 03° 17' 69" and LONGITUDE 60° 37' 14" (Figure 1) with an area of 7,329,234 km<sup>2</sup> and has 96,236 inhabitants according to IBGE/2018.

According to Silva, Freitas and Franco (2007) the climate of this region is called an equatorial climate, (tropical rainy and humid), this is because it is a region that is close to the equator. Having average temperatures ranging from 24 °C to 34 °C. Some data used were collected through the Green Ocean Amazon (GoAmazon) project, the collection was carried out in Manacapuru in the period 2014 and 2015, in which it aimed to develop research related to forest dynamics and its interaction with the Atmosphere.

The study was divided into three parts: i) The analysis of the variation in monthly concentration of pollutants and precipitation variation; ii) Comparison of the fleet of motor vehicles with the beginning year (2014) of the GoAmazon project and the most recent year (2018) made available by the IBGE website and, iii) Study of the influence of pollutants on the environment.

The data variation of the monthly concentration of pollutants were obtained through the GoAmazon project, where in 2014 and 2015, variations in concentrations of air pollutants that cause impacts to the environment were analyzed and computed. The data was organized into a table, using the excel tool as the basis for creating cells with the values of the concentration variation of CO<sub>2</sub>, O<sub>3</sub>, NO<sub>x</sub>, Precipitation, MP<sub>1</sub>, MP<sub>2</sub>, MP<sub>5</sub> e MP<sub>10</sub>.



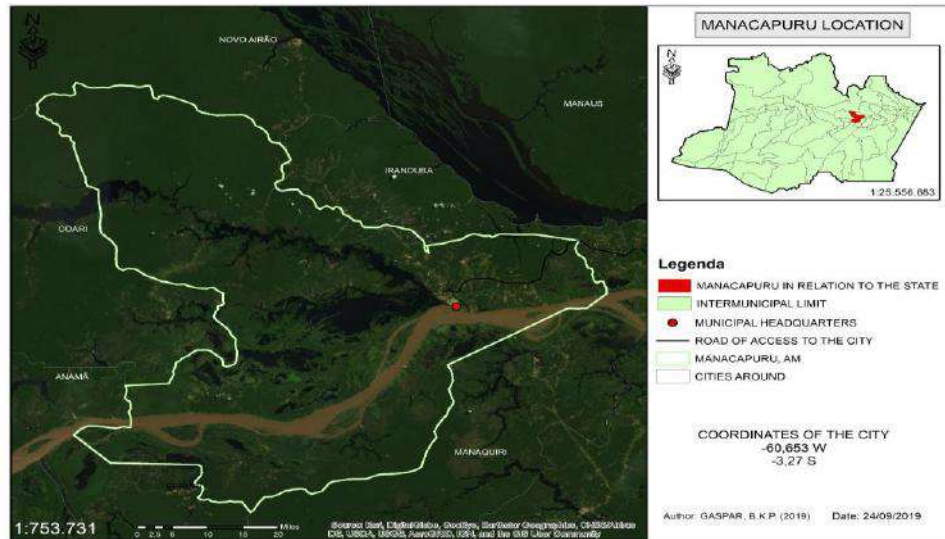


Fig.1 – Manacapuru Location.

From the collection of existing data, also through the excel tool, it was possible to compare fleets of manacapuru motor vehicles in 2014 and 2018, available on the IBGE website. With these data, the percentage of the increase in

vehicular fleets in recent years (Table 1) was reached, resulting in studies of possible damage that can cause to the environment.

Table 1 – Comparative of vehicle fleets 2014 x 2018

Comparative of vehicle fleets 2014 x 2018				
	Year of 2014		Year of 2018	Growth in %
Automobile	2.377	Automóvel	2.778	16,87
Truck	354	Caminhão	392	10,73
Pickup Truck	940	Camionete	1.136	20,85
Pickup	293	Camioneta	303	3,41
Microbus	79	Micro-ônibus	88	11,39
Motorcycle	6.302	Motocicleta	7.977	26,58
Motor scooter	2.450	Motoneta	3.214	31,18
<b>Total</b>	<b>12.795</b>	<b>Total</b>	<b>15.888</b>	<b>24,17</b>

### III. RESULTS

In this section, the results of the analysis of the concentration of pollutants in the city of Manacapuru/AM will be presented in 2014 and 2015. The analysis period is based on the transition period between the dry and rainy season, showing the impact on the environment and human health by increasing the concentration of pollutants by vehicular fleets.

#### Variability of the concentration of polluting gases CO<sub>2</sub>, O<sub>3</sub>, NO<sub>x</sub>, PM<sub>1</sub>, PM<sub>2</sub>, PM<sub>5</sub>, PM<sub>10</sub> and precipitation in the transition period between the dry and rainy season

Figure 2 shows the levels of pollutant concentration in August, both for CO<sub>2</sub> and O<sub>3</sub>. The results show that the

concentrations are quite high, because the month of August, is the month where the dry season begins and begins to intensify. In September, October and November CO<sub>2</sub> levels fluctuate, but still continue to have high levels, so it is months where a higher temperature is found. The increase in atmospheric CO<sub>2</sub> can have impacts on plant species, as their concentration can lead to, in the loss of nutrients from foliage. This can be demonstrated in Bordignon (2016), where the author performs analyses on soybean leaves, showing high levels of CO<sub>2</sub> concentration and temperature, it was observed that CO<sub>2</sub> lowered the capacity that Nitrogen (N) exerts on plants, which are responsible for its growth.

The concentration data were obtained through the

GoAmazon project database, where it was not possible to analyze O<sub>3</sub> in September, October and November, in return it was possible to analyze the month of December that in relation to CO<sub>2</sub> levels that fell, O<sub>3</sub> levels were quite high, because December is when the transition from dry season to rainy season occurs, that is, what explains this high level of

concentration is thermal inversion, which causes the pollutant to be trapped in the cold air layer, and thus preventing the exchange between cold air and hot air and polluting circulates. In addition, the weak local winds interfere with the dispersion of pollutants.

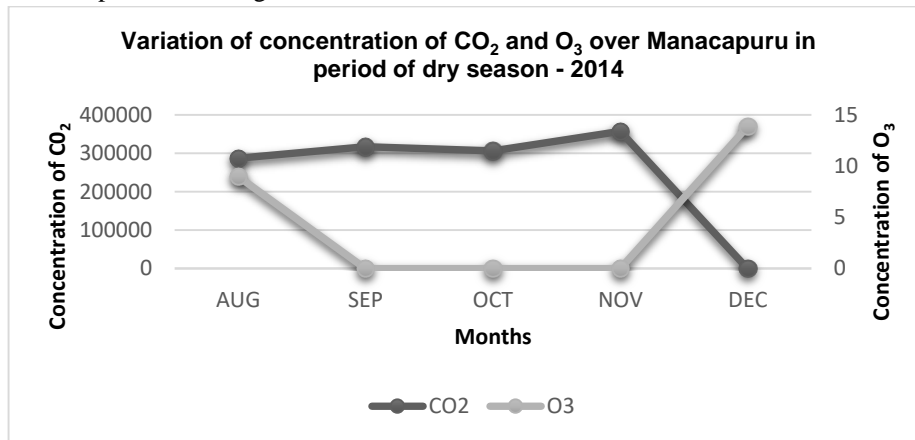


Fig.2 – Variation of concentration of CO<sub>2</sub> and O<sub>3</sub> over Manacapuru in months of august, october, november and december of 2014, period of dry season.

The variation in the concentration of CO<sub>2</sub> and O<sub>3</sub> shown in Figure 3, in 2015, an inverse behavior in the concentration of pollutants, from September to November the concentration of CO<sub>2</sub> is high, while the concentration of O<sub>3</sub> showed a lower concentration. Furthermore, the concentration of O<sub>3</sub> in 2015 showed higher values than 2014. To high

concentrations of O<sub>3</sub> present in the troposphere are harmful both to the environment and humans, this due to being a secondary pollutant, generated from CO<sub>2</sub> oxidation solar radiation. In Dutra, Fioravante and Ferreira (2009) the study showed that the amount of O<sub>3</sub> found in the atmosphere is related to the increase in vehicular fleets.

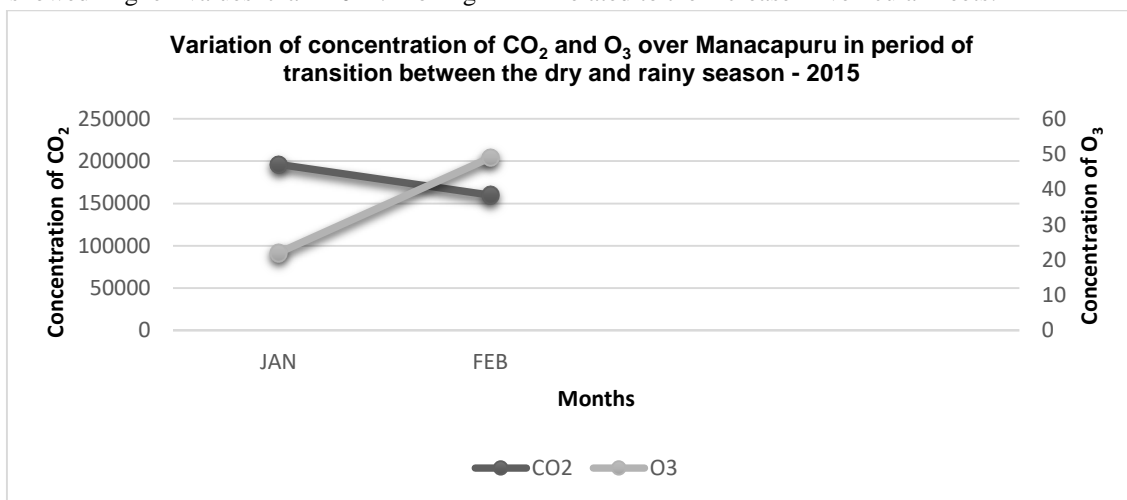


Fig.3 – Variation of concentration of CO<sub>2</sub> and O<sub>3</sub> over Manacapuru in months of january and February of 2015, transition between the dry and rainy season.

Nitrogen oxides (NO<sub>x</sub>) are part of the group of nitrogen compounds, naturally formed in the atmosphere, through natural rays and actions that happen in the soil, but

when they come from human actions they can generate greater amounts that are harmful. These anthropic actions that cause it are burning fuels, high temperature of polluting sources,

being fixed or mobile (CÓNSUL et al., 2004). It is noted in Figure 4 that during the months of October and December there were no records of precipitation. On the other hand, during November accumulated precipitation showed high

values, while NO<sub>x</sub> concentrations were lower. Thus, at the beginning of the rainy dry season, they increased considerably in September and fluctuated in October, November and December.

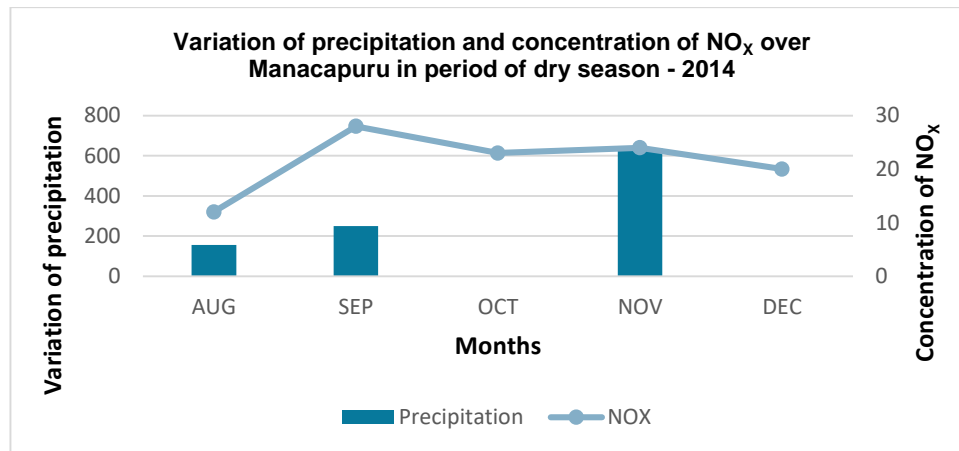


Fig.4 – Variation of precipitation and concentration of NO<sub>x</sub> over Manacapuru in months of august, september, october and december of 2014.

Similar to the previous figure, Figure 5 also showed the absence of information in January. On the other hand, in February it was verified that accumulated precipitation had a significant increase compared to the period 2014. Nevertheless, the NO<sub>x</sub> concentration remained almost the same as that of the dry season. However, Martins (2006)

showed that NO<sub>x</sub> is one of the main pollutants assist in the emergence of tropospheric O<sub>3</sub>. These are pollutants generated from the burning of fuels, and does not depend on the speed of the vehicle, but on the other hand, the important variables are the time of existence of a vehicle, distance traveled, wind directions, among other factors.

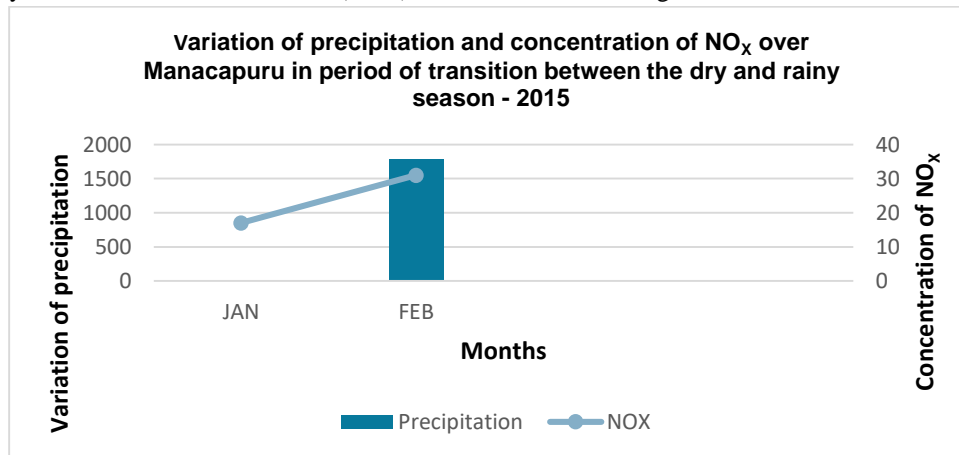


Fig.5 – Variation of precipitation and concentration of NO<sub>x</sub> over Manacapuru in months of January and February of 2015.

In 2014, particulate materials known as PM<sub>1</sub>, PM<sub>5</sub> e PM<sub>10</sub>, respectively breathable particle, thick and inhaleable particle. Fornaro (2017) shows that inhaled particles are particulate materials (thin + thick) or PM<sub>2.5</sub> + PM<sub>2.5-10</sub> that result in PM<sub>10</sub>, that manage to be smaller than a hair and a grain of sand, which make them highly dangerous, while the

PM<sub>1</sub> are breathable particles that do not pose risk to the health of the environment.

While thick particles (PM<sub>1</sub>) and inaltable (PM<sub>10</sub>), continuous behavior during the months analyzed, the PM<sub>5</sub> shows rapid growth during December, presenting the highest levels of concentration. The inhaled particles (PM<sub>10</sub>) have

higher values than the concentration of PM<sub>1</sub> present in the atmosphere, which can be explained to the dry period, due to the low accumulated precipitation. Presenting an analysis on the behavior of particulate matter in Manaus/AM, Dutra (2018) showed that particulate matter moves from the urban

area towards the Amazon River. Thus, it is remarkable that the high concentration of this pollutant can come from in most vehicular fleets is more numerous in the capital, transporting the pollutant to neighboring cities.

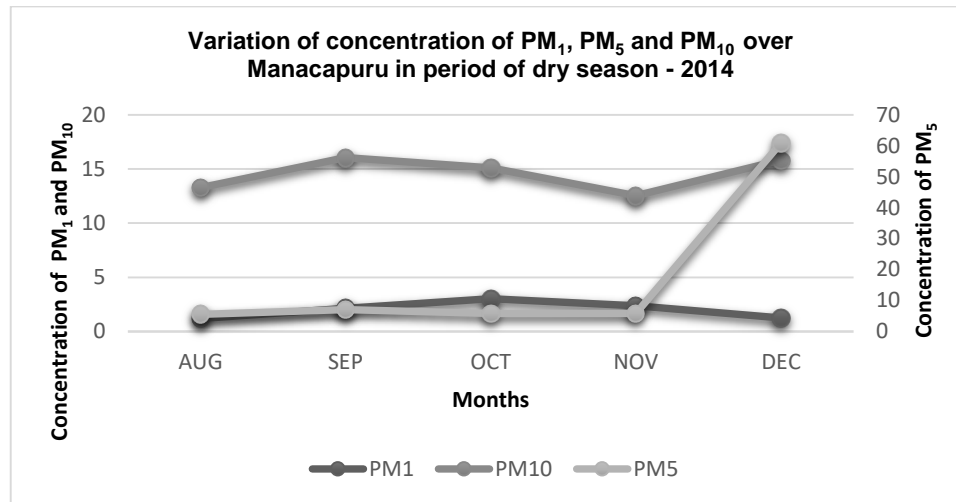


Fig.6: Variation of concentration of MP<sub>1</sub>, MP<sub>5</sub> and MP<sub>10</sub> in months of august, september, october, november and December of 2014.

**Impact caused by increased vehicular fleets on the environment**

Figure 7 shows the comparison of the vehicular rate in 2014 and 2018, showing a growth in the fleet of motor vehicles. There is a clear growth of the vehicular fleet from 2014 to 2018, after all it is 4 years from one year to another, the percentage growth totaled 24.17 % a value that may seem small, but for an average-small town of only 96,236

inhabitants, can result in large environmental impacts on the environment and society.

Dutra (2018) in his research on emissions of polluting gases, showed that there is the possibility of polluting gases dispersing in opposite directions. This may explain, because some concentrations do not reach emergency levels, as this occurs when there is a very high concentration level of a given pollutant.

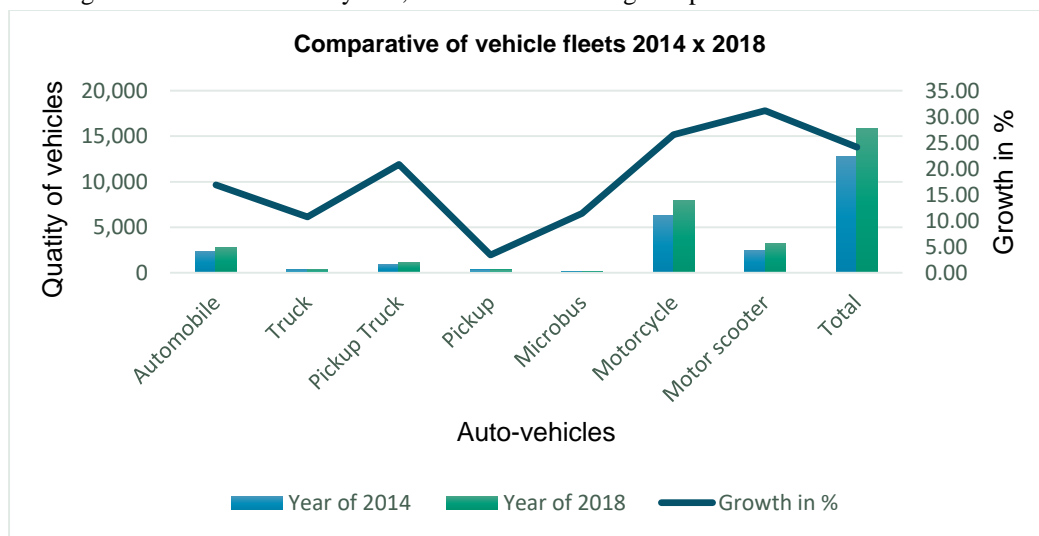


Fig.8: Comparison of vehicle fleet growth in 2014 and 2018.



### Impacts on the Environment

According to RESOLUTION CONAMA No. 491/2018 it is necessary to have an air quality control indicating management, which aims to establish amounts of air pollutants generated, to provide better quality of life to humans, thus avoiding the increase in the rate of diseases and mortality in Brazil. Thus, Brazil's standards are divided into two categories: Intermediate quality standards (PI) and final air quality standards (PF) (CONAMA, 2018). It is possible to see the cause of small particles of pollutants through details that go unnoticed, such as the color change of a plant, yellowish or whitish spots, plant wear for no apparent reason, or as if they were burned.

It is very common to find them in this situation, especially those in urban cities. Plants absorb gases through their pores that are in the surface part of the leaves, so they are more prone to impacts of gas toxicity. According to Pedrosa (2007) there are three pollutants present in the troposphere that can be considered the most dangerous for vegetation, which are SO<sub>2</sub>, NO<sub>x</sub> and O<sub>3</sub>. Because they cause reactions that not only affect leaves, but also roots, soils and water resources. In addition, NO<sub>x</sub> and O<sub>3</sub> gases, in contact with vegetation cause the formation of acid rains, changes in operation and weakening of agriculture.

He also believes that stress and accumulation of pollutants can occur through breathing, that is, some animals end up becoming weakened and over time mortality increases. Due to air pollution, some animals end up making a change in their natural habitat. In the case of the state of Amazonas, industries are close to green areas, depending on the climate of the place dust particles can become quite harmful to both human, plant and animal health.

Air pollutants cause damage to materials, being can corrode metals, darken them, wear historical monuments, car paintings, among other things like damaging civilian buildings. According to Kucera and Fitz (1995) damage to materials are the main caused by air pollution and that soon appear, weakening the structure of buildings. And they claim that in addition to SO<sub>2</sub>, NO<sub>x</sub> and O<sub>3</sub> also contribute greatly to the acceleration of the deterioration process and not only to the external area of buildings, but also to the internal area, harming even electronics.

Currently, health problems due to air pollution have only grown in urban cities, over time air quality control has also progressed, but the more urbanized cities become, the more population growth increases, this indicates increased pollution which can lead to uncontrollable air quality.

### IV. FINAL CONSIDERATIONS

Through the analyses presented, it was observed that the variability of the concentration of pollutants in the dry period is directly related to the high levels of CONCENTRATIONS of CO<sub>2</sub>, O<sub>3</sub>, NO<sub>x</sub> and PM and during the period when the rainy season begins, these pollutants disperse, resulting in low concentration levels. In addition, it is noticeable that in the period when there are higher concentrations of pollutant particles, rainfall levels are much lower, thus being inversely proportional phenomena, because when the atmosphere is clean, precipitation levels may be higher, when there are many particles of pollutants levels decrease, this is not to say that there is no rain, but rather that the rains are less recurrent, the raindrops are smaller and more acidic, becoming harmful to the environment.

Although this article is limited to the analysis of concentrations of pollutants in 2014 and 2015, it was observed that the increase in vehicular fleets in recent years can lead to higher concentrations of pollutants, that is, the tendency is that over time, with the development of the city of Manacapuru/AM, if there is no air quality control, environmental impacts and human health can become increasingly harmful.

With the study of influence of pollutants on the environment and health it was possible to pay attention to the various risks caused to the ecosystem, such as the weakening of vegetation, causing changes in its breathing process, which results in its nutritional loss and even diversity, causing negative effects also to fauna, because for the most part and diversity, they are found in forests, the loss of their environment results in loss of living beings that need the natural cycle of life. Polluting gases do not interfere only in human health, but in living beings in general, everything that has life is affected, the big difference is that in humans this can be noticed more easily, because they present respiratory diseases, cardiovascular diseases, allergies and other diseases linked to the respiratory system.

Finally, with the analysis of the data obtained in this article, it was possible to make a study with knowledge in the area of environmental engineering, of the impact caused by air pollution. It was concluded that high concentrations of pollutants and the increase in vehicular fleet over time contribute to various environmental impacts caused by air pollution and, among these impacts are acid rain, temperature rise, loss of environmental services and loss of diversity.

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# The Analysis of the Presence of Necrochorume in Communities in the Vicinity of the Cemetery Parque de Manaus and Nossa Senhora Aparecida

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**Abstract**— This work aims to analyze the possible contamination in the water table, by the Necrochorume of the cemeteries Nossa Senhora Aparecida and Parque de Manaus, which are located on Avenida do Turismo n° 107, km 12, in the tarumã açu neighborhood, are the largest extension cemeteries and the only ones in Manaus to carry out burials. Necrochorume is the main contamination residue from bodies that are in a state of decomposition, this liquid that is composed of water, mineral salts and organic substances, are responsible for soil pollution and underground aquifers. Chemical, physical and microbiological analyses of 2 supply points were performed, one inside the cemetery and the other outside, in October, the results show a change in pH, turbidity and the occurrence of microorganisms having the potential to cause serious health and environmental problems.

**Keywords**— cemetery, necrochorume, contamination.

## I. INTRODUCTION

Brazilian capitals are responsible for housing a majority part of the country's population, and the abrupt growth of these, can cause increased problems such as the lack of basic sanitation, degradation of preservation areas, soil pollution and resources (PESSOA et. al., 2016; ROCHA et. al., 2017). In addition, certain areas that in the early days of the development of cities were located outside the limits of the city, today they are in the urban perimeter, such as cemeteries. It was thinking about this problem that urban planning came to be considered as an efficient tool for the solution (CARNEIRO, 2008).

Around the 1970s, manaus necropolises became critical due to the high population growth caused by the emergence of the Free Zone. With this growth came the problem of cemeteries that soon ran out of room for new graves. In 1974, the Municipal Department of Works conducted a study to find new locations for a model necropolis (DUARTE, 2009).

However, cemeteries in fully urbanized areas are still frequent despite the implications such as groundwater and surface contamination (ROCHA et. al., 2017). These

problems are still common even with the existence of bans on CONAMA resolutions 335/2003, 368/2006 and 402/2008, which regulate the environmental licensing of cemeteries (WEBER, 2010; KEMERICH et. al., 2014). Therefore, the choice of an appropriate place for cemeteries requires a rigorous and careful previous study, because in addition to contaminating the areas water resources, can change the process of decomposition of cadavers (CAMPOS, 2007; JALOWITZKI, 2011; LORENA et. al., 2018).

The study the rain and surface waters are essential because, the rainwater when they penetrate the soil flows through the graves, coming into contact with the decomposing bodies. But on the other hand, this decomposition process can take months to years, depending on the type of soil and room temperature, which can pollute water resources in the same year (BARROS, 2008; JALOWITZKI; 2011). Yet, Lorena et. al., (2018) and Pacheco and Mendes (2000) showed that during the decomposition of the corpse there is proliferation of microorganisms that despite difficult conditions of survival can cause tetanus, gasgangrene and food toxoinfection. In

addition, viruses such as hepatitis that when coming into contact with water can cause serious harm to the health of consumers (PACHECO e MENDES, 2000).

In addition, carneiro's study (2008) showed that contamination of underground aquifers are more difficult to remedy, as it is at great depths, which compromises the spring with viruses and bacteria more resistant, making water unfit for consumption. The resulting of human putrefaction is called necrochorume characterized by being a viscous solution, composed mostly of water, rich in mineral salts and degradable organic substances, being released around 30 to 40 liters per human.

Necrochorume has as main characteristics, viscosity greater than water, average density of 1.23 g/cm<sup>3</sup>, polymeizable, brownish or grayish color, strong and unpleasant odor, pH between 5 and 9, at a temperature of 23 to 28°C, varied degree of pathogenicity (MATOS, 2001).

Despite the legislation, the areas of ancient cemeteries do not present any kind of planning, usually built in places where the underground is quite vulnerable. In most of them the drainage of rainwater is precarious, with flooding of some graves that are often in precarious consumer status (PACHECO, 2000). Rainwater, after crossing the cemeteries, falls into the urban rain network, and then channeled into bodies of water contaminating the surface waters with the substances present in the necrochorume. In cemeteries located where the water table is shallow, the chances of groundwater contamination are great (CARNEIRO, 2008).

The Parque de Manaus and Nossa Senhora Aparecida Cemeteries, located in the West Zone of Manaus municipality on Avenida do Turismo, n. 107, Km 12 – Tarumã, are chosen for the new burials. The original plan for the Cemetery Parque de Manaus was shallow field with gardens different from conventional crosses and grave of traditional cemeteries, while Our Lady of Aparecida arose by an emergency that the other cemeteries were no longer able of receiving new graves (DUARTE, 2006).

Therefore, this work aims to evaluate the possible impacts caused by cemeteries through the decomposition of cadavers thus harming public health, and through the results compare whether these fit with the potability standard of Ordinance No. 2914/11 Art. Second. This Ordinance applies to water destined for human consumption from a system and alternative water supply solution. Thus, this work will show an analysis of the physicochemical conditions of groundwater in the area of a cemetery located in the urban area of the city of Manaus / AM. This project is justified by the fact that the population around the area of the cemetery studied, use water for consumption.

## II. MATERIALS AND METODOS

The study was delimited in the Cemetery Nossa Senhora Aparecida and in the Cemetery Parque de Manaus, located in the Tarumã neighborhood, which is administered by the Municipal Department of Urban Cleaning. This cemetery is located in the region of the Giant basin, which integrates seven neighborhoods of the city in an area of 105,433 hectares (Figure 1a). The Cemetery Nossa Senhora Aparecida has as activity new burials, since the Cemetery Parque de Manaus serves only burials in family grave (SEMUSP, 2019).

First, a survey of the watershed and the neighborhoods adjacent to the cemetery (Figure 1a and 1b) it was possible to observe the path of the bodies of water that are part of the basin and their respective levels. Because as Almeida (2005) showed the presence of cemeteries in slope areas, increase the chances of contamination by Necrochorume.

Based on this analysis, it was possible to determine the areas to which the water samples would occur, and two points were chosen within the delimited area, as shown in Figure 1b.



Fig.1: a) Neighborhood Location Map;

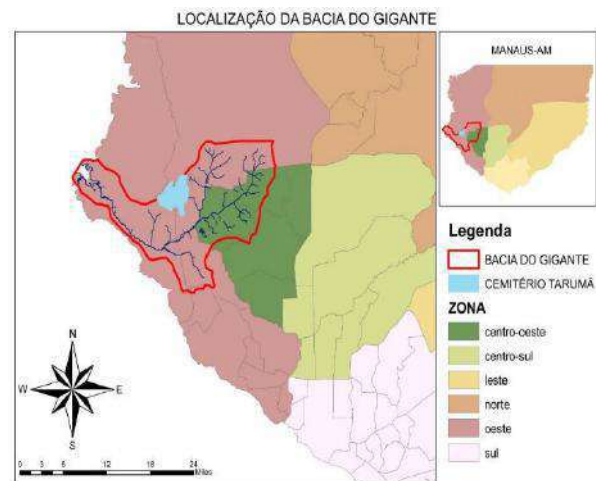


Fig.1 b). Location of the Giant Basin



After delimiting the study area and collection points, the parameters that will be analyzed were determined to identify the presence or not of Necrochorume. Thus, only the parameters shown in Table 1 were analyzed.

Comparison was made with reference values and potability parameters according to the methodology in which they are contained, meeting national and international standards, such as the Standard Methods of Examination of Water and Wastewater 23rd ED. analyzed were:

Table 1: Parameters analyzed

Parameter Analyzed	
<b>pH</b>	Recommended for human consumption, between 6.0 and 9.5.
<b>Temperature</b>	Recommended for human consumption, between 6.0 and 9.5.
<b>Total solids</b>	Indicator capable of evaluating the total weight of mineral constituents present in water by volume unit, granting up to 1,000 mg/L
<b>Turbidity</b>	Difficulty measure of a beam of light crossing the water sample, as well as suspended solid materials; up to 5.0 UNT.
<b>Calcium</b>	Granted up to 250 mg/L, excess of this element in water can cause problems such as kidney stone.
<b>Chlorides</b>	Determines the degree of water mineralization or indications of pollution. Allowed up to 250 mg/L
<b>Nitrite</b>	It is indicative of recent contamination in water, from organic plant or animal material. Amounts granted up to 1.0 mg/L
<b>Nitrate</b>	It is indicative of recent contamination in water, from organic plant or animal material. The standard of potability that is 10 mg/L.
<b>Sulfates</b>	Determined by Decree-Law No. 306/07 of August 27, as parametric value 250 mg/L in water for human consumption.
<b>Heterotrophic bacteria</b>	Heterotrophic bacteria feed on organic molecules from other living beings and depending on origin, should not exceed 500 Colony Forming Units per milliliter (CFU/mL)
<b>Total coliforms</b>	The mere presence of bacteria in this group in water intended for human consumption discards water as non-drinking, with NMP/100 ml allowed.

In this work the methodologies used in the determination of analytical parameters, were the same used in Cunha (2008). Samples were collected on 10/29/2019 at 14:10, which basically is an Artesian well located inside the Cemetery, and a second collection point in a commercial establishment a few kilometers from the first sample, but outside the boundaries of the cemetery. Although rainfall indices are very low at this time of year, which allows for lower surface flow and necrochorume infiltration in the deeper areas of the soil, and water table, during the day of collection rain showers.

Table 2: List of used equipment.

Equipment	N. Série
Phmetro Digital PG 2000	17041055001012
Conduimeter HI 2300	08456546
Digital Turbidimeter HI 98703	08393410
Digital Spectrophotometer DR 3900	1585105

### III. RESULTS AND DISCUSSIONS

In this section will be shown the results of the research carried out in the Parque cemetery of Manaus, which sought to identify the presence of necrochorume in groundwater. The research is of essential relevance, in view of its location in a fully urbanized area, and still being a source of supply for human consumption.

The results of the water analysis inside (Table 1) and outside (Table 2) of the cemetery presented a low pH in both samples, where the limits are between 5.51 and 5.90, respectively. These values are characterized as a body of water of considerable acidity, which indicates the presence of some polluting agent in the water body or evidence of the presence of necrochorume, as indicated by the limits set by the legislation. Despite this, Amorim (2017) shows that water in the northern region is originally acidic and should not be used initially as an indicator of pollution.

Furthermore, analyzing the other indicators it was possible to verify that most of them presented acceptable limits, maintaining the criteria determined by Consolidation Ordinance No. 5/2017.

However, the levels of turbidity analyzed in sample 1 presented values around 4.00 UNT, very close to tolerated, while sample 2 (Table 2) these values are even lower presenting values around 1.00 UNT. Although both samples have turbidity levels below 5.00 UNT (limit tolerated by legislation) a longer period of operation of the cemetery is easily exceeded. Also, for Campos (2007) and Carneiro (2007), the presence of suspended solid materials (silt, clay, colloids), finely divided organic and inorganic matter, microscopic organisms and algae are the main influencers of increased turbidity in a body of water.

Table 1: Results of parameters analyzed in groundwater well inside the cemetery.

PARAMETERS	CONSOLIDATION	RESOLUTION CERH	SAMPLE 01
	ORDINANCE N° 5/2017	No. 01, OF 19 JULY 2016	
pH	6,0 a 9,50	**	5,51
Temperature (°C)	**	**	25, 6°c
Total Dissolved Solids	Up to 1.000 mg/L	**	66,00 mg/L
Turbidity (UT)	Up to 5,0 UNT	**	4,00 UNT
Calcium (Ca)	Up to 250 mg/L	**	0,35 mg/L
Chlorides (Cl)	Up to 250 mg/L	**	0,200 mg/L
Nitrates (N- NO <sub>3</sub> )	Up to 10 mg/L	**	0,900 mg/L
Nitrates (N- NO <sub>2</sub> )	Up to 1,0 mg/L	**	0,600 mg/L
Sulfates (SO <sub>4</sub> )	Up to 250 mg/L	**	0,300 mg/L
<b>BACTERIOLOGICAS</b>			
Parameters	Unidade	Amostra	V.M.P
Bacteria Heterotrophic	u.f.c/ml	47	500
Coliforms Total	NMP/100 ml	Out	Out

Regarding the parameters of potability and their respective limits, it is known that the potability of water is essential to the life and maintenance of human health, because the consumption of improper water can cause several consequences human health.

Temperature has an influence on biological processes, chemical and biochemical reactions occur in water and other processes, such as solubility of mineral salts and dissolved gases cause reaction with acids (CAMPOS, 2007). For Oliveira (2009) it is essential to emphasize that temperature interferes with microbiological progression, so that each microorganism has an ideal temperature area to develop.

The temperature values observed in samples 1 and 2 presented very close values, remaining around the range of 25.6° C in sample 1, while the show 2, presents a temperature of 26.6°C. However, the high values of groundwater in this region are normal, due to high temperatures in the city of Manaus/AM that have annual averages around 24° to 26 °C.

The values obtained in the analyses of dissolved solids performed in the 2 wells met the limit tolerated by the legislation, which the maximum allowed is 1,000 mg/l (VMP). Nevertheless, it was noticed that the solid content dissolved in well 1 was considerably higher than that found

in sample 2, this is due to the high amount of sand granules in the well area.

Calcium is an element that is present in large quantities in most waters, and just as calcium carbonate (CaCO<sub>3</sub>) is common to find it in waters with pH above 8.2. Silva (2012) shows that the presence of calcium in groundwater is frequent and its association with carbonates is also used to determine alkalinity in groundwater and surface waters (BIGUELINI et al., 2012). The calcium concentrations detected in the analyzed samples showed values at the limit of the standard required by legislation in both samples 1 and 2, that is, values that are in accordance with the Consolidation Ordinance 5/2017.

In addition, chlorides are very soluble compounds and tend to enrich themselves along with sodium in groundwater. Contents above the M.S reference pattern (250 mg/L) are contamination indicators, in the results of the analyses show that it is well low.

Nitrate is a highly soluble salt characterizing organic matter contamination, usually present in landfills (COSTA, 2002). Biguelini and Gummy (2012) in studies conducted in Australia and Canada found a significant increase in congenital malformation "every defect in the constitution of some organ or set of organs that determines a structural morphological anomaly present at birth due to the

environmental or mixed genetic cause" (BARROS, 2008). However, it was found that in sample 1 nitrate values were around 0.900 mg/L, while in sample 2, nitrate was around 0.001 mg/L, as shown in Tables 1 and 2.

Regarding nitrite all the results were satisfactory, because in the two wells analyzed, did not exceed the maximum limit allowed by consolidation ordinance No. 5/2017, which is 1 mg/l. It was verified that in well 1 the amount is around 0.600 mg/L, while in well 2 it has lower values, around 0.001 mg/L. Still, Santos (2015) shows that the presence of nitrite can cause damage to human health because, when present in the water in demasia.

The results obtained show an increase in pH and temperature results, which indicate a possible change from

the decomposition of the cadavers. According to the World Health Organization (WHO) man is subject to an average daily consumption of about 500 mg/L of sulfates from water, because if ingested above this limit can cause gastrointestinal disorders.

Regarding microbiological results, heterotrophic Bacteria is shown to be worth 500 u.f.c/ml which is requiring for human consumption, while total Coliforms were absent. The amounts of parameters analyzed are few for the size of contaminants coming from the decomposition of this pollutant.

Table 2 - Analysis of Drinking Water Analytical Report.

PARAMETERS	CONSOLIDATION ORDINANCE No. 5/2017, ANNEX XX-MS/GM	RESOLUTION CERH No. 01, OF 19 JULY 2016	SAMPLE 02
pH	6,0 a 9,50	**	5,90
Temperature (°C)	**	**	26, 6°c
Total Dissolved Solids	Até 1.000 mg/L	**	30,00 mg/L
Turbidity (UT)	Até 5,0 UNT	**	1,00 UNT
Calcium (Ca)	Até 250 mg/L	**	0,010 mg/L
Chlorides (Cl)	Até 250 mg/L	**	0,100 mg/L
Nitrates (N-NO <sub>3</sub> )	Até 10 mg/L	**	<0,001 mg/L
Nitrites (N-NO <sub>2</sub> )	Até 1,0 mg/L	**	<0,001 mg/L
Sulfates (SO <sub>4</sub> )	Até 250 mg/L	**	0,175 mg/L
<b>BACTERIOLOGICAS</b>			
<b>Parameters</b>	<b>Unit</b>	<b>Sample</b>	<b>V.M.P</b>
Bacteria	u.f.c/ml	03	500
Heterotrophic			
Total Coliforms	NMP/100 ml	Out	Out

#### IV. CONCLUSION

This work showed an analysis of artesian wells, being the first located inside the Cemetery Parque Tarumã, and the second well in the external area. The choice of the well of the external area followed the flow of the first point analyzed. Water samples from sites where the groundwater level is closer to point 1 of collection, from the surface have higher pH, greater turbidity, less amount of dissolved oxygen than well 2 samples where at a distance of approximately 600 meters outside the cemetery. However, the number of samples collected is small to statistically evidence the risks, even if there is evidence of contamination, although the results indicate good groundwater quality.

Given the current legislation, it was contacted that a change in turbidity in the two collection points where the results of 4.00 UNT and 1.00 UNT show difference being this change due to the presence of particles suspended in the samples, such as sand, clay and microorganisms present, pH was shown in the first collection with low acidity of 5.51 and the second with 5.90 acidic waters for human consumption.

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# Study and Perception of Air Pollution in the City of Manaus-AM

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**Abstract**— This article aims to obtain the perception of students from a University Center on air pollution in the city of Manaus-AM, located in northern Brazil. Due to the action of man and the exponential growth of the population, there has been an increase in polluting waste released into the atmosphere, and these have brought strong consequences to day-to-day activities and human health. Thinking about this problem, some questions have been drawn up and sent through an online form. The interviewees were the professors of the FAMETRO University Center, located in the region with the highest flow of automotive vehicles and people from the city of Manaus / AM. The results showed that of 100% of the data, 93% answered that they had little perception, 4% answered that they had a lot of perception and 3% had no perception regarding air pollution in the city of Manaus.

**Keywords**— Air pollution, Welfare, Perception.

## I. INTRODUCTION

Located in northern Brazil, the city of Manaus/AM is part of the largest hydrographic basin on the planet and houses the largest rainforest in the world. Due to its great biodiversity the forest is considered a natural treasure, but despite this, the region is constantly suffering from the environmental impacts and environmental damage generated by the growth of industries, urbanization, deforestation and burning accumulating damage from the past to the present (SÁNCHEZ, 2015). Some of them are water pollution, noise pollution, air pollution or air pollution, soil pollution among other types that arise over time (DERISIO, 2016).

All types of pollutions are worrisome, however, air pollution is a type that is attracting society's attention, because with it several diseases such as respiratory and cardiovascular (TUFIK, 2017), which can lead to death children, the elderly, animals, to cause births of stillbirthbabies, in addition to the premature death of vegetation, this showed the work of Drumm and Chagas (2014). The authors showed that air pollution can be caused from incorrect disposal of polluting gases into the atmosphere, anthropic actions.

Among the categories of pollutants are MP (Particulate Matter) which is classified into three types of particles such as: thick particles of diameter greater than 10 $\mu$ m, being directly linked to soil resuspension, inhaled particles (MP<sub>10</sub>) with diameter less than or equal to 10 $\mu$ m, derived from smoke, large causes of irritations and inflammations and thin inhale particles (MP<sub>2,5</sub>), with a

diameter less than or equal to 2.5 $\mu$ m from organic compounds, metals and soot (EPA, 2003; WHO, 2005; BARBOSA, 2014).

Present in abundance in the atmosphere aldehydes, sulfur dioxide, nitrogen dioxide, hydrocarbons, particulate matter, carbon monoxide, ozone, short-lived climate pollutants (PCVC), are some of the pollutants capable of changing quality in mind, the indexes called air quality standard appear that can be defined as a tolerable maximum limit of pollutants in the form of gases, particles and liquids (LISBON and KAWANO, 2007), determined through resolutions n° 491 and n° 492 of the CONAMA.

Como the human being is totally dependent on the air to survive, so the concern about air quality has grown a lot and became known to all, the need forced the population itself to seek knowledge on the subject. Something invisible and extremely important is coveted by all, many countries need to buy carbon credit because in the country itself no longer has quality in its air (BRICKSUS and NETO, 1998).

For Motta (1995), the damage caused by air pollution in human health is several, when fossil fuels are burned directly affects humans in many ways such as: respiratory problems, discomfort, eye irritation, nose in general asthma symptoms, fatigue and chest pain. While Simas's results (2003) add that the population perceives and experienced the effects of air pollution on cities. Furthermore, the authors added that on days the atmosphere presents strong evidence of the presence of pollution, it is normal for people to complain of itching in the eyes and

tearing, and these symptoms are known as indicators of a polluted atmosphere.

Presenting a similarity to this work, Silva e Oliveira (2011). This article will show the results of a survey conducted with students from a private college in the south-central region of Manaus/AM, where the flow of automotive vehicles is very intense during the hours and days of the week. For this, we sought through online questionnaires to analyze the perception of students air pollution.

## II. METHODOLOGY

This study had as object of study the students of the FAMETRO University Center, located in the metropolitan region of the city of Manaus / AM (Figure 1). According to the Brazilian Institute of Geography and Statistics (IBGE, 2010) the city of Manaus is the largest city in the state, and it concentrates most of the population, of about 3,483,985. Despite being next to the largest rainforest in the world, high urbanization makes the region concentrate the highest pollution rates in the northern region (PINHEIRO, 2017).

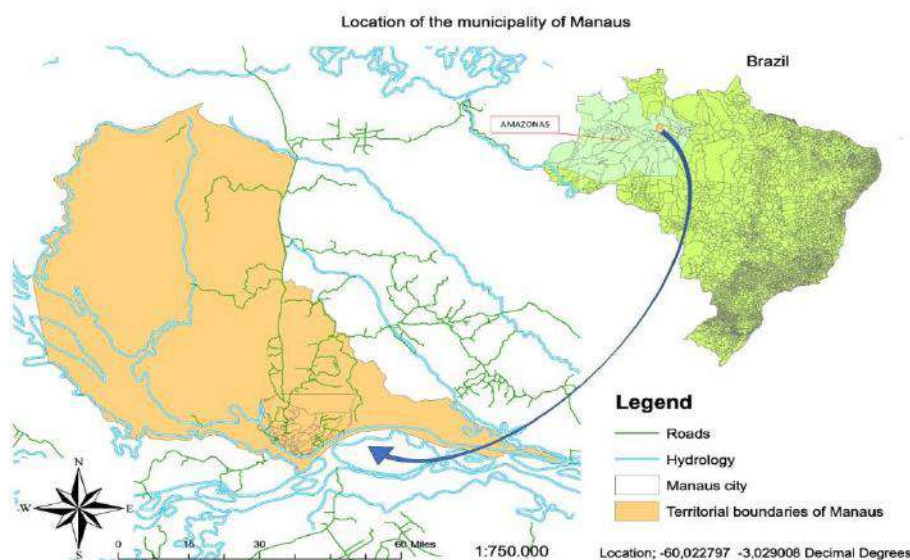


Fig.1: Location of the city of Manaus / AM.

The research universe was the student body of CEUNI-FAMETRO. The IES campus has four units located between the two avenues in the south-central region of the city, one of the areas with the highest concentration of

vehicles. In the units circulate about 15,000 registered students daily, who are exposed daily to air pollution. Thus, the methodology built for this work has four basic steps, as shown in Figure 2.

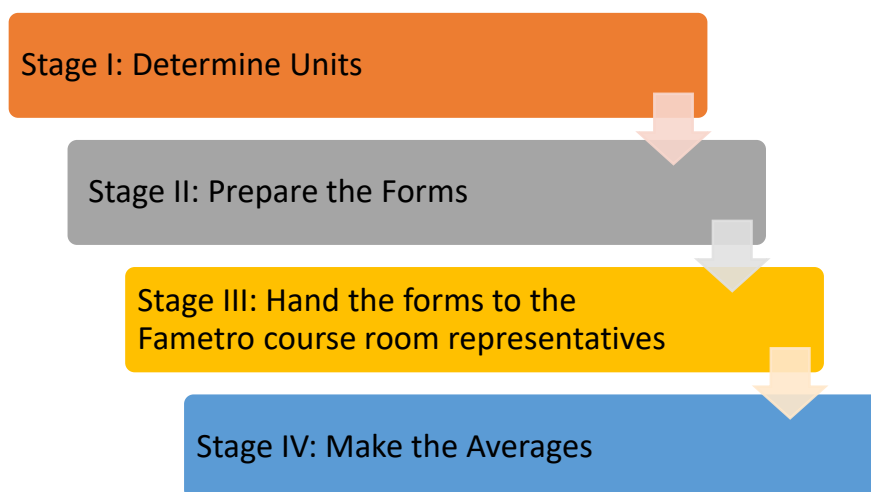


Fig.2: Graphical scheme of the four steps of the methodology

Before starting the research, the units, courses and sectors of the IES were chosen, to which the study was carried out. Subsequently, the group of people and sectors to which the forms were applied was chosen. In this way, the link with the form was disclosed so that selected users could respond to the form, either via desktop, laptop or smartphone.

The forms were sent to units I, II (exact) and III (health and humane), in prior agreement with the coordinators of the main courses of IES, environmental engineering, civil, electrical and production; administration, architecture and urbanism, biomedicine, nutrition, nursing, administration, pedagogy and social work. The search units are in Figure 3.

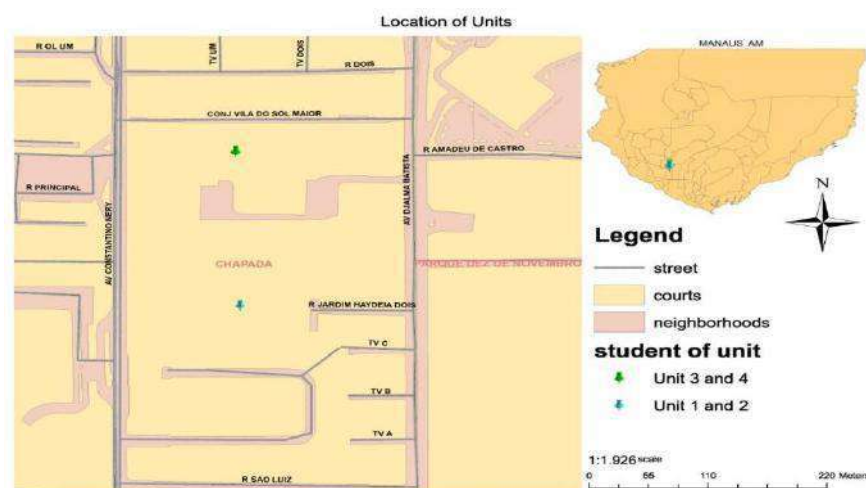


Fig.3: Location of units 1, 2, 3 and 4 of the FAMETRO University Center.

The forms were created on the "Google Forms" platform, where a spreadsheet in Excel stored all the information in real time. From the properly tabulated questions, a statistical treatment of the information was performed, so that the results could be interpreted and analyzed. For the analysis of the results, the graphs generated by the platform itself were elaborated, where the statistics of the number of responses and user are presented. In addition, the platform provided the percentage of each question answered.

The link containing the with the questions was sent via SmartPhone Whatsapp app ([https://docs.google.com/forms/d/e/1FAIpQLSe259gxjgFIqR9IGP5VGP1Dqg2916H6Q9SH3ZgSTN-R2Qa4w/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSe259gxjgFIqR9IGP5VGP1Dqg2916H6Q9SH3ZgSTN-R2Qa4w/viewform?usp=sf_link)) to all class representatives of ceuni's 12 courses, which redirected to classmates. As the student began filling out the questions on the form, their respective answers were stored in a database.

During the application of the form the term Air Pollution was replaced by Air Pollution. The form applied consists of ten objective questions, which question the interviewee's perception of the current state of the atmosphere in relation to pollution, and additionally issues related to age group, gender and general knowledge on the subject.

### III. RESULTS

The results presented in Figure 3a show that of all students of Ceuni FAMETRO who answered the questionnaire, 98% of the interviewees answered that they did not have any kind of knowledge about the theme, and that only 2% among the interviewees understand the theme. At the same time, Figure 3b shows that among the 98% of the interviewees, 44% are female, 58% male and only 2% did not respond. This shows that although media presented information about air pollution and its health implications, students have not shown any kind of information.

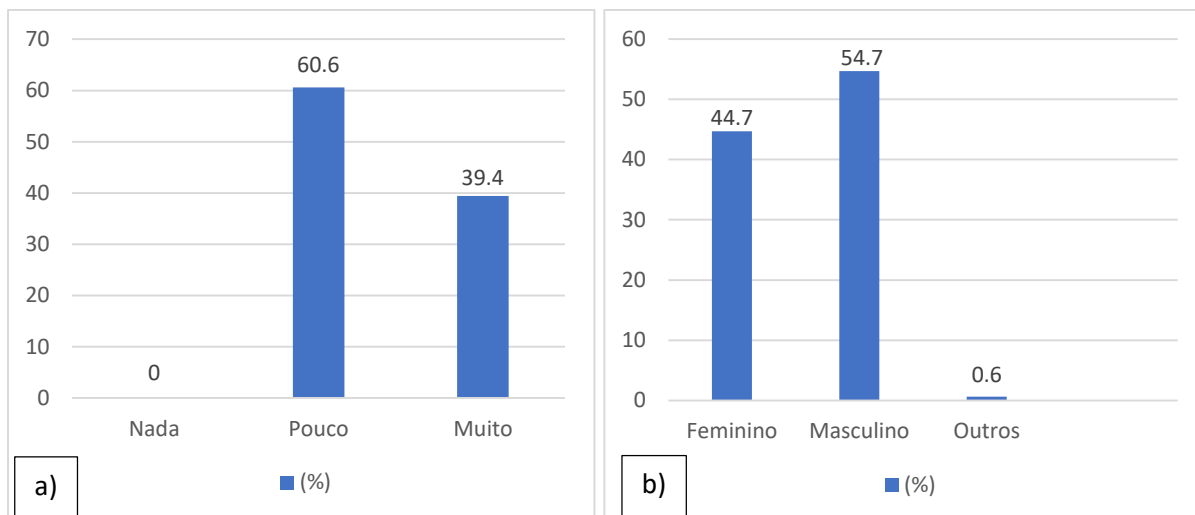


Fig.3: a) Percentage of students who have knowledge about air pollution; b) Percentage of men and women who answered the questionnaire.

Furthermore, it was possible to characterize the profile of the interviewees by age group, as shown in Figure 4. When it is observed, it is observed that about 50% of the interviewees are within the age group from 17 to 22 years. In a way, this high percentage of post-adolescents may explain the lack of knowledge and the implications of air pollution, because people in this age group do not have the

habit of obtaining information through the news in the written environment and Internet. Still 32% between 23 and 28 years, a very young audience. Although the teachers belonging to the latter are mostly finalist students, they do not also present a mature profile for understanding the theme.

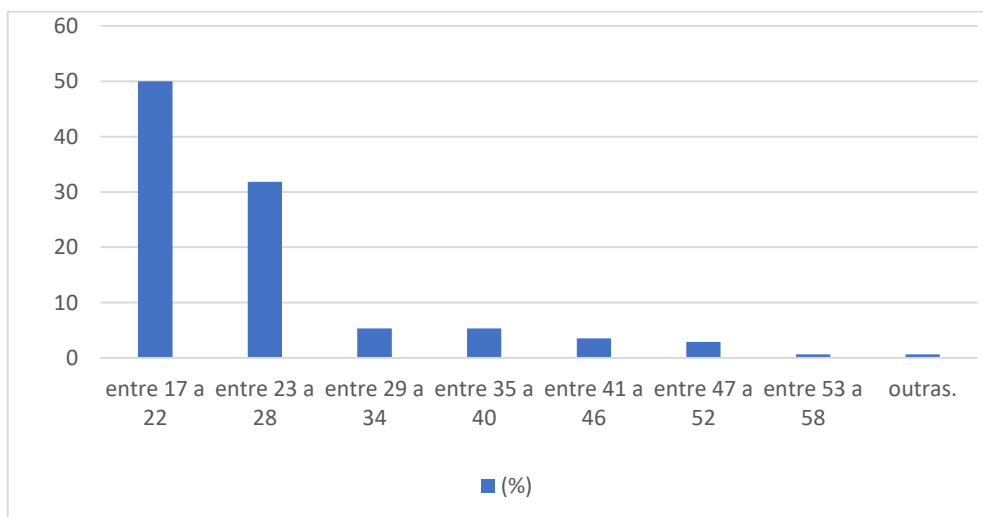


Fig.4: Data from the Ceuni-Fametro community, by age group.

Regarding the place of residence of the students of Ceuni-Fametro, it was possible to observe that 26% of the students are residents of the north, while 17% in the south-central area. Also obtained in Figure 5, it verified a percentage of 15% south zone, 15% west zone, 15% midwest zone and finally, 12% live in the east zone. The region can influence responses because it is related to the degree of exposure to pollutants. In a study on the displacement of pollutants in the city of Manaus, Dutra et.

al., (2019) showed that one of the regions most affected by the concentration of particulate matter was the west zone. Nevertheless, the questionnaire shows that students (15%) that inhabit in that region are unaware of such information. It is also known that, according to the results shown in Figure 6, 92% stated that the influence of air pollution intensified due to the increase of automotive vehicles in the urban area, while only 4% deforestation, 2% burned and 2%



industries, believe that air pollution can be derived from other origins.

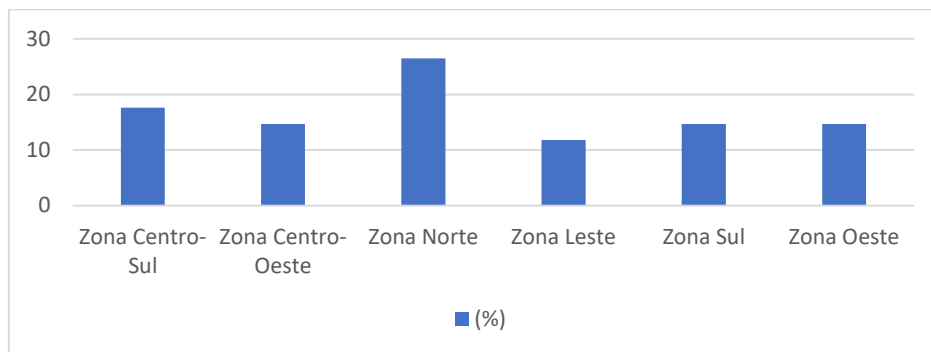


Fig.5: Percentages of students interviewed by the city areas;

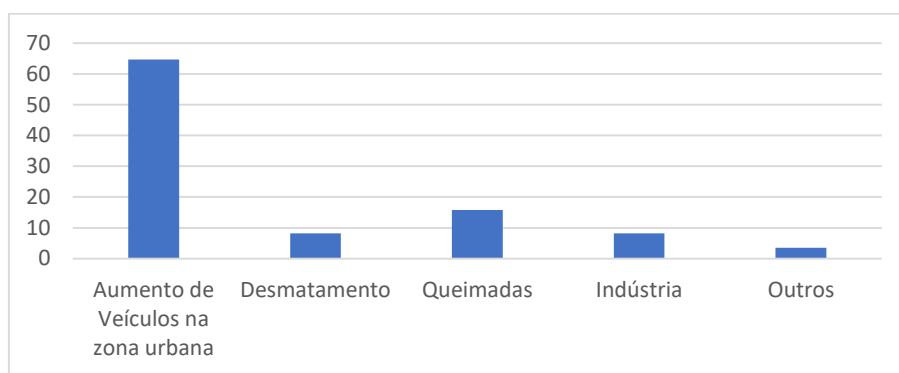


Fig.6: Influence of the type of air pollution on the lives of the inhabitants of the city.

Data on academics felt air pollution, and how it would affect people who worked exposed to it or not, if they perceived any change. Dutra et. al., (2019), clearly shows that particulate matter is concentrated where the flow of cars is stronger, such as at peak times, or on avenues that are very busy, thus people who are exposed where the particulate matter is concentrate is more conducive to acquiring diseases such as influenza, asthma, rhinitis, sinusitis among

others, at the same time Santos (2019), states that from the increase in outbreaks of fires, more toxic particles can be detected to humans, reaching directly the health and well-being of the population of Manaus city. Approximately 64% who work yes exposed, 25% did not work and 11% maybe, and about 48% have had flu or have, 22% have rhinitis, 12% have sinusitis, 9% have asthma and other diseases that are linked to air pollution.

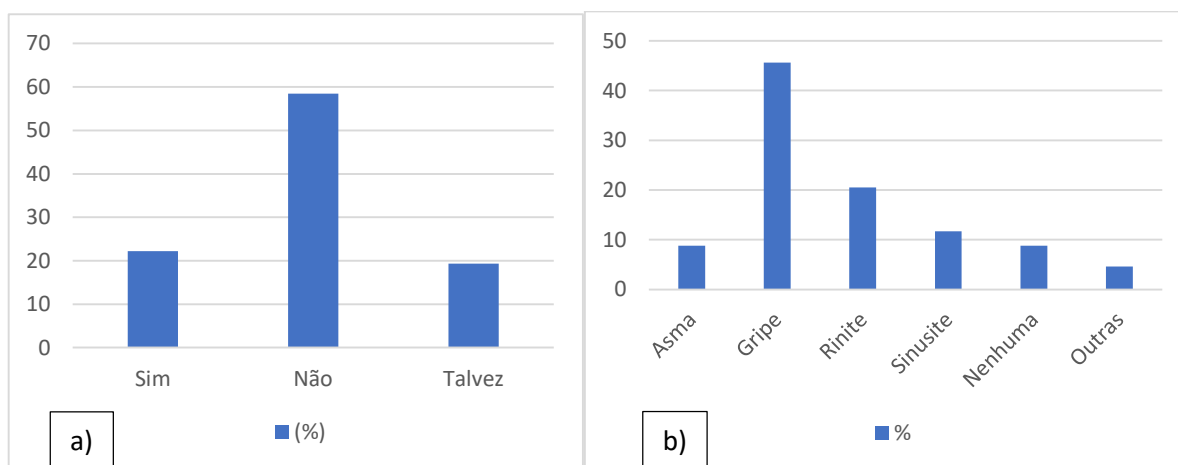


Fig.6: a) If people work exposed to air pollution, b) Diseases related to air pollution.

Figure 7a shows how, or how they felt about air pollution. Where 93% answered that they had little perception regarding the theme addressed, 4% answered that they had a lot of perception and 3% had no perception. Oliveira (2019), says that it is necessary to have a development of technologies for constant monitoring of pollutants as a precautionary form, this observation is

related to Figure 7b who sought to analyze the level of discomfort felt by the population of Manaus/AM in order to understand if society can feel differences levels of air pollution in the city of study, where 60% answered that they feel very discomfort, 37% feel little and 3% do not feel discomfort.

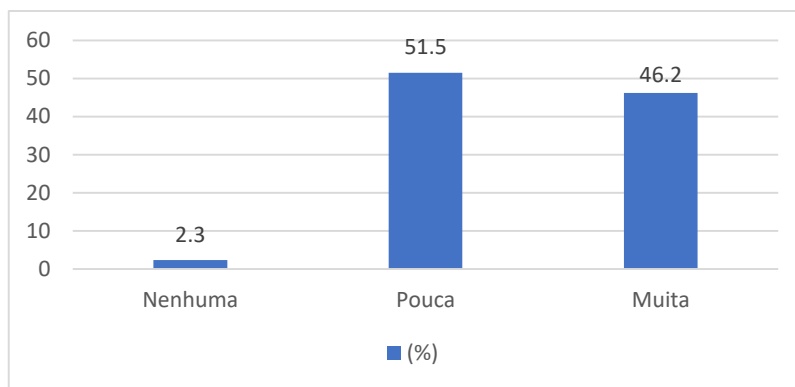


Fig.7: Perception of the level of discomfort felt of the interviewees in Ceuni FAMETRO.

Although previous results showed that the individuals interviewed have a low perception of the theme, they were asked how they would imagine the situation of air quality in 10 years. The results shown in figure 8 indicate that 73% of respondents answered that they imagine a future where air pollution is unpleasant, 24% believe that it may be unpleasant and only 3% think it would be very pleasant.

Although previous results show the lack of familiarity with the environmental issue and air pollution, it is perceived that a sample of students analyzed, is on alert about the future of air quality. climate change is intensifying more and more and this factor associated with rising fires and urbanization can get much worse, and thus contribute to the growth of large-scale air pollution.

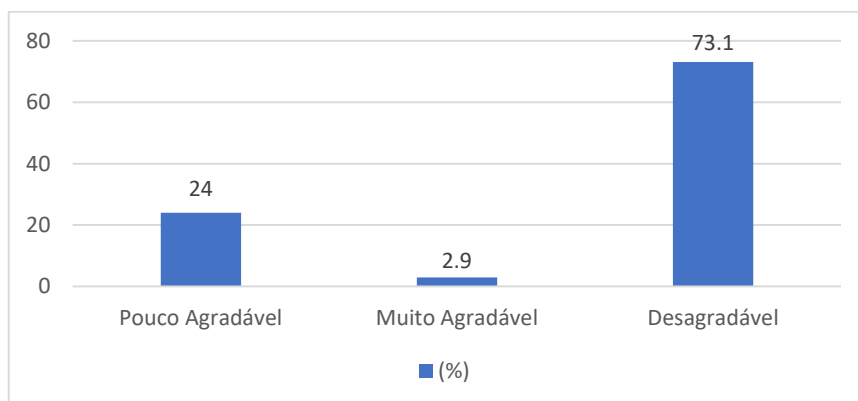


Fig.8: How do respondents imagine air quality in 10 years.

#### IV. FINAL CONSIDERATIONS

During the development of the project, information was obtained about the sensitivity of the Amazon population, more specifically those who frequent Ceuni-Fametro assiduously, in relation to air pollution in the city of Manaus /AM, to know in fact whether the Fametro community know what air pollution is and whether it is affecting their lives. Based on how society can feel and observe the effects of air pollution, this study clearly

showed the perception of the Ceuni-Fametro community, when the questionnaires were applied and through them, statistical analyses can be developed in order to show results.

With the answers of the 664 forms it can be understood that the population of Manaus understands and understands little about the pollution of the air, that is, they have little perception. The perception of each individual showed how they felt or perceived air pollution, where 93% answered that they had little perception regarding the theme

addressed, 4% answered that they had a lot of perception and 3% had no perception.

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# Surface Temperature and NDVI Behavior Analysis in September in Manaus/AM City

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**Abstract**— The city of Manaus has been going through a process of accelerated and disorganized urban growth, which causes situations that characterize many challenges and environmental problems. Among these, we highlight the change in the local climate, causing the so-called Urban Heat Island (UHI) that arises in the area of the metropolitan region and is characterized by the rise in surface temperature when compared to the predominant temperature in the regions of urban sites. This phenomenon relates to anthropic activities on the surface and its consequence in the lower troposphere, which results in the increase in average temperatures and the number of hot days, intensifying thermal discomfort in the population. Thus, the objective of this work is to analyze the evolution of the heat island in the geographic space of the city of Manaus in the last 10 years, using remote sensing data, to estimate the values of surface terrestrial temperature, using Thermal maps generated from composites of AQUA satellite images, MODIS sensor: Surface Temperature and NDVI from THE LPDAAC (Land Processes Distributed Active Archive Center, NASA. Based on the data and analyses performed, it was possible to see an increase in temperature with a temporal variation in the years 2010 to 2019 as well as the expansion of warmer spaces, which invigorates the influence of UHI in the amazonense metropolis.

**Keywords**— Surface temperature, heat islands, thermal comfort.

## I. INTRODUCTION

During recent decades, high demographic, territorial and industrial growth in cities, causing changes to natural and built environments. The city of Manaus reached the mark of 2,182,763 inhabitants in 2019, representing a population growth of 1.74%, compared to the previous year, when the city had the number of 2,145,444 inhabitants (IBGE, 2019). The disorderly growth of cities can lead to problematic effects on urban climate issues (WERNECK, 2018). In addition, some studies such as Santos (2010) and Saydelles (2005) showed that the loss of vegetation, and soil are directly related to the atmosphere, because, as the soil is exposed and without vegetation will suffer a higher incidence of solar radiation thus changing the components of the energy balance and consequently the surface temperature.

The process of urbanization of the city of Manaus happened quickly and absent from planning. Its accelerated development has caused the city's vegetate areas to be drastically reduced, which has led to changes in geographic space and thus causing changes in the surface temperature (ST) terrestrial and adjacent air, favoring thus the development of microclimatic phenomena such as the heat islands (HI). In addition to the removal of vegetation cover, HIs can be intensified by asphalt of the streets, use

of construction materials and verticalization processes thus becoming the cities even more vulnerable to heating and training of areas overheated in cities.

The creation of HIs is a perennial problem in the 21st century, caused by the intense process of urbanization and industrialization of cities (RIZWAN et al., 2008). One of the causative agents of HI is the change in the amount of solar energy that falls on the earth's surface through physical mechanisms, which leads to the change of certain meteorological elements, specifically surface temperature and air. study conducted by Matson et al., (1978) in July 1977 in the United States of America (USA), the authors showed the emergence of an amount greater than 50 urban heat islands, evidencing a temperature gradient of 2.6 °C to 6.5°C between urban and zone Rural.

Over the years the way in which urban space is used is altered by worsening the natural quality of the planet. Also, Neto and Amorim (2017) showed that temperatures are rising, in order to evolve the creation of heat islands, openly threatening the living conditions of fauna and flora, in addition to the quality of life of the population.

The phenomenon of UHI in the city of Manaus was addressed in Souza (2012) and Corrêa et. al., (2016), through the use of satellite images and information of



Numerical Models, the authors showed a significant increase in surface temperature in some regions of the city. Furthermore, HF is a phenomenon capable of causing great discomfort in the population, as it results in higher temperature indices and decreased air quality, causing greater possibilities of thermal stress, and may even cause diseases and serious damage in more sensitive individuals. In addition to bringing negative effects to the environment, as they contribute to the intensification of the effect of global warming and air pollution.

According to Assisi (2005), both temperate and tropical areas, UHI are related to local climate changes and the decrease in evaporative and convective cooling rates due to soil paving, reduction of vegetated areas, and also the reduction in wind speed due to increased surface roughness.

Thus, this work tried to show a temporal analysis of ST and vegetation index (NDVI) during the period from 2010 to 2019. Seeking to quantify variations in NDVI and ST and relate to urban expansion of the city of Manaus associated with thermal comfort, atmospheric phenomena such as El Nino South Oscillation and precipitation variations in this period.

## II. MATERIAL AND METHODS

The city of Manaus/AM is located in the heart of the legal Amazon, around 3°S latitude and 60° W longitude, between the Negro and Amazonas rivers. Despite its location the city between the forest and the rivers, the city has shown strong population growth, which allows the rise of the islands of heat. Thus, data from the AQUA satellite, moderate resolution imaging spectroradiometer (MODIS): Surface Temperature (ST) and Normalized Difference Vegetation Index (NDVI) of the National Aeronautics and Space Administration (NASA) were used, through the LAND Processes Distributed Active Archive Center (LP) available in : <https://e4ftl01.cr.usgs.gov/MOLA/> and <https://e4ftl01.cr.usgs.gov/MOLT/>, validated in Wan (2008). The analysis was carried out in September during the ten-year period (2010 to 2019). The PRODUCT MYD11A2, provide Kelvin-grade TS with 1 km x 1 km pixel spatial resolution, and 4-hour time. In addition, the MOD13A3 product provides daily images of the vegetative index (NDVI), with spatial resolution of 1 km x km. The NDVI is the response of wavelength reflected by the vegetation of the earth's surface. Finally, the accumulated rainfall was used in September, from 2010 to 2019, obtained through the database of the National Institute of Meteorology.

The method used in this work was the qualitative analysis of the images, and through them to identify the

evolution of the heat islands. During the 10 years, the maximum/minimum TS was verified during the month of September, considered the hottest and drier month in the Amazon region. For this, an average of all images made available, pixel by pixel, the final product being the monthly image. Considering that the images are global, only the area that delimits the city of Manaus/AM was selected. The averages were also calculated in each pixel of surface reflectance; thus, it was possible to compare the maximum and minimum temperature areas with the areas of significant vegetation cover or not.

## III. RESULTS AND DISCUSSIONS

Located near the Equator line (latitude and longitude), the city of Manaus/AM is located in a privileged geographical position, in the watershed, and the largest rainforest in the world. Despite this, in recent years, with the exponential growth of the population and consequently, urban areas grow. Thinking about it, through Figures 2 through 4 we will show the spatial distribution of TS and NDVI during september, from 2010 to 2019. While Figure 5 will show the accumulated rainfall in August and September of the years analyzed. In order to understand the signing of the development of HI in Manaus, Figure 1 presents the location of the areas and neighborhoods of the city.

Observing the average ST in September 2010 (Figure 2a) it is possible to identify a well-defined area with high ST, which can reach maximums around 47°C in the north, south center and midwest zones (represented in Figure 1 with dark green color, orange and white). It is worth mentioning that, analyzing Figure 2b, it is noted that these areas of Maximum ST coincide with the areas with the lowest emissivity of the vegetation. The areas of low emissivity represent places with absence or very little vegetation, constructions and waterproof areas. In addition, the months of September in the northern region is considered one of the hottest and driest months of the year which contribute to the increase in ST. When we analyze rainfall totals for the month of September (Figure 5) it is evident the low values accumulated around 26.6 mm, which contribute to the increase in ST. Together in September, accumulated rain in August is also shown to be low while maintaining the soil even drier, decreasing emissivity by vegetation (Figure 1b).

The year 2011 was marked by the decay of high temperatures (Figure 2c) in almost all areas of the city of Manaus, restricting high temperatures to a narrower range between the central south and midwest zones and a small core to the north. This decay is possibly associated with increased precipitation during the months of August and September with accumulated around 60 mm. It is



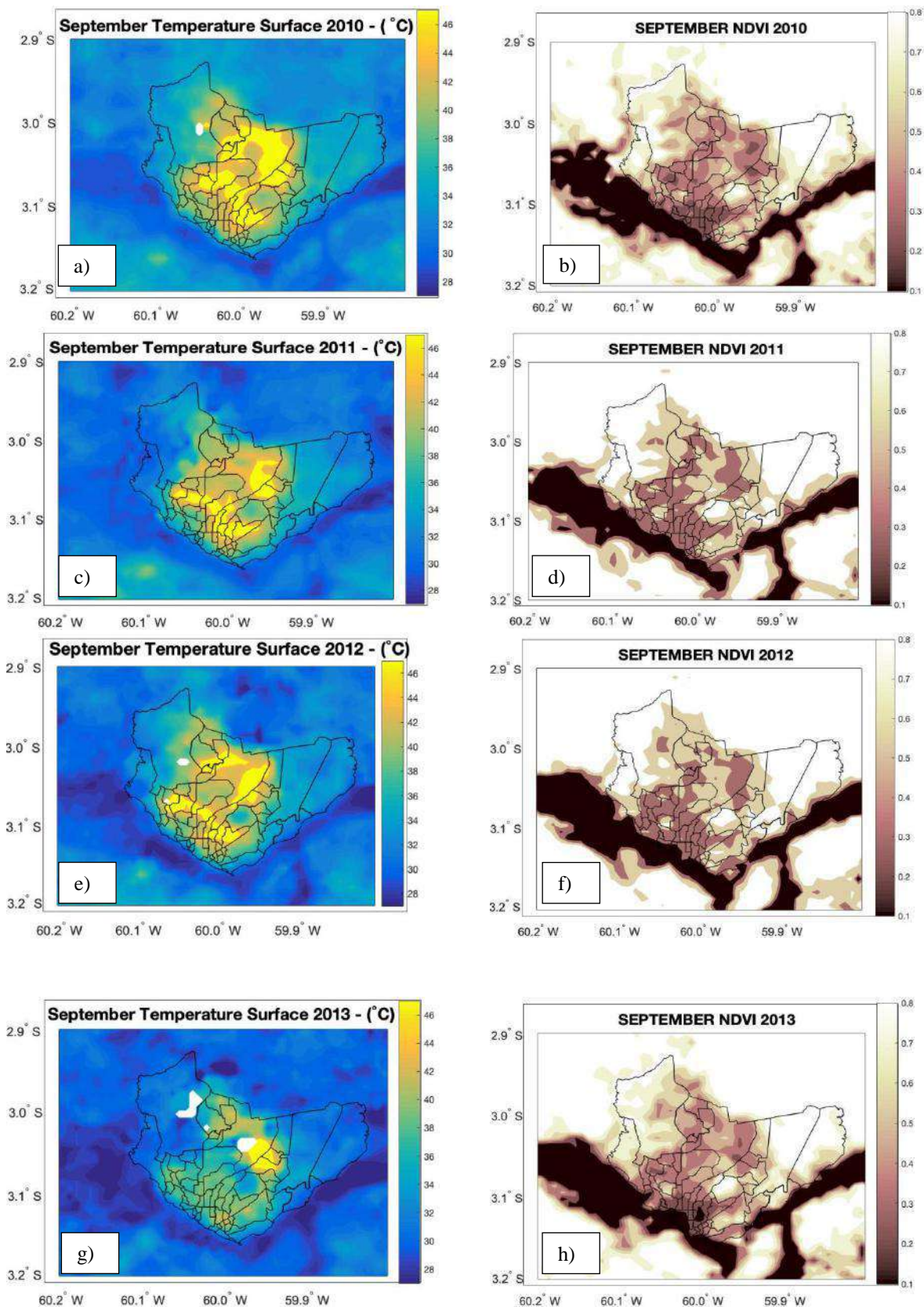


Fig.2: a) Surface temperature in September 2010;b) NDVIin September 2010;c) Surface temperature in September 2011; d) NDVIin September 2011;e) Surface temperature in September 2012;f)NDVI in September 2012; g) Surface temperature in September 2012;h)NDVI in September 2012.By satellite by MODIS satellite, 1x1km.



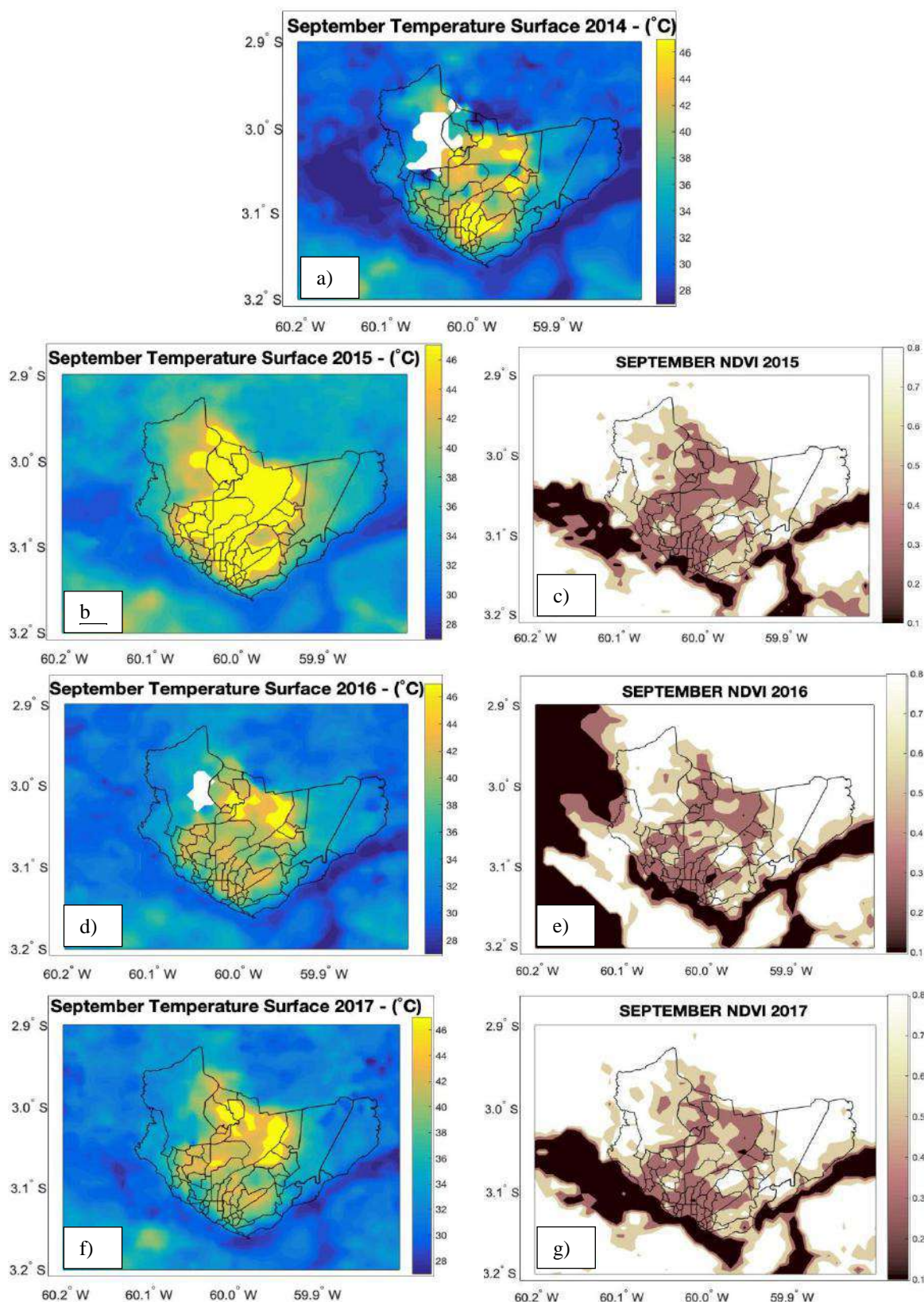


Figure 3: a) Surface temperature in September 2014; b) Surface temperature in September 2015; c) NDVI in September 2015; d) Surface temperature in September 2016; e) NDVI in September 2016; f) Surface temperature in September 2017; g) NDVI in September 2017. By satellite by MODIS satellite, 1x1km.



The year 2014 was marked by the increase of ST's throughout the metropolitan region of Manaus, mainly in the south and north regions, reaching highs of 46°C (Figure 3a). Due to technical issues, unable to create NDVI image.

The year 2015 is marked by an episode of ENOS in the hot phase, called El Niño. This phenomenon is characterized in the northern region by a period of prolonged extreme droughts, which further increases the foci of fires in the region. A set of factors such as low rainfall indices during August and September (Figure 5), weak emissivity emitted by the surface and El Niño-Southern Oscillation(ENSO) contributed to the increase in ST thus expanding HI. These expansions of areas with temperatures close to 47°C reached regions of the city that previously did not have such high Values of ST. Figure 3b shows that even the vast green area of the campus of the Federal University of Amazonas (UFAM) which is one of the most significant green areas of the city, presented more less ST values.

In other cases, the years 2016 and 2017 were marked by an increase in precipitation totals (above 100 mm) and consequently a decay of ST. These two years present a similar behavior of the spatiality of ST, in

addition to the similarity of NDVI maps. ST maximums are found in the north and east regions (Figure 3).

The last two years analyzed (2018/2019) were marked by a progressive increase in CI (Figure 4a and 4c), showing a predominance of the north and south-central regions. It is still possible to verify that although the north zone has high temperatures during all the years analyzed, in this region is located the Botanical Garden of the city. This fact shows us that despite the presence of extremely abundant vegetation is not enough to mitigate the effects of heat islands in the region.

Over the years the exponential growth of the city Manaus and consequently the decrease of its vegetated area in the urban environment, has transformed the climatic dynamics of the region. Knowing then that land use is of great importance, as its disorderly occupation causes the deterioration of the environment, the practices of management of the city's territory and its forms of land use robust with thermal variability and lime islands or. It is possible to observe a gradual growth of temperature with the flow of the years precipitously in the less vegetated regions and with higher rates of urbanization and verticalization.

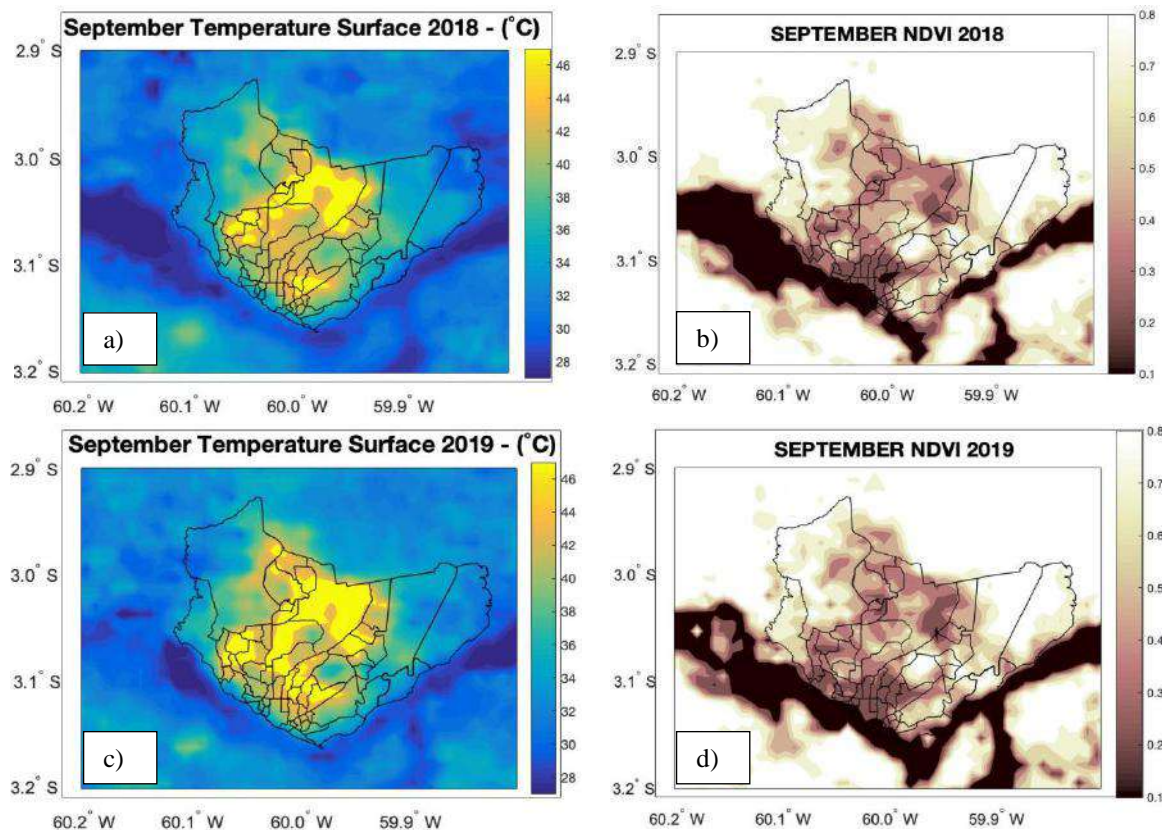


Fig.4: a) Surface temperature (°C)in September 2018; b)NDVI in September 2018;c) Surface temperature (°C)in September 2019; b)NDVI in September 2019; By satellite by MODIS satellite, 1x1km.

Regions with higher vegetation indexes record the lowest temperatures compared to the others, understanding that vegetation collaborates to mitigate the phenomenon of urban heat islands, contributing to the air being less hot. It

can be noted that the appearance of the most intense heat islands is most commonly in urban extension regions, as well as high temperatures.

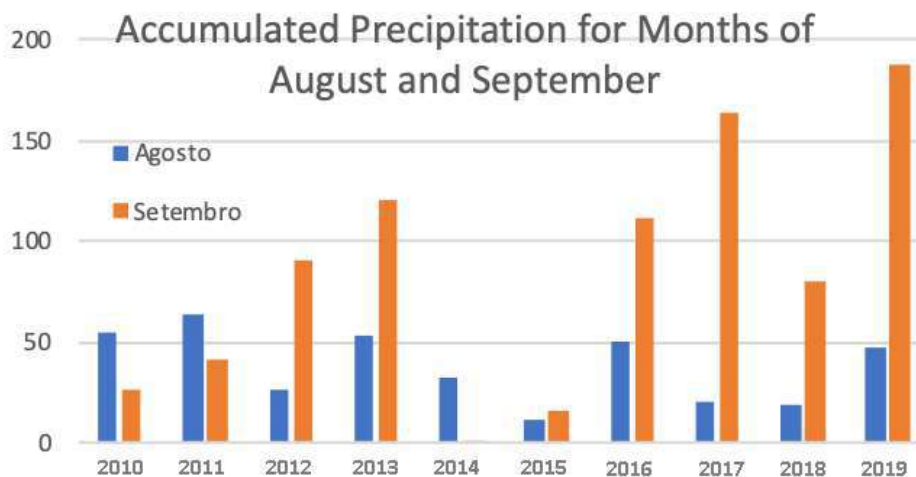


Fig.5: Accumulated precipitation (mm) in August (blue color) and September (orange color).

Figure 5 shows the degree of precipitation from 2010 to 2019 in August and September, which are the months of dry climate in the region. Manaus receives about 2,300 mm of rain per year, with its highest rainfall in december to May and decreases between June and November. In 2010 he heard a period of drought that is related to the occurrence of large-scale ocean-atmosphere coupled systems El Niño-Southern Oscillation (ENSO), which influenced the rainfall levels of the Amazon this year, leaving the rains less intense.

#### IV. FINAL CONSIDERATION

The city of Manaus/AM is known worldwide for its location next to the Amazon rainforest. Although tropical regions are characterized by high temperatures throughout the year, the forest has the role to collaborate in thermal comfort. On the other hand, the increase in urbanization, of spaces often built without any kind of inspection, are making the city of Manaus hotter every day. This work showed through MODIS images, that in the period 2010 to 2019 surface temperatures showed a significant increase, reaching values close to 47° C. These temperatures are concentrated in the "T zone" comprising the north, south and midwest areas. In parallel, in the same regions designated as "Zone T", NDVI images also showed a predominance of low emissivity, in all years, thus showing that the increase in temperature in these regions are characterized by vegetation.

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# Biodigester Carseiros Production of biogas and Biofertilizer

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**Abstract**— The present work developed a prototype of biodigester in a conventional way. The construction of the prototype used materials that easily access the population, especially PVC materials and reusable scraps that can be found in any community. Furthermore, the prototype was created in order to facilitate the manipulation of this technology by the community in general. To obtain results, the pH parameters, and electrical conductivity (EC) of the organic matter introduced and the final by-product, the biofertilizer, being compared the results between them. The other survey to quantify biogas production was done using the Chen method (1983) perfected by Mito (2018), which resulted in the production of 0.215 m<sup>3</sup>CH<sub>4</sub>/ day, the experiment can be used daily as cooking gas, in addition to a second functionality, such as biofertilizer, such as fertilizer in plantations and nutritional control of the soil.

**Keywords**— *Biodigesters; Biofertilizer; Biogas.*

## I. INTRODUCTION

When man began to use mineral coal along with petroleum derivatives (diesel oil, butane gas, gasoline, kerosene), as a form of heating and energy production, demand for natural resources began to intensify in a way uncontrolled, natural resources have boosted large corporations around the world for progress, which has caused severe consequences for the health of the population and the ecological balance of the environment, such as the intensification of the through anthropogenic actions that have occurred due to the burning of combustible fuels.

According to Netto (2010) in the second half of the eighteenth century, the industrial revolution reorganized human activities with new techniques and materials, contributing to the development of industries, the expansion of the railway system and the emergence of new forms of power generation, with hydroelectric and petroleum derivatives, initiating greenhouse gas emissions.

In the 1970s when there was the first oil crisis, which hit several countries including Brazil, made them engage in the search for new forms of power generation, and making them more independent. Brazil began to invest in the exploration of new oil reserves and in the development of renewable sources, such as hydroelectric installations and the use of biofuels, starting Proálcool (National Alcohol Program) in 1975, an initiative that aimed to intensify the production of ethanol (fuel from sugarcane), to insert in the automotive sector, as well as Pro-Oil (Plant oil production plan for energy purposes), in order to meet energy demand.

Rural areas began to use biodigesters for biogas production as an alternative with the support of the Ministries of Agriculture and Energy Mines, reaching out to be installed about 8,000 units, using the Chinese and Indian models, as well as models conventional in smaller dimensions, silk built up to 1,900 units functioning properly Andrade (2002). On the other hand, in Brazil cuts of funds for the propagation of biodigesters, caused a lag in the use of this technology in other regions of the country.

Biodigesters also known as Bioreactors, according to (NETO, 2012; FERREIRA, 2013; LEITE, 2017) are hermetically waterproof equipment within which organic material is deposited to ferment for a certain retention time, where the biochemical process called anaerobic biodigestion occurs, resulting in the formation of biogas biofertilizer. Biodigesters used to obtain biogas can be classified in relation to the process used for the production of the by-product, and the batch and the continuous.

As Coelho (2006) and Moura (2014) showed, biogas is a product derived from the decomposition of organic matter, such as animal waste, plant waste and organic products of residential or industrial origin. Its processing takes place through a biochemical process in the absence of oxygen and in adequate conditions of moisture, pH, Temperature. The biogas according to Metz (2013) is formed by a mixture of various gases and consists mostly of methane gas (CH<sub>4</sub>).

In addition to the biogas production, biodigesters became a great solution for the disposal of



effluents from the agricultural sector, which was previously thrown directly into the tributaries impacting the environment began to be used in plantations. For Andrade (2002), the final liquid by-product of anaerobic digestion, derived from the initial and nutrient-rich organic matter, can be used as biofertilizers for fertilization and nutritional control of the soil, and can replace fertilizers chemicals on the other, promoting not only profitability and savings in maintenance and control, but also adds value to products, agricultural crops, which use organic fertilizers being beneficially economical since it is no longer necessary to use of chemical fertilisers.

Due to technological advances, currently the popularization of this technology provided the diversification of the models of biodigesters used and models can be found for various purposes, such as models made of masonry with a large size of biogas production for power generation and or conventional using PVC materials for biogas production to be used in homes such as cooking gas. in addition to a second functionality, such as biofertilizer, used as fertilizer in plantations and nutritional control of the soil.

Although the use of biodigesters are still limited in some regions of the country, this research is justified in an

attempt to encourage and disseminate the use of this technology, especially in the state of Amazonas, through a prototype of biodigester made in a conventional way, using in particular PVC mateiras and scraps that are available in small community and thus be able to produce biofertilizer and biogas. The present study accounted for biogas production in volume according to parameters of the waste used. And for biofertilizer (effluent) a comparative analysis of the input material (tributary) of the values of hydrogenic potential (pH) and electrical conductivity (EC) highlighting the economic and environmental benefits, after the installation of this technology simple and sustainable.

## II. METHODOLOGY

The demonstrative biodigester was developed in order to show the feasibility of simplified construction and use of this technology. Additionally, due to its simple form of assembly allows to use it in the community in general and also, serving as multidisciplinary content for schools. The methodology was based on Metz's work (2013), which perfects biogas production to be used as cooking gas, combustion engine drive and other purposes.

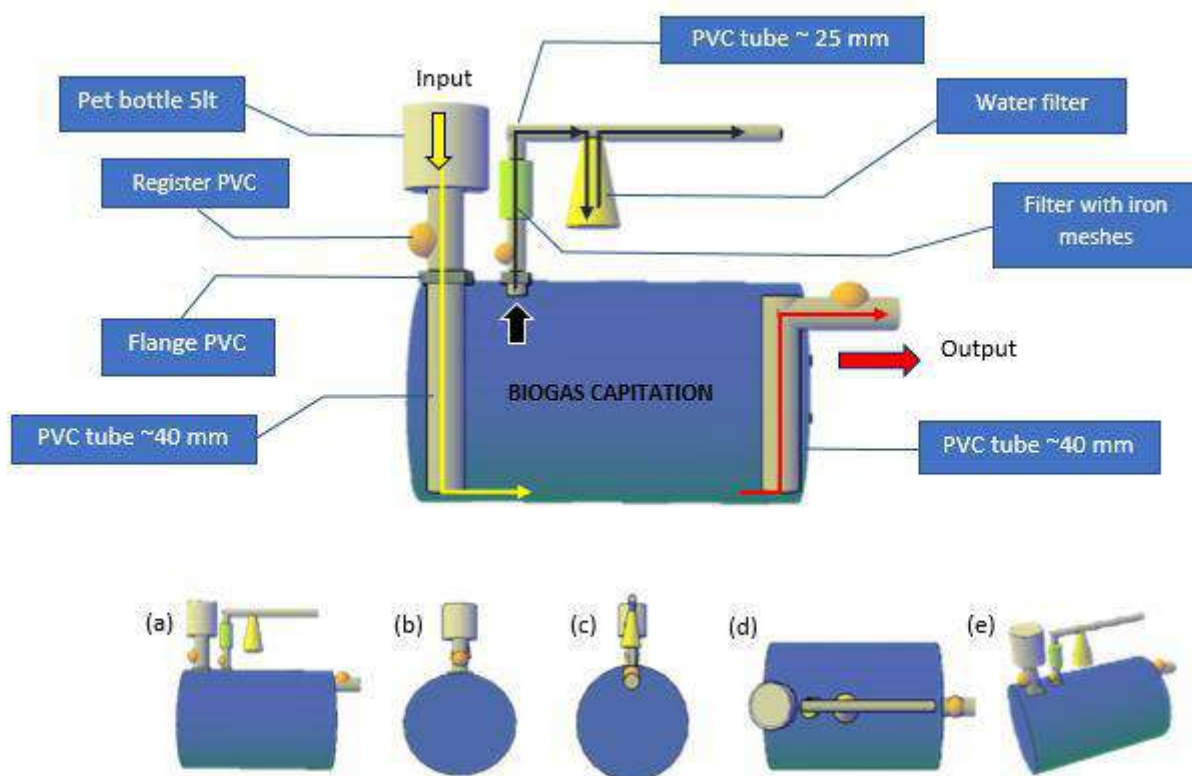


Fig.1: Internal Biodigester scheme: a) Side View; b) Rear View; c) Frontal View; d) Superior View; e) Transverse view

The experiment was developed in a workshop in the municipality of Caapiranga in the interior of the state of Amazonas 153km away from the capital Manaus, whose

climate is called Equatorial and average annual temperature of 26°C. During the construction of the biodigester we opted

for the use of PVC materials and scraps that can be reused by enabling costs and creating a form of sustainability.

First for the construction of the project, a sketch was made of the way the structure was built, using the Autocad program. The idea was to use the bombona horizontally and thus taking advantage of the side dimensions and holes already existing for the construction of the entrance, capturing the biogas output of the biofertilizer, the figures below show the planning and internal scheme of the project.

After planning, the materials for construction were separated (see Table 1). Most of the materials used were scrapped, making the equipment even more sustainable. The main component of the biodigester is a 200lt pump where they were installed as inlet, outlet and capture structures of biogas (see Table 1).

Table 1: Scrap table used for biodigester construction.

Materials	Measures	Quantity
2lt pet bottle	-----	1
5lt pet bottle	----	1
Transparent hose	----	40 cm
Sturdy plastic plate	----	14 x 14 cm
Wood	----	----
Bombona PVC	200 litros	1
Tubo PVC Soldável	40 mm	1
Tubo PVC Soldável	25 mm	1
Flange PVC	40 mm	1
Flange PVC	25mm	1
Registro PVC soldável	40 mm	2
Registro PVC soldável	25 mm	1
Tê PVC soldável	25 mm	1
Joelho 90° PVC soldável	25 mm	1
Joelho 90° PVC soldável	40 mm	2
Junta Líquida Secativa p/PVC	-----	-----
Adesivo Plástico p/PVC	-----	-----
Fita veda rosca	-----	-----
Cola Durepoxi	-----	-----

The entry structure of the biodigester was based on Mattos methodology (2011) and improved for the size of the biodigester, at the installation used the due materials, a flange, a register and tubes, both PVC with a diameter of 40mm and a pet bottle of 5lt, which served as a funnel facilitating the entry of organic matter into the system. For the output structure, a 90° knee, a log and pipes, both PVC with 40mm diameter being coupled into the holes already existing in the bombona.

In the process of eliminating odor and other impurities, biogas goes through the filtration process into two dots, the first by the filter produced with iron meshes and the second by the filter with water, where they are able to segregate the gases present inside the biodigester in a significant way and by capturing methane gas (CH<sub>4</sub>) interesting for use due to the energy potential.

The iron mesh filter aims to prevent a significant portion of the passage of sulfuric gas, responsible for the bad smell produced during the decomposition of organic matter. For the preparation of the filter were necessary; PVC materials, a weldable tube of 50mm diameter with 45 cm long and two reductions from 50mm to 40mm, filled with iron mesh. The filter with water allows the removal of odor, and the decrease of carbon dioxide mixed with methane, increasing efficiency in the biogas capitation process. For the construction of the second filter, the following materials were used, a 90th PVC weldable of 40mm in diameter, 30cm of 1mm hose, 50g Durepoxi glue.

For the survey of biogas production, two methods were used to estimate production and calculations based on Chen methodology (1983) altered by Mito (2018), allowing a stipulation of production from theoretical basis, The methodology addresses important parameters such as volatile solids (SV) and the maximum production capacity of biogas by waste (B<sub>0</sub>) and, therefore, has been widely used to estimate the theoretical potential of biogas production, calculated through equation 1, the other method for accompanies biogas production will be done through the use of a monometer coupled in the biodigester by pressing accompany ing the through the preção biogas productivity.

Theoretical estimate of biogas production, Equation 1.

$$PdM = \frac{Bo * SV}{TRH} * \left(1 - \frac{K}{THR * \mu m - 1 + k}\right)$$

Onde: *PdM* – (m<sup>3</sup>CH<sub>4</sub> m<sup>-3</sup>bio day<sup>-1</sup>) yield in methane m<sup>3</sup> per m<sup>3</sup> of the biodigester per day; *Bo* - (m<sup>3</sup> CH<sub>4</sub>. kgSV<sup>-1</sup>) methane production capacity by the; *SV* - (gSV L<sup>-1</sup>) concentration of volatile solids; *TRH* – (days) hydraulic retention time; *K* – (Dimensional) kinetic coefficient; *μm* - (day<sup>-1</sup>) maximum speed of specific growth.

Furthermore, for the calculation of the kinetic coefficient, the equation 2 was used

$$k = 0,5 + 0,0043 * e^{0,051 * SV}$$

Where: *k* dimensional kinetic coefficient; *SV* (gSV L<sup>-1</sup>) concentration of volatile solids. Furthermore, for the

specific growth rate the following equation was used 3:

$$\mu_m = 0,013 * T - 0,0129$$

For the terms of the equation above we highlight:  $\mu_m$  (day-1) maximum specific growth speed; T (°C) temperature. Furthermore, it will be necessary to estimate the amount of methane daily, where the Chen method (1983) that presents daily production through equation 4 was used.

$$PrM = PdM * Vbio$$

Where: **PrM** (m<sup>3</sup>CH<sub>4</sub> day-1) daily methane production; **PdM** (m<sup>3</sup>CH<sub>4</sub> m<sup>-3</sup>bio.day-1) methane yield; **Vbio** (m<sup>3</sup>) biodigester volume

Table 2: Chen methodology tables (1983) for qualitative parameters.

Type	SV (gSV L-1)	B0 (m <sup>3</sup> CH <sub>4</sub> kgSV -1)
Pigs	31,50	0,50
Cattle	64,70	0,20
Confined cattle	-----	0,35
Other cattle.	-----	0,25

Source: alterada de Mito (2018).

The use of the monometer directly enables the monitoring of biogas production, which results in a better production survey and can be compared the two productivity parameters. The monometer to be used measured the measurements in the following units of preton, Kg/cm<sup>2</sup> and LB/in<sup>2</sup> and can be converted by converting unit into kg/m<sup>3</sup>.

For the analysis of the levels of degradation of organic matter, the following stops, electrical conductivity (EC) and hydrogen potential (Ph) were verified, through the use of electronic devices capable of generating results related to the observed parameters. The conductivity apparatus capable of indicating electrical conductivity through dissolved solids, allows an analysis of the levels of nutrients dissolved in the tributary/effluent (biofertilizers), while the pHmetro, makes it possible to evaluate acidity levels and compare the results of the effluent/effluent of the biodigester.



Fig.2: Instruments for data collection a) conduitmeter; b) hm-1072 model pHmetro.

Figure 2 shows the conductivity and pHmetro, used respectively to obtain electrical conductivity (EC), measured in  $\mu\text{S/cm}$  (micro Siemens per centimeter) Factory pre-calibrated with European Conformity Seal (EC); and the second, an HM-1072 model meter, with European Conformity Seal (EC), used to identify the levels hydrogen potential (pH), evaluates acidity on a scale from zero to 14.

The operation of the biodigester was the following way, a 35kg amount of bovine manure was added within a reservoir of 100lt that occupied about 40lt of the reservoir volume, and which was diluted with 60lt of water, forming an aqueous mixture to be inserted within the biodigester, where I pass a 60-day retention theme to evaluate the results, until the introduction of a new load of organic matter.

### III. RESULTS AND DISCUSSIONS

One of the objectives of the construction of the demonstrative biodigester was to verify the feasibility of biogas production for family and small properties. This is due to the practicality, compact design and low cost which would enable its use by producers: what does not require great technical knowledge but requires installation guidance by people specialized in the installation of the system.

With the system already installed, some characteristics inherent to biomass used were observed. For methane production; time, type, temperature, and also biofertilizer; pH and electrical conductivity.

Previous examples as in Metz (2013), show that the lack of procedures interferes with the quality of the gas produced, the exhaled odor and that climate conditions of the environment are directly proportional. As previously mentioned in the experiment conducted by Metz (2013), where there was no filtration of the biogas causing the odor malodor and low inflammation of the gas. And from these observations we sought to improve the system by adding new parameters and procedures, which resulted in the



success of the burning of the biogas produced. These are the following actions taken in improving:

To build an improved system, the filter construction was carried out in two stages inspired by the Junior method (2018), providing not only the elimination of the evil odor, but also increased the efficiency of biogas burning. On the other hand, the segregation of gases removes impurities that decrease or prevent inflammation

of the biogas. Thus, the filtered biogas was stored inside the gasmeter, where it passes through gas pipes and then be manipulated for burning as kitchen gas.

The use of records for inlet and exit control made the biodigester operation easier, as it allowed the removal of the fertilizer in the main manner safely controlling the amount that allows removal.



Fig.3: Adaptations made; a) two-step filter; b) gasometer; c) input; d) output; e) Complete biodigester.

To evaluate the feasibility of using biogas as cooking gas, burning time was quantified through a two-mouth stove adapted in the system. Thus, it was possible to obtain better results, such as: a quantified output a time of

38 min and for the two linked outputs were quantified 20 min. It is worth mentioning that this time is proportionally related to the size of the gasometer, and becomes feasible to use for such purpose.



Fig.4: Prototype of the equipment during the process of burning biogas;



The calculation of biogas production generated by the prototype was performed using the Chen (1983) method perfected by Mito (2018), which totaled a volume of 0.215 m<sup>3</sup>CH<sub>4</sub>/ day, in a retention time of 60 days in the chamber, using bovine waste as raw material. Unfortunately, in the survey through the monometer it was not possible to obtain results, due to the pressure was not enough for the monometer pointer to mark measurement able values. However, even without measurements by the monometer, the burning itself on the stove and the filling of the gasmeter identifies the pressure formation within the system.

After the 60 days of retention, the analysis of biofertilizer (effluent) by means of a pHmetro shows the significant results for comparison with the added organic material (affluent), and an increase in the pH level can be identified after biodigestion. At the same time, Matos (2017) and Queiroz (2018) showed that the occurrence of acid pH occurs due to the gasification process of organic matter being basically composed of fatty acids, neutralizing the pH of the biodigester load, and thus, the environment is more susceptible to the action of metnogenic bacteria. At the same time, Santos (2016) states that for increased gas volume productivity the ideal range for pH would be between 6.5 and 7.5, while for Metiz (2013), the appropriate pH is in the range between 6 and 8.

Table 4: Values of pH, EC parameters for comparison between tributary and effluent.

Analyzed Material	pH	Electric conductivity
affluent	5,3	523X10 μS/cm
effluent	6,2	375X10 μS/cm

For the use of effluent as biofertilizer the ideal pH, according to the Ministry of Agriculture (2009) : class D effluents, organic fertilizer that, in its production, uses any amount of raw material from the treatment of sanitary dumps, resulting in a safe use product in agriculture, as is the case, must have a minimum pH of 6.0. On the other hand, for resolution CONAMA 375/06, which defines criteria and procedures for sewage sludge generated in effluent treatment plants in agriculture, for the application of the product, the criteria for effluent and soil analyses should be met, where soil-effluent mixture does not exceed the neutral pH limit (7,0).

Electrical conductivity (EC), measured through the pocket digital conductivity, is able to measure ec from the dissolved sais through the ions present in the mixture, made it possible to compare the levels of dissolved nutrients between the tributary and effluent. Matos (2017) in his

study points out that EC is related to mineral salt levels from anaerobic biodigestion in biofertilizer, and the decrease in values in his experiment was due to a decrease in the amount of salts dissolved during the process of anaerobic digestion. In the study developed by Junior (2018) the increase in EC levels after digestion indicates what in the degradation process occurred the transformation of the most complex substances into simpler by-products, thus increasing dissolved sais and consequently the increase in EC. On the other hand, if we compare the results of this study to those of Junior (2018) and Queiroz (2018), it is verified that pH and EC are inversely proportional.

#### IV. FINAL CONSIDERATIONS

With the results analyzed, it was possible to conclude that the application of the experiment is of great viability in environmental issues. Because the use of this provides a control of organic waste, minimizing impacts and increasing environmental safety. Furthermore, the tests and results with the prototype presented previously presents an economic bias, because it uses the by-products of anaerobic digestion such as biogas. The biogas produced in this experiment can be used daily as cooking gas, in addition to a second functionality, such as biofertilizer, such as fertilizer in plantations and nutritional control of the soil.

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# The Memory of Exclusion of the other and your Look in Speaking Patients with Dermatological Pathologies

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**Abstract**—This study presents, concisely, the results of our PhD thesis defended in the Graduate Program in Memory, Language and Society of the State University of Southwest Bahia (UESB), where we show how the congenital or acquired marks, intentionally or unintentionally, or left by different skin pathologies, they not only mark the individual's skin; but also allow the materialization of different lines, which are configured and reconfigured from different events. The methodological approach undertaken in the analysis follows the indicative paradigm, which states that we must observe the details, the details, in order to arrive at the construction of the research hypotheses and, subsequently, to be led, by these same hypotheses, to conclusions about the relationship between what we are calling “skin tags” and the construction of a certain memory. The results showed that the skin marks are also memory marks that: i) contribute to the constitution of the subjectivity of the marked subject; ii) favor the maintenance of socially constructed stereotypes, which reinforce negative images about oneself in the marked subject; and iii) relate to the question of desire and, consequently, with the constitution of the unconscious of each marked subject.

**Keywords**— *memory; skin; dermatology; speech; subjectivity.*

## I. INTRODUCTION

This study analyzes the memory of the marks that dermatological pathologies have left on the skin and in the lives of people who had and live with such diseases. This memory constantly appears in the speech of these subjects in their role as patient. Therefore, it is a matter of verifying the connections between the speech (s) of the research subjects with memory / body / skin, since these three elements are considered here as indicators that indicate different forms of constitution of the subject.

In this perspective, we analyze this memory that these pathologies left in the skin and life of these patients, which is socially constituted in the relationship between oneself and another; since, as we found in Halbwachs (1990: 26), “our memories remain collective. , and they are reminded of us by others, even if these are events in which only we were involved.”

Therefore, we seek, in this work on skin tags and their role in the constitution of the subject, to analyze how what comes from “outside” inscribes internal meanings, and these, in turn, although carefully housed in the recesses of soul, inwardly personal and secret, protected and hidden in the basement, eagerly scream, show themselves, and determine who we are and where we are going.

It is for this reason that we propose to study such personal marks that we carry on our bodies and which are *untransferable* and *rememberable*, which announce a pain, trigger a wound, enunciating, through their presence in the body, the lasting and indelible memory of unpleasantness of pleasure, which often accompany us (VAZ, 2006: 59). From this point of view, the skin itself can enunciate a lot, especially if it has spots (nevus) or scars and marks left by various skin pathologies. Thus, skin and memory dialogue with society and open avenues for reflections that fall on the mechanisms through which the subject can enable the understanding of man's senses in history, in their most diverse aspects and possibilities, following the tracks recorded in the skin., as a body wrap, and as an image of the subject presented to the world, as discussed in Prates (2016).

## II. THE CONSTITUTION OF THE SUBJECT AND THE MARKED SKIN

The skin, which covers the whole human body, is not only the first obstacle to be overcome by a strange being or element that triggers our organic defense system, but acts to drive the perception of the senses, and also permeates the first contact of the body individual with the world at birth. This biological and multifunctional tissue

incorporates the possible meanings that are in the order of the constitution of the subjects, whose physiology in full activity directs and leads, in the richness of its complexity, the beauty of the subtle texture of existence, of experiences, of perception, promoting and enabling multifaceted experiences.

In a society like ours, “the individual is undoubtedly the fictional atom of an 'ideological' representation of society; but it is also a reality fabricated by this particular power technology that is called 'discipline' ” (FOUCAULT, 2011: 161). The term subject can be understood in two ways. The first concerns the way in which one individual subjects himself to another through control and dependence. The other way refers to the way in which the individual attaches to his own identity through consciousness or self-knowledge. In these terms, we have two senses that “suggest a subjugating and subjecting form of power” (FOUCAULT, 2013a: 278).

Coincidentally, there are two types of memory that the individual participates in, that is, we can admit that “there would be individual memories and, as it were, collective memories.”(HALBWACHS, 2006: 71). This finding compels us to recognize that we are often forced to refer entirely to the memory of others; given that it allows us to access facts that have happened in the past or that have happened in the present “in a summarized form and schematic, whereas the memory of our lives would present us with a much more continuous and less dense panorama” (HALBWACHS, 2006: 73).

Or, these two types of memories are directly linked to how power is immediately produced in people's lives. It “categorizes the individual, marks him with his own individuality, binds him to his own identity, imposes on him a law of truth, which we must recognize and which others must recognize in him. It is a form of power that makes individuals subject” (FOUCAULT, 2013: 278).

In this perspective, all these instances of functional individual control, in general, are characterized by the dual mode of action in which there is a binary division and a marking (crazy-not crazy; dangerous-harmless; normal-abnormal); a coercive determination and a differential distribution (who he is; where he should be, how to characterize him, how to recognize him; how to exercise constant vigilance over him, etc.) (FOUCAULT, 2011). Thus, individual and collective memories are under the order of this form of power which is also responsible for controlling not only the body, but discursive practices and discourses.

Under these circumstances, the constitution of the subjectivity of those who have such a dermatological disease occurs through a process of subjectivation that

marks the individual throughout his or her life. It is this process that subjects this potential individual to an identity marked by exclusion and social meal; that is, this process forces any individual who might have such a pathology to be coined with an identity that no one wants to have. The marks of the body and the possible deformations end up becoming symbols of this identity that forces it to be cut from the contact of social life, an exclusion that is incorporated into its body through the memory of the events that are behind this process of subjectification; thus, “individuality, individual identity are products of power.” (FOUCAULT, 2006: 84).

Therefore, it seems to us that we need to understand more these subjectivation processes that produce material effects directly on our bodies, especially the subjectivation processes that impose the bodies we don't want to have. The following analysis is based on this idea.

### III. THE SUBJECT-PATIENT SPEECH AND THE MEMORY OF THEIR PHYSICAL AND SOCIAL MARKS

The speeches of the patients suffering from these dermatological disorders, gathered in this study of ours, contain the memories we used to build this story that we talked about earlier. It tries to draw from the thickness of discourse the historical conditions that the materiality of power produces in these sick individuals, but also from the power given to the physician, “an individual who emerges as an object of medical knowledge and practice.”(FOUCAULT, 2012: 111). Hence his status as a physician whose power “comprises criteria of competence and knowledge; institutions, systems, pedagogical norms; legal rights that give it right - not before setting limits on it - the practice and experimentation of knowledge ”(FOUCAULT, 1972: 57). All in this way of being and acting constitute the ways in which the individual who is a physician should be subject. They are part of the processes of subjectivation and identification of this activity that require an enunciative function whose power could establish a new alliance by seeing and saying (FOUCAULT, 1977: XI, emphasis added).

However, where is the patient in this game that involves discursive practices and processes of identification and subjectivation, considering that “the subject is divided within and in relation to others” (FOUCAULT, 2013:273)? In other words, “what chain, what determinism is there between one another?”(FOUCAULT, 1972: 57). The answer to these two questions that we now launch is in the order of the speeches of these patients that we will analyze from now on. The relationship between doctor and patient, as we see



it today, stems from a certain clinical experience that took place “around the last years of the eighteenth century” (FOUCAULT, 1977: X). This is the moment when modern medicine reflects upon itself, identifying “the origin of its positivity with a return, beyond all theory, to the effective modesty of the perceived” (FOUCAULT, 1977: X).

This was, therefore, the first opening in Western history that would soon be taken as a kind of simple confrontation, “without concept, between a look and a face, between a glance and a dumb body, a kind of contact prior to every speech and free from the embarrassment of language, whereby two living individuals are 'caged' in a common but not reciprocal situation”(FOUCAULT, 1977: XII). This is how we will treat the reports that appear in these statements, being aware of the role of doctor and researcher that we perform in this study. Let us pass to the transcribed sayings that spell the appearance of the disease, below:

*[...] when I left, there were always people talking, saying something like that, I saw that there were people who didn't want me to get close, they didn't want to get close to me, they were afraid of getting the disease, and there were people who even asked "are you with leprosy?" Until then I've heard! So, I didn't go to the club anymore, I didn't have the courage to get in a pool, because I thought that if I get in the pool, then everyone will leave, or someone from the club will call me and tell me to leave the club. [Report of a patient with vitiligo].*

The speech that appears in this account enunciates the desperate fear that has to be cut from social life. This type of subjection is the most feared in these times when social networks in the virtual world began to interfere in the lives of individuals everywhere on our planet. Nevertheless, the desperate fear that is enunciated does not appear with the disease, it is in our collective memory.

The statement “are you with leprosy?” said, in our present, goes back to the time when the sick were forcibly isolated in colonies for lepers. This fact is present in the collective memory of our society and even those who did not live at that time, are reunited with such memory, either through books, movies, magazines, or through conversations with family members who lived in the period etc. Despite all the progress that the treatment of this pathology has achieved in our day, and can cure the patient, prejudice still remains alive, as we can verify in this report.

Leprosy is a disease of infectious character, chronic and prolonged course, and is caused by *Mycobacterium leprae*. It predominantly affects the skin and peripheral nerves. Due to its clinical characteristics, it can commonly

be confused with other infectious diseases that affect the skin, such as syphilis, tuberculosis and leishmaniasis; with rheumatological diseases such as rheumatoid arthritis and lupus erythematosus; with hematological diseases such as leukemia, and with several other pathologies (SITTART, 1998: 125).

Today has its highest incidence in India, and Brazil has the second highest worldwide incidence of this disease. It is a disease of compulsory notification and its treatment, in Brazil, is available at the referral centers, free of charge, by the Ministry of Health.

Therefore, leprosy has become, over these two millennia, a dermatological disease that always puts people on alert because of its history that brings many negative memories. Hence any dermatological disease that causes some change in the skin causes people to be in this alert state, and enunciate the question: “Do you have leprosy? ”, And all its variations (Is this leprosy? Do you have leprosy? Etc.).

The report given by an individual with psoriasis is another way of proving the relationship between leprosy's collective memory and other dermatological pathologies. When the person says: “it doesn't take!” Is vehemently another way of saying: “this is not leprosy”? Let us look at the transcript of this segment below:

*[...] I always said that it does not, that the doctor said that it does not. I do not know, the doctor there knows, but I do not know, but the doctor said that does not take anyone, the psoria [sic], right? People don't know what psoriasis is and the first question they ask me: “Got it? What is it” [Report of a psoriasis patient].*

The reports of these subjects help us to understand the changes and to observe the mechanisms that penetrate the body and control its gestures and behaviors, especially in the current relations between the subjects and the contemporary world. Dermatological diseases produce great suffering, beyond the physical, particularly because of this utopia that affects the psyche of the individual who presents them; that is, these pathologies are the opposite of what we want to be and have.

Under these conditions, the skin can be considered as the envelope of the “I” and, in this condition, delimits its relations with the outside world. Due to this position of interface between the individual and the environment, the skin acts as a privileged field of action, where the tensions between the exogenous and the endogenous, triggered for the processes of physical and psychic elaboration, operate. In this sense, we can say that the skin plays an important role in the human psychic constitution, since the relationships that develop between psyche and skin encompass most of the subjective elements that appear in

the singularity of being, such as emotions, feelings, the fantasies and the wishes.

Although we should consider that it is the individuals themselves, marked by certain dermatological pathologies, who impose on themselves their exclusion from social life; On the other hand, we are obliged to recognize that such exclusion is the effect of discursive practices and a kind of social disciplinary device imposed on all individuals by society itself. We come to this line of thought because we take into account Foucault's statements in *Discipline and Punish*, a work that deals, among other things, with disciplinary devices and the appearance of the Panoptic in Western societies, as we have shown earlier. The Bentham Panopticon illustrates well how our society has gradually enhanced the homogeneous effects of power to solve the problem of the accumulation of men; that is, how Western societies have solved the population problem by inducing us to "a conscious and permanent state of visibility that ensures the automatic functioning of power" (FOUCAULT, 2011: 167).

This state makes us vigilant of others and ourselves. In this way we are affected by the memory of the other, which is also part of the collective memory. The images of these pathologies, which we will show later, are the visible record of what no one wants to see in themselves or others. They end up being associated with what is abnormal by means of a selection device between normal and abnormal. Therefore, we see in these images what is contrary to our desire for a utopian body that has become as perfect and incorporable as it is powerful.

#### IV. FIGURES



Fig. 1: Hypertrophic Scar - Source: Google



Fig. 2: Vitiligo - Source: Dermis Net



Fig. 3: Psoriasis - Source: Global skin atlas

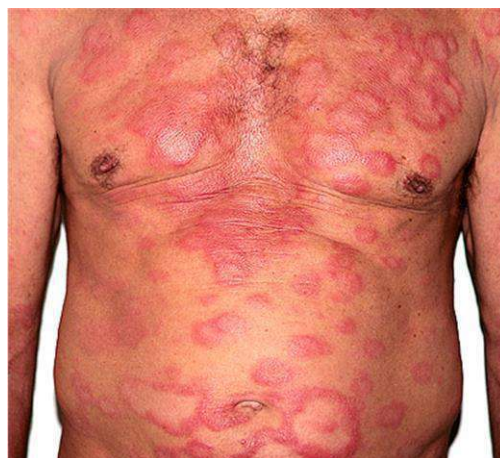


Fig. 4: Borderline Leprosy - Source: Atlas dermatológico

#### V. CONCLUSION

In this paper, we seek, in a way, to bring medical knowledge and practice closer to new interlocutors, without, however, abandoning the postulates that guide good medical practices. In this perspective, we seek to promote the dialogue between medicine, particularly the area of dermatology, with interdisciplinary perspectives, taking as a central issue the memory in its different meanings. In this way, we consider consecrated social theories to guide us in the search for the answer to our research questions, all related to the role played by

memory and the presence of marks and skin pathologies in the complex processes of construction and constitution of the subject, in contemporary times.

The analysis showed, in general, the various and distinct manifestations that are triggered from the visual experience of the other face of the appearance of visible skin lesions, difficult to camouflage. The inevitable exposure of these also arouses unpleasant feelings in the subject of such attentions, comparable to those provided by other pictures of intense physical pain, as reported by some patients during the dermatological consultation, with the difference that the first, according to them, "Hurt the soul the most."

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# Environmental Analysis of Guamá River Floodplain, with Emphasis for Clay Mining in the City of São Miguel do Guamá (PA)

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**Abstract**—The use of natural resources, in recent times, has intensified in exponential scale as well as their degradation, fostered by the inadequate management of the soil, water bodies and biodiversity. One of the most affected places by this dynamic is related to floodplain or lowland, since the vegetation suppression, present in this environment, is subtracted by anthropic actions through practices such as agriculture, urban construction and mining. This last one, in the municipality of São Miguel do Guamá, state of Para, occurs as a result of the extraction of clay, used from the manufacture of ceramics (bricks, tiles, etc.) to medicinal treatments. The approval of Federal Law No. 12,651 / 2012 allows mining activity in floodplain and Permanent Preservation Area (APP). Thus, the present study aims to analyze the recurrent environmental impacts in these areas, focusing on the Guamá river APP, inserted in the municipality of São Miguel do Guamá, by mapping the floodplain, APP and land cover in this area; identification of clay extraction sites; gauging the environmental impacts of extraction; quantify land cover; evaluate and propose measures to mitigate environmental impacts. Based on the results it can be concluded that floodplain forest suppression and fragmentation directly influence the provision of ecosystem services to the local population. The main factor of this loss is the change in land use and the activity of clay extraction along the lowland.

**Keywords**— Natural Resources, Sao Miguel do Guamá, Permanent Preservation Area, floodplain, clay extraction.

## I. INTRODUCTION

The process of degradation of natural resources, as a result of land use dynamics, such as inadequate management of soil, water and biodiversity, has been a cause of global concern in recent decades (BRASIL, 2019).

The transformation of forests for agriculture, livestock and mining, as well as urban-industrial activities has had a negative impact on terrestrial and aquatic ecosystems. This change compromises the functioning and natural regulation of the environment, therefore its ability to supply ecosystem (SE) and environmental (SA) services (BRAZIL, 2019).

According to MEA (2005) SEs are the benefits / improvements that humans derive from ecosystems. These include provision services (food and water); regulating services (erosion, climate, air, water regulation); cultural services (cultural diversity, educational and aesthetic values, social relations); and support services (soil

formation, photosynthesis, nutrient and water cycling). But the SA, for Muradian et al. (2010), are defined as environmental benefits arising from intentional practices of society in the dynamics of ecosystems. In this way, ecosystem / environmental services have not only economic impacts, but also health and human welfare.

Among the various ways to protect and conserve the environment, the preservation of riparian forests (riverbank vegetation, streams, lakes, dams and springs) contributes to the construction of ecological corridors, recovery and maintenance of biodiversity in rivers, conservation of the hydrological cycle in the river basins, hindering the erosion process of river banks and siltation of their beds, besides helping in the biological balance of pests and improving the quality of life (BONONI, 1989). Due to its important role for environmental balance, the riparian forest is considered by the Brazilian Forest Code as Permanent Preservation



Area (APP), its main objective is to preserve fragile places such as riverbanks, springs, slopes and hilltops (BRAZIL, 2012).

However, not only the riparian forests present in the above mentioned sites deserve protection, but also the preservation of the vegetation along the floodplain (lowland) has an important role in establishing the balance of a watershed. Benatti et al (2005, p. 24) define the floodplains as “areas marginal to water streams, periodically flooded, either by tidal influence or by river overflow due to rain”. Floodplains are considered a priority ecosystem for conservation due to their high biodiversity and offer benefits to society, such as: aquifer recharge, water storage and purification, flood control and food in this habitat (ROLON et al., 2006). However, over the years, vegetation suppression has been observed in these environments, substantially affecting the energy balance. Typical vegetation in these areas has been replaced by crops intended for agriculture, pasture and city expansion without proper planning (LEITE, 2013).

In floodplain, in APP sites, mining activities may occur. In the economic vector, these activities provide income generation through the use of raw materials in industrial sectors. In the social context, there is the generation of jobs that the sector represents, in addition to tax collection and economic circulation (SANTOS, 2014). Some ores such as clay are used directly in construction, ceramics and health care.

However, like any other economic activity, unplanned mining results in negative impacts on the environment, such as subtraction of plant and animal species, lake formation, and erosion (PARA; FIBGE, 1995). However, according to art. 8 of the New Forest Code, Federal Law No. 12,651 / 2012, the intervention or suppression of vegetation in APP will only occur if there are assumptions of public utility, social interest or low environmental impact (BRAZIL, 2012).

In the municipality of Sao Miguel do Guamá, state of Para, mining activity is mainly related to the extraction of clay, since its use ranges from the manufacture of ceramics (bricks, tiles, vases, among others) to medicinal treatments. Its formation derives from the alteration of some rocks and can be found near the rivers, has varieties in their colors, and can be white and red. This material is a constituent part of the soil next to silt and sand and has particles with high moisture retention capacity. When aggregated with other compounds, clays give rise to extremely fertile soils (JACOMETI, 2011).

The flexibility of Federal Law No. 12,651 / 2012 allows, through mining activity, greater possibilities for soil

degradation and vegetation cover, producing negative impacts on APP and floodplain, thus modifying existing ecosystem and environmental services. Thus, analyzing the dynamics of land use and land cover is essential to understand the impacts occurring in the floodplain, focusing on areas protected by legislation (APP), because, although there is the presence of mining activity, it is possible to achieve balance of the ecosystem for the sustainable use of existing natural resources.

## II. STUDY AREA

### 2.1 General Characterization

For this research we took as study area the municipality of Sao Miguel do Guamá (Fig. 1), located in the Intermediate Region of Castanhal and Immediate Region of Castanhal, according to the new regional division of the Brazilian Institute of Geography and Statistics (IBGE), and in the Northeast Paraense Mesoregion and Guamá Microregion according to the previous division. The municipality has as the southern limit, the Guamá River (Fig. 2), where its floodplain and APP will be the focus of the environmental analysis of the research, considering the external interference from the economic activities developed in the municipality in question.

In 2010, the municipality of São Miguel do Guama had 51,567 inhabitants distributed over 1,100,175 Km<sup>2</sup> in its territory, and according to the estimate made in 2019, its approximate population is 58,986 people (IBGE, 2010). In the seventeenth century, the period of its colonization the main economic activity revolved around the vegetal extraction of fruits and woods, trade, agriculture and subsistence livestock. Until the 1960s, its main route of locomotion/interconnection with other municipalities and rural villages was through the Guamariver. From the second half of the twentieth century onwards, the logging and mining activities began to be highlighted, with the extraction of clay. In 1970, the manufactured companies were the ones that consumed the most labor generating jobs and income in the municipality. Only in 1980, the ceramic activity stood out in the local and state economic scenario, when there was the installation of industrial production units (CORDOVIL, 2010).

According to the National Department of Mineral Production, the municipality of São Miguel do Guamá is home to the main ceramics district in the north of the country, and potteries correspond to a percentage of 60.7% of the companies housed in its territory (DNPM, 2010).

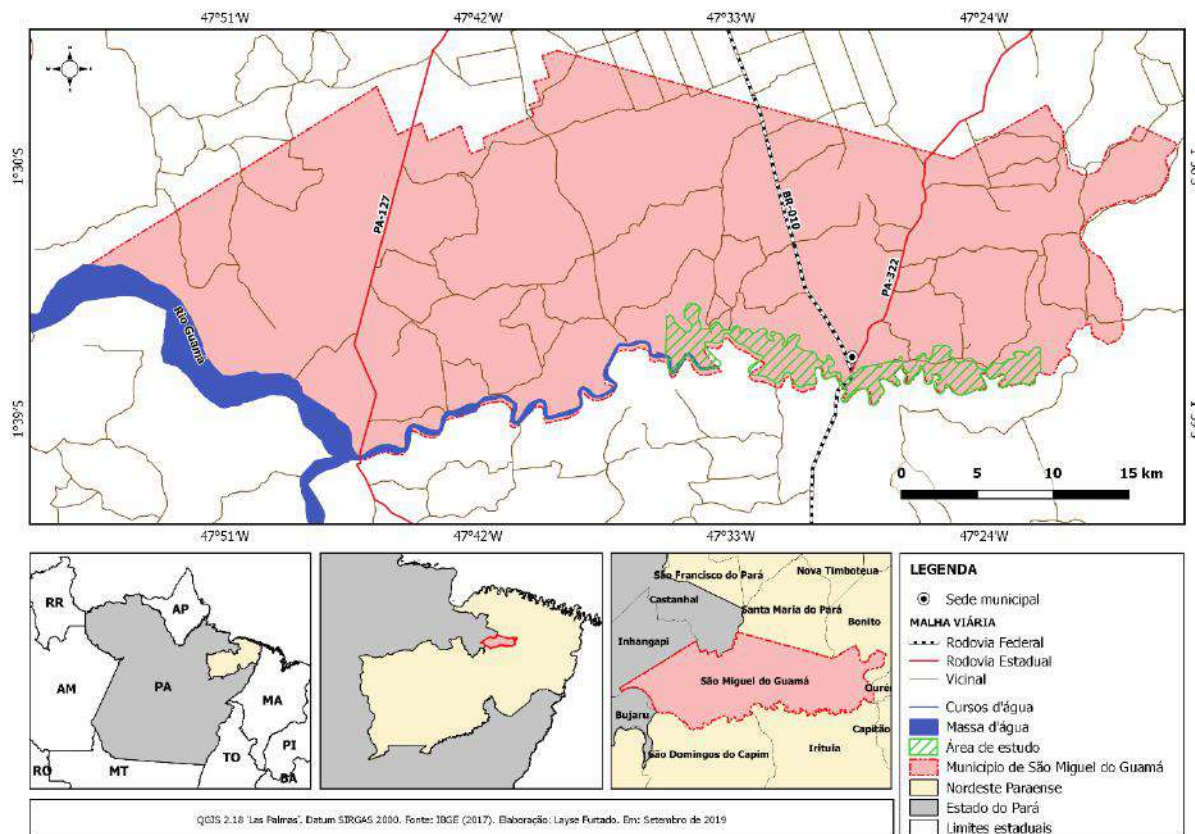


Fig. 1: Location map of the municipality of Sao Miguel do Guamá / PA.



Fig. 2: Photographic record of the Guamáriver between the municipalities of São Miguel do Guamá and Irituia.

### 2.2 Physical-Environmental Characterization

The study area is inserted in a floodplain (floodplain) ecosystem, in which there is a period of ebb during the less rainy season between June and December, when the volume of the Guamá river falls; and another of flooding in the rainy season between January and May, characterized by the increase of waters, which overflow cause flooding of marginallands in different degrees of intensity (BENATTI, 2016). The Alluvial Dense Ombrophilous Forest (or floodplain forest) (Fig. 3), whose vegetation

occurs along rivers and floodplains, is usually less diverse than the adjacent dryland, and houses animals and plants adapted to seasonal hydrological conditions ( KALLIOLA et al., 1993). The lowest diversity occurs because few species have morphophysiological mechanisms that tolerate the seasonal rhythm of flooding (SILVA et al., 1992). The lowest diversity occurs because few species have morphophysiological mechanisms that tolerate the seasonal rhythm of flooding (SILVA et al., 1992).



Fig. 3: Photographic record of the vegetation present in the floodplain.



A vegetation cover characterized mainly by secondary forest (Fig. 4), result of intense suppression of native forests. On the other hand, the interior of the vegetation with alluvial Herbaceous lacustrine vegetation, remnants of the original cover, can also be found in the marginal portions of the Guamáriver.

The main hydrographic accident in the municipality is the Guamáriver, which borders the municipalities of Irituia, São Domingos do Capim and Bujaru. The right bank portion of the Guamá river is cut by several tributaries, including the Cupera, Matupireteua, Ajuai, Crauteua, Aracuí, Urucuri streams. The topography has a soft relief, showing few oscillations. In the municipality the altimetric quotas have little amplitude, average of 20 meters above sea level, and the maximum quota around 73 meters, with minimum around 10 meters.

Geologically, cohesive sandstones, named “Guamá Sandstone”, appear in the vicinity of the municipal headquarters, characterized by well-rounded, well-selected medium-sized quartz-sandstone layers with a high degree of textural and compositional maturity, probably of

Silurian age (MARTINS, 2019). Its geomorphological feature is characterized by the retouched flat surfaces. The eastern portion of the municipality consists of rocks from the Gurupi group, dated from the Precambrian, formed by phyllites, shales and metavolcanic, and may find quartz and auriferous veins. In smaller quantities it is possible to find rocks of the Maracaçumé Complex present in the quarries of the Bragantina region. Alluvial deposits are located on the banks of the Guamá river and tributaries, typical of a River Plains environment (DIAGNOSTIC REPORT FOR PREVENTION ACTIONS, 2017). The Barreiras Group, more specifically the clayey sandy facies, represents the most prominent geological unit in the municipality, consisting of clayey layers, and few amounts of sand are generally incoherent, gray to yellowish, sometimes variegated (GOES, 1981; KOTSCHOUBEY et al., 2017). This group underpins the geomorphological compartment named by the Bragantina Zone Tablelands, formerly named Lowlands of the Amazon by Barbosa and Novaes Pinto, in 1973 (DANTAS and TEIXEIRA, 2013).

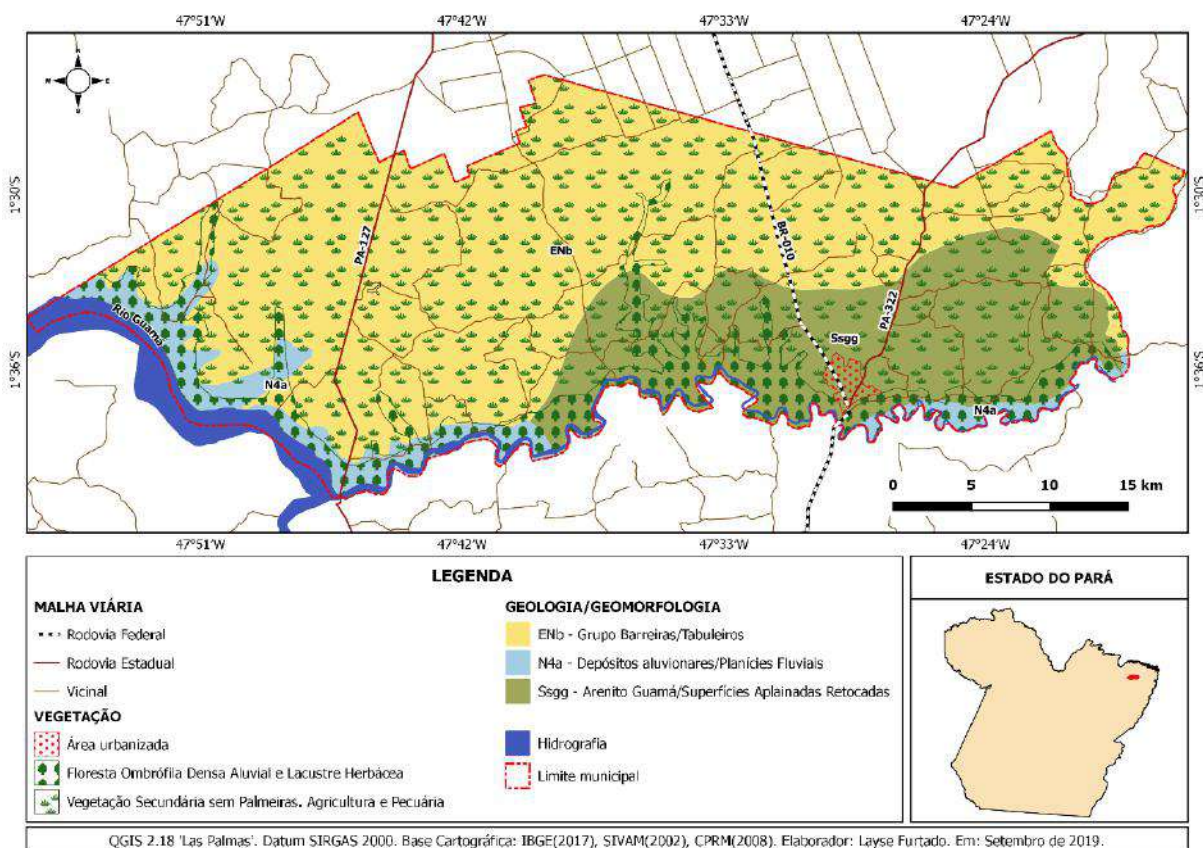


Fig. 4: Physical and environmental map of the municipality of Sao Miguel do Guamá / PA

### III. MATERIALS AND METHODS

Initially, it was necessary to consult specific studies and current legislation, collect primary and secondary data

through field visits and digital platforms, respectively, in order to better understand the processes of use and occupation. on the floodplain and on the Guamá river APP.

Next, the other materials and methodological processes used in this research will be presented.

### 3.1 Cartographic Database

To know the physical-environmental aspect of the study area, it was necessary to consult and acquire the cartographic data available in the digital collections of the Brazilian Institute of Geography and Statistics (IBGE), Amazon Surveillance System (SIVAM), Mineral Resources Research Company (CPRM), on a scale of 1: 250,000, as well as the National Department of Mineral Production (DNPM), which was adopted for the identification of mining areas through DNPM-registered mining processes, available on the System's online platform Geographic Information Service - SIGMINE. This information was collected in July 2019, at the same time as the field visit, with the intention of generating more accurate results in the identification of active and inactive caves. All information available on SIGMINE is official and used according to the frequency of each institution, thus being updated daily at 24h.

Data related to geology, geomorphology, vegetation and mining areas were spatialized in a Geographic Information System (SIG) environment, program QGIS 2.18. These systems, when related to other technologies, can acquire, store, manipulate, simulate, and model geographic data, helping to interpret the natural and anthropogenic processes that occur on the earth's surface over the years.

To delimit the floodplain it was necessary to use aerial photographs of the municipality sent by the CPRM virtual library. It makes available the first collections of the Geological Services of Brazil, as well as a collection of DNPM publications. This online platform includes a significant number of technical documentation, especially photcartographic, digitized and integrated in a search technology.

This online platform includes a significant number of technical documentation, especially photcartographic, digitized and integrated in a search technology. The nominal scale of the photos in black and white infrared film is 1:70 000 and the photo index is 1: 250 000. These two photographs have a 30% lateral and 60% longitudinal overlap, which helps in better interpretation of the images targets.

After obtaining the photos in the SIG environment, their georeferencing was performed, by means of the recognition of control points in a 2B sentinel image, in order to start the floodplain vectorization. This image has a MultiSpectral Instrument (MSI) sensor with a spatial resolution of 20 meters and corresponds to June 30, 2018, available from the United States Geological Survey (USGS). Through it was possible to identify and vectorize the targets, with scale of

1:35 000, classified in: water mass, extraction area, anthropized area, natural fields, undergrowth and dense vegetation.

Finally, adjustments were made to the geometry of the Guamá river based on the Sentinel satellite image and the hydrographic vector file provided by IBGE. In view of the delimitation of the river channel, the buffer tool was used, inserted between the spatial operators belonging to the geoprocessing, to design the APP's according to the parameters established by law.

### 3.2 Fieldwork

The trip to the field was extremely important to validate the data collected in the laboratory and to verify the social and environmental aspects present in the study area. The *on-site* visitation is necessary as long as targets smaller than 20 meters in the satellite image cannot be identified and may be confused or generalized with other targets of similar spectral responses. Given this, this procedure allows to guarantee the reliability of digital data through reality in the field.

Throughout the area covered by the Guamá River, with the help of tools such as questionnaires, camera phone and Garmin GPS, it was possible to record some areas with environmental impacts in photographs, as well as to identify and collect geographical coordinates of the extraction sites of active and inactive clay.

After recognizing these sites, the visit was made at the Municipal Environment Secretariat (SEMMA) and the Municipal Finance Secretariat (SEFIN), with the purpose of understanding what are the mitigating measures adopted in the extraction sites and which are the main activities, prevailing economic conditions in the municipality.

## IV. RESULTS AND DISCUSSIONS

The results presented here are divided into 3 stages for the environmental analysis of the floodplain and the Guamá River Permanent Preservation Area (APP). The first step is based on the mapping of floodplain, APP and land cover and their quantification. In the second stage, the clay extraction sites are identified and the environmental impacts of this activity are verified. And the last step was designed to evaluate and propose measures to mitigate environmental impacts.

### 4.1 Floodplain Mapping; Permanent Preservation Area (APP) and Land Cover and their Quantification

#### 4.1.1 Floodplain mapping

In the study area, the floodplain contiguously follows the right bank of the Guamá river, has an area of 4,473 ha, approximately 24,700 km long and with a width ranging from 150 meters to 4 km, which can be covered by floods of the Guamá river and its tributaries.



From the aerial photographs of the late 1970s it was possible to identify the primary vegetation, however, with the presence of small clearings of deforestation and / or flooded fields (Fig. 5). The beginning of these small anthropogenic changes in the landscape of the municipality

was intensified due to the economic activities developed in the 70s and 80s with the logging and red ceramics, is last having greater significance in 1980 with the installation of industrial production units, remaining until nowadays.

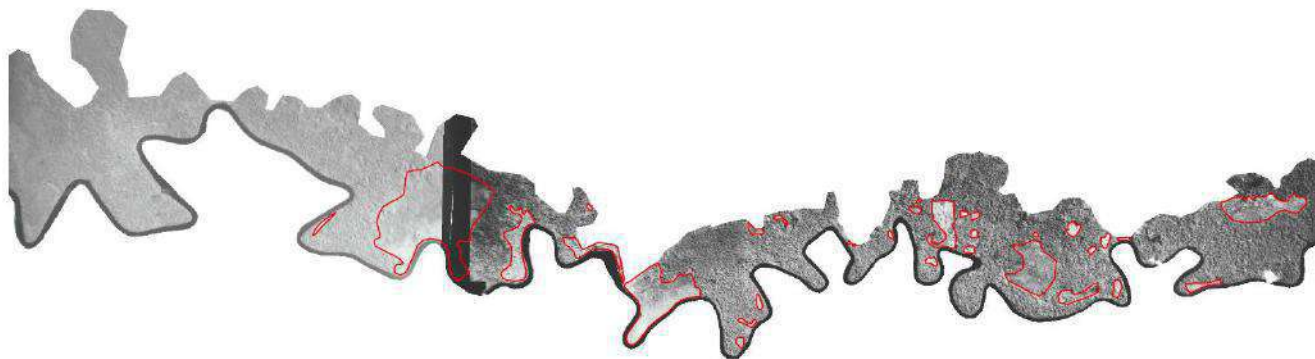


Fig. 5: Deforestation clearings and/or flooded fields on the Guamá river floodplain.

#### 4.1.2 Permanent Preservation Area (APP) Mapping

To demarcate the Permanent Preservation Area (APP) of the Guamáriver, it was adopted by Law No. 12.727 of 2012, which determines an APP according to margin ranges of any perennial and intermittent natural watercourse, excluding ephemerals, since the edge of the regular bed chute. From this determination, the Guamá river vectorization process was carried out by means of satellite images and the IBGE hydrographic cartographic base, wherethe buffer tool was used to determine the distances stipulated by the forest code.

In the region under study, for the most part, the width of the river is between 50 and 200 meters, and only a portion, which has a physical boundary between the municipality of São Miguel do Guamá and Irituia, has a river width of over 200 meters, which guarantees a greater delimitation of the APP in this section. Given this, the Guamá river APP, in the study area, has a range of 100 and 200 meters, totaling an area equivalent to 529 ha. In some locations further east of the urban core, near BR-010, there is a significant presence of active and inactive clay extraction pits (Fig. 6) and fish ponds (Fig. 7) within the APP. Abandoned caves (Fig. 8) located in the region generate water accumulation, favoring the proliferation of disease vectors. Because they are adjacent to the Vila Sorriso and Patauteua neighborhoods, this situation is problematic from a social and environmental point of view.



Fig. 6: Photographic record of the clay extraction pit in the floodplain.



Fig. 7: Photographic record of the fish farming tank in an old extraction area.



Fig. 8: Photographic record of an abandoned pit with possible proliferation of disease vectors.

It is noteworthy that intervention or plant suppression in these areas is only allowed in the hypotheses of public utility, social interest or low environmental impact provided by law. Conama Resolution 369/2006, regarding the possibility of mineral exploration in these areas, authorizes environmental agencies to intervene, provided that it respects the legal requirements in cases of public utility, for the activities of exploration and extraction of mineral substances. except sand, clay, gravel and gravel (BRAZIL, 2001).

Given this, the presence of clay extraction in the Guamáriver APP is supported by law, but it must be considered that there are clandestine clay extraction sites, in addition to the irregular expansion of extraction areas delimited by DNPM. This confirmation was possible thanks to the in situ visit and the help of technologies capable of imagining the region of interest.

4.1.3 Mapping of land cover and its quantification

Due to deforestation, changes in the vegetation cover of the municipality of São Miguel do Guamá are evident, with the suppression of much of the primary forest. Currently the municipality has predominance of secondary forests, with some remnants of primary vegetation, belonging to the Dense Forest of the Low Plateaus and Dense Forest of the Alluvial Terraces, this last located in the areas of influence (lowland) of the Guamá river and its tributaries, affected by flooding.

As illustrated in Fig. 9, land cover in this region was classified into five categories, namely: pioneer vegetation with river and / or herbaceous lake influence (1,010 ha), characteristic of wetlands / natural fields; alluvial dense ombrophilous forest (2,283 ha); secondary vegetation, temporary culture and pasture (175 ha), result of economic activities (livestock and agriculture); mining area (470 ha), where clay extraction pits are present; and the urbanized area (84 ha), corresponding to the urban core, more specifically the edge of the city and its surroundings.

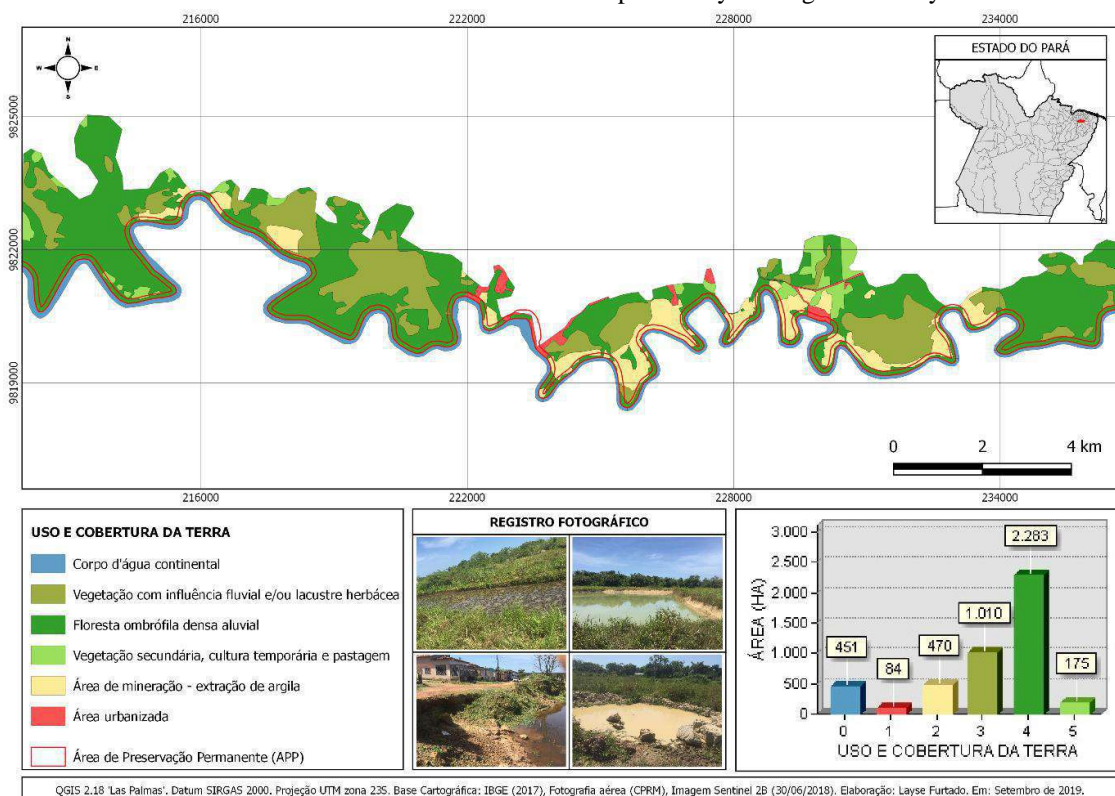


Fig. 9: Map of land cover in part of the flood plain in the municipality of São Miguel do Guamá -PA.



Along the floodplain there are many natural fields and almost all around them clay extraction pits, some of which are in the process of deactivation and others being used as fish ponds. This new economic activity in the region has intensified because of one of the projects developed by the Para State Rural Assistance and Extension Company (Emater-Para) as a mitigating measure of the areas altered by clay extraction, making it an economically and socially sustainable alternative. It is noteworthy that this initiative was due to the lack of proper management of natural resource extraction causing a high environmental liability, with the emergence of large abandoned caves, which were filled with surface and groundwater and aquatic vegetation, promoting an unhealthy and dangerous to the health of the population.

It is also worth mentioning that part of these extraction sites are present inside the APP, something relevant because even with the inspection of the environmental agency there are irregular areas making use of this activity, in addition to vegetation suppression and solid waste pollution in several places near the edge of the APP city, causing pollution and silting of the Guamá river (Fig. 10).



Fig. 10: Photographic record of an infrastructure-free stretch of the city's waterfront, with the presence of solid

waste, little vegetation and the initial silting process of the Guamá river.

In addition to the use of the floodplain for mining, another activity that has been taking place in the study area, and in the municipality in general, is beef cattle. According to information from the Municipal Finance Department, the activity of the Beef Cattle is in 3rd place, behind the Ceramic Activity and the Logging Activity, respectively, considered one of the most profitable economic activities in the region. Found in 1983 by Embrapa, keeping up to the present day, the development of livestock in the region has led to the formation of indirect services by some farmers and / or cattle breeders, mainly in the axis of Castanhal and São Miguel do Guamá, called pasture rental system (HOMMA et al., 1983).

#### 4.2 Mapping of clay extraction sites and verification of environmental impacts resulting from this activity.

Present in the history of Sao Miguel do Guamá, the ceramic activity is marked by two distinct moments, being the artisanal and industrial phase, this happens because the produced merchandise is still the same: bricks, tiles, but presenting a quite different productivity. Even with the installation of industrial production units in the municipality in the 1980s, only in 1990 was created the ceramic pole, formed by approximately 42 industrialists. In 2009 this set of industries was consolidated as one of the main economic activities of the municipality, both in the generation of wealth, as well as the generation of jobs, as well as becoming the spatial element of identification of the city, since no city in the northeast has such a marked landscape. by the presence of ceramic industries such as this municipality (CORDOVIL, 2010).

As shown in Fig. 11, there are two substances extracted within the floodplain, clay and sand, the first being the main natural resource extracted from this region, with a total of 51 extraction areas, classified by process phase: search authorization (1), licensing (43) and licensing application (7).

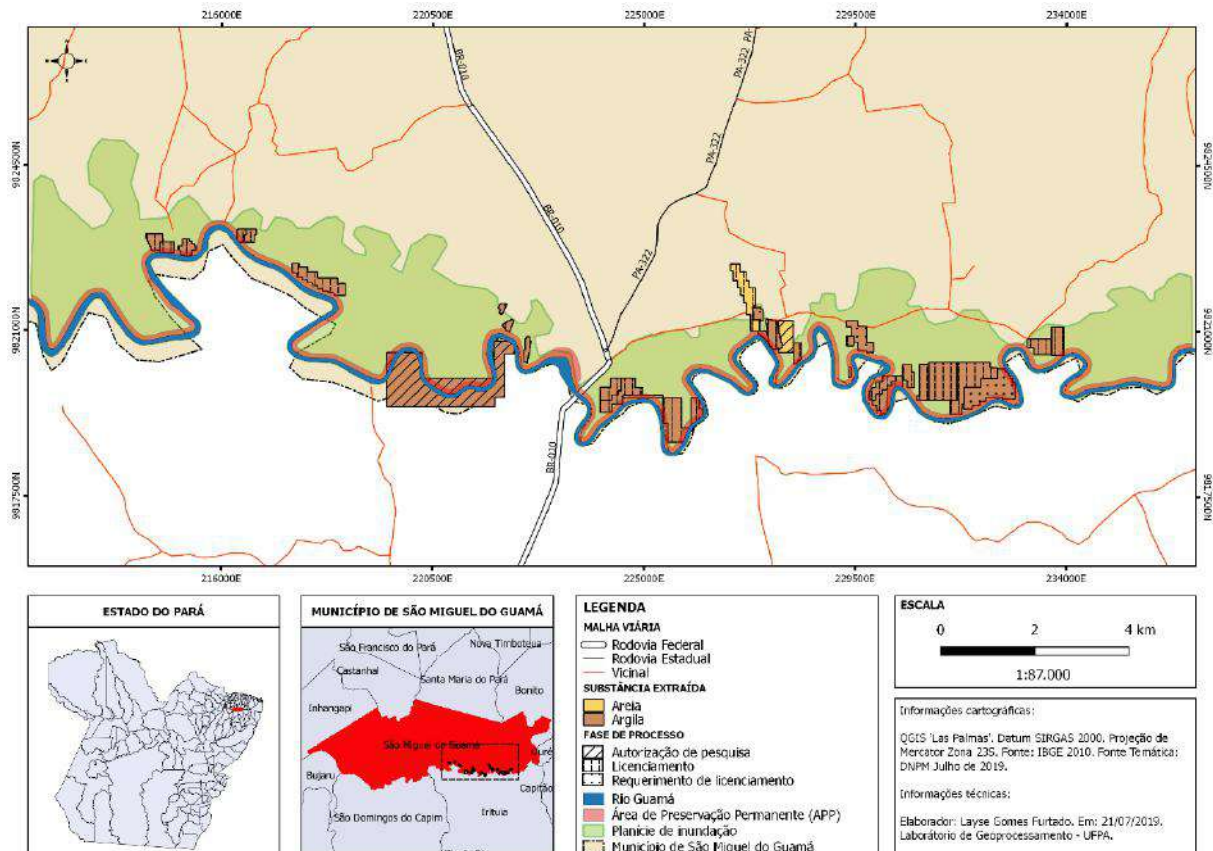


Fig. 11: Mining in the Guamá river floodplain.

With the initial recognition of this area, through laboratory mapping, followed by the field visit, it was possible to identify a pottery (Fig. 12) in activity near the bridge that connects the municipalities of Sao Miguel do Guamá and Irituia, inserted in the plain flood and APP area.



Fig. 12: Photographic register of the pottery.

Almost total vegetation suppression in this area (Fig. 13) and soil compaction were found due to the access of heavy loads on the soil, causing damage to the environment and the population, such as river silting and respiratory problems, since the access road is not paved.



Fig. 13: Photographic record of vegetation suppression in the Guamá river APP near a pottery.

The exploitation and processing of clay have positive impacts on the economy of the municipality, but when extracted irregularly has negative impacts on the environment. According to Para and FIBGE (1995),



degradation can happen by both human and natural intervention. Human degradation occurs when the natural landscape has been replaced by the artificial landscape. These include degraded areas, such as those undergoing man-made changes, such as those used for livestock, agriculture, trade, industry, buildings, mining and all areas abandoned after use.

The first landscape changes related to the excavation of the mineral extraction process are deforestation and the removal of soils and rocks, which are common effects of open pit mining. As every impact requires a consequence, in mining is no different, due to these changes in the landscape, results such as: elimination of plant and animal species, formation of ponds, loss of stratigraphic record and erosive processes, are environmental consequences of this economic activity.

During the field visit, from a holistic view, it was noticed that in the extraction sites there is presence of the consequences mentioned above, some with higher intensity (vegetation suppression, pond formation and erosion) and others with lower intensity (loss of record). stratigraphic). Regarding the elimination of plant species, it is important to emphasize that deforestation is not restricted to the pits, but extends laterally to facilitate the movement of machinery and equipment, thus affecting the biological cycle in other adjacent areas. This vegetation removal causes the exposure of the soil that is at the mercy of erosive processes, intensely accelerating the amount, shape and arrival rates of rainwater on the ground (SANCHEZ, 1991). In relation to the stagnant waters in the caves, forming lakes, begin to suffer deterioration process, favoring the proliferation of insects and microorganisms harmful to health.

#### 4.3 Environmental assessment of the study area and environmental impact mitigation measures.

From the recognition of the area, the impacts of the ceramic activity and the importance of floodplain conservation it can be inferred that the region has 77.5% of vegetation, whether large or small, used or not for agriculture and livestock, but has an important role in maintaining the ecological balance of the lowland. It was found that there is an intense ceramic activity in this region, covering an area of 10.5% which although smaller than the vegetation classes, is already a significant number in the area given its fragility. Although there is a high amount of vegetation, an evaluation regarding its quality and use has not been performed, and management of these areas for extraction, livestock and even agriculture may occur.

Regarding APP, 18.5% are occupied by this activity, and being a protected area by law, requires greater care, since riparian forest offers several benefits to the environment and quality of life, for example: soil conservation and protection

against possible erosion and compaction, barriers to prevent siltation of the Guamá River and its tributaries, and nutrient and water cycling.

According to the data presented on land use and land cover in the floodplain, it appears that there is an environmental balance, even in areas that are occupied by anthropic activities. Attention in these places should be increased, as long as there is profit the tendency to expand the area of activity of activities is inversely proportional to places with vegetation. This reveals to us the importance of the supervision of the competent body and the awareness of the human being with nature.

Given the importance of this ecosystem for life, it is necessary to take actions that aim to minimize adverse events that have the potential to cause environmental impacts to the natural environment, known as mitigation measures. These are present in the Environmental Impact Study (EIA) and the Environmental Impact Report (RIMA) which are required documents for the opening of projects and aims to carry out a comprehensive and complete assessment of significant environmental impacts and indicate the corresponding mitigation measures. This document is necessary to obtain the environmental license, but in some cases, when the undertaking undertaken is not considered patent to cause greater damage to nature, the license can be obtained without the need of EIA / RIMA, as happens in the opening of clay mining in the municipality of Sao Miguel do Guamá.

According to information from the Municipal Secretariat of the Environment, for the opening of the mining in the municipality is required the Operating License (LO) that corresponds to the operation phase of the enterprise, it was emphasized that the Preliminary License and the Installation License are generally united in this single document with the Degraded Areas Recovery Plan (PRAD), which is nothing more than the set of measures that will provide the degraded area with conditions to establish a new dynamic balance, with soil suitable for future use and aesthetically harmonious landscape.

Most PRAD's focus on recovery from native plant species using seedling or no-tillage techniques; transposition of organic soil or litter with propagules and general reforestation. If he does not follow these measures, he must intervene according to the damage and location peculiarities and protect the area from factors that may hinder the area's return to environmental quality, seeking effective results and future performance.

In addition to reforestation in these areas, Para and FIBGE (1995) emphasize that there are various ways of restoration and restoration of areas degraded by mining,

such as agricultural use, fish farming, urbanization, recreation areas and landfill.

Below is a presentation of these recovery activities and the appropriate ones suggested by Para and FIBGE (1995), considering the physical-environmental reality of the study area.

**Agricultural Use:** The implementation of this activity in these areas requires a previous recovery of the organic layer of the soil, which can be done by improving the vegetation cover as well as by replacing the black earth. In the case of tillage, crops should not require large root penetrations, as there is little thickness of the soil horizon, thus restricted to temporary crops (rice, maize, cassava, lettuce, cabbage, etc.).

**Fish farming:** For this use water can be accumulated naturally as a result of rainfall, or through containment barriers. According to studies presented by Bastos et al. (1998) The introduction of exotic species in these enterprises should be carefully considered, as they risk great losses. Therefore, care should be taken to prevent eggs and fingerlings from escaping from tanks and reaching the Guamá River.

**Urbanization:** For this alternative, it is recommended to adopt minimum infrastructure in the places where the pits operated and to prepare them to be allocated to families, especially low-income families, or construction of popular houses to be sold to this population, for example. means of long-term financing. Because it is a floodplain, urbanization as an alternative for future use is poorly recognized.

**Recreation areas:** The use of these exhausted or abandoned areas for leisure should be based on the proximity of the urban center to enable the population's mobility. Again, the nature of the plain limits physical structures, such as football fields and nature parks, etc.

All of these recovery and restoration alternatives mentioned above are some mitigating measures rewritten and restructured according to the necessity and feasibility of the project implementation in the study area. Highlighting, promptly, that the use of fish farming is already being made in most abandoned caves that are located in the flood plain of the Guamá River.

## V. CONCLUSION

The present work explored the relationship of the dynamics of land use and land cover in the floodplain, considering its importance for the ecological balance and the well-being of the population of the municipality of Sao Miguel do Guama and surroundings, which benefit through the services of provision offered for the preservation and conservation of their forest.

Based on the results it can be concluded that floodplain forest suppression and fragmentation directly influence the provision of ecosystem services to the local population. The main factor of this loss due to land use change is the activity of clay extraction along the floodplain. This activity makes the municipality of Sao Miguel do Guamá known as the main ceramic district of the north of the country.

Although other types of land use have been identified in this region, mining is still considered as the main anthropic action, causing the most significant environmental impacts, as the extraction of a non-renewable natural resource will bring more damage to the soil than other economic activities such as extractivism and livestock, existing in the place. However, it is noticeable the presence of competent bodies in the supervision of extraction areas and in the implementation of recovery and restoration projects in areas degraded by mining. One proof of this is the implementation of the fish farming project, which was found during a field visit.

This research is complementary to the identification of possible areas of irregular clay extraction and as a model of evaluation of land use and coverage in the region, as well as to suggest suggestions for the reuse of degraded areas.

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# Energy Efficiency Assessment of the Involvement of an Educational Building using the Prescription Method (RTQ-C).

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**Abstract**— For a building to be considered sustainable, it is essential that it be energy efficient and assess the impact that its implementation and use will have on the environment. The evaluation of the energy efficiency of the systems that make up a building becomes fundamental. For this, the analysis of the envelope, its materiality, its conductivity indices and thermal transmittance directly influence the energy consumption of a building. Based on the Technical Quality Regulation for the Energy Efficiency Level of Commercial, Service and Public Buildings (RTQ-C), it was possible to evaluate and classify the efficiency levels of an educational building located in the municipality of Lajeado, Rio de Janeiro state. Grande do Sul, Brazil, applying natural and innovative materials for thermal insulation of wraps. The original rating of Level D goes to levels A and B, depending on the amount of insulating material applied. It is noteworthy that for the building to be classified as Level A, it is necessary to reduce the energy consumption of the artificial lighting system by 65%.

**Keywords**— Energy efficiency; Wrapper; Thermal insulation; RTQ-C.

## I. INTRODUCTION

For a building to be considered sustainable, it is essential that it be energy efficient. The impact it will have on the environment should always be considered, always aiming at its reduction, aiming at a reduction in water and energy consumption if purchased from conventional constructions (YUDELSON, 2013).

So, energy efficiency,

“Can be understood as obtaining a service with low energy expenditure. Therefore, one building is more energy efficient than another when it provides the same environmental conditions with lower energy consumption.”(LAMBERTS et al., 2004, p. 14)

For these cases, concepts related to the study of the physics and thermal behavior of materials, mainly related to heat transfer, and the potentiality of a given material to conduct heat apply. Understanding the basic concepts of heat transfer in buildings tends to improve the thermal comfort of environments and optimize costs related to electricity consumption. ASDRUBALI et al. (2015a)

mentions that “thermal insulation systems and materials aim to reduce heat flow transmission. The thermal insulation performance of single or combined homogeneous materials is generally assessed, respectively, by thermal conductivity and thermal transmittance” (ASDRUBALI et al., 2015, p. 2).

### 1.1 STANDARDIZATION AND CERTIFICATIONS

According to NBR 15220 (ABNT, 2005), which presents the method for calculating the Thermal Performance of Buildings. The fundamental index is the thermal conductivity ( $\lambda$ ) of the materials, which, as described in the first part of NBR 15220, is the “physical property of a homogeneous and isotropic material, which has a constant heat flux, with a density of 1 ° C. W / m<sup>2</sup> when subjected to a uniform temperature gradient of 1 Kelvin per meter”, and its unit of measurement is W / (mK) (ABNT, 2005, p. 1). A material may be considered as a thermal insulator if its thermal conductivity index is less than 0,07 W / m.K. (ASDRUBALI et al., 2005).

According to NBR 15220 (ABNT, 2005), the thermal conductivity for conventional materials such as Styrofoam (EPS), glass wool and rock wool, with indexes ( $\lambda$ ) of approximately 0.038 W / m.K. Wiebeck et al. (2005)

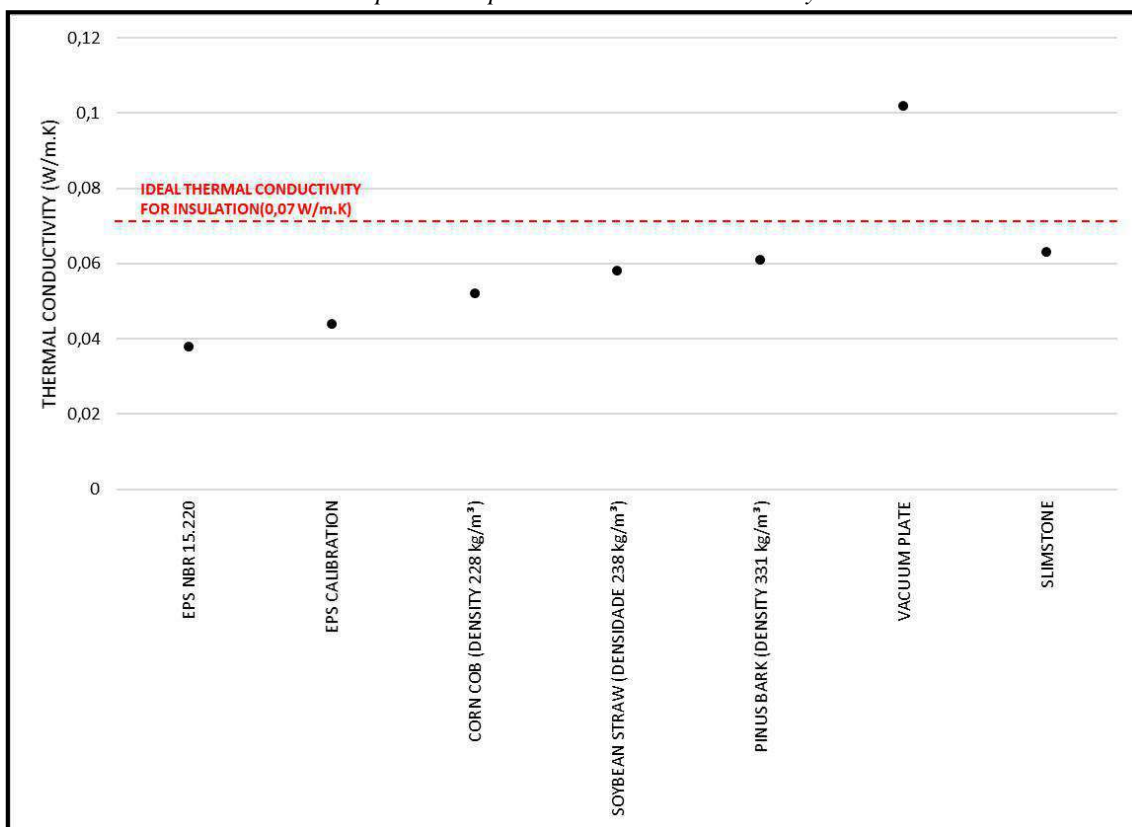


presents data related to synthetic polymers (EPS and XPS), as being materials with good fire resistance, acoustic insulators, and do not propagate fungi. In their composition, polymers (PU) have isocyanates, being volatile substances, pose a risk to the health of the people who inhale them.

Spinelli et al. (2019, forthcoming), presents thermal conductivity results with the use of vegetable raw

materials such as corncob, soybean straw and pine bark, together with innovative materials such as vacuum layer and waste insulation board SlimStone Industrial. It is noteworthy that when comparing materials developed with natural elements, they have thermal conductivity indexes similar to the industrialized and standardized materials, as shown in graph 1 (Spinelli et al., 2019, forthcoming).

Graph 1: Comparative Thermal Conductivity



Source: Spinelli et al., 2019, forthcoming.

The second part of the standard presents the thermal conductivity of several conventional materials (ABNT, 2005, p. 13). In the fourth part, NBR 15220 details the method for determining thermal resistance and thermal conductivity using the protected hot plate principle (ABNT, 2005). By determining the Thermal Conductivity of a material, it becomes possible to calculate the Thermal Resistance (R) of elements and components, the Thermal Transmittance. (U)<sup>1</sup>, Heat Flow Density (q)<sup>2</sup> of an opaque closure, and the Heat Flow (Q)<sup>3</sup>. The determination of these variables directly influence the thermal behavior of

buildings, especially with regard to Thermal Capacity<sup>4</sup>and Thermal Delay<sup>5</sup>. Also noteworthy is the Solar Heat Gain Factor for buildings, which can be distinguished as solar gain for opaque elements. (F<sub>So</sub>) and for transparent and translucent elements (F<sub>St</sub>). This Solar Factor is directly related to solar radiation (I) that affects building components, especially transparent ones, and how much of this radiation is absorbed, reflected and relayed to indoor environments (ABNT, 2005).

<sup>1</sup> “The inverse of the total thermal resistance of a component” (ABNT, 2005).”

<sup>2</sup> “Quotient of the heat flux that crosses a surface by the surface area” (ABNT, 2005).”

<sup>3</sup> “Quotient of the amount of heat that crosses a surface over a period of time” (ABNT, 2005).”

<sup>4</sup> “Amount of heat required to vary the temperature of a system by one unit” (ABNT, 2005).”

<sup>5</sup> “Time elapsed between a thermal variation in a medium and its manifestation on the opposite surface of a constructive component subjected to a periodic heat transmission regime” (ABNT, 2005).”

Thus, considering the importance of energy performance for the quality of buildings, NBR 15575 was prepared to meet the requirements of users of housing buildings, a behavior related to the period of their use. It is a set of standards that stipulates performance according to requirements (qualitative), criteria (quantitative or assumptions) and evaluation methods that provide the construction of safer and more efficient buildings. It also highlights the demands of residential building users by presenting an overall list divided into safety, livability and sustainability. This performance standard complements pre-existing standards, not replacing them, where performance and prescriptive standards are to be used together (ABNT, 2013).

Cambeiro et al. (2016) describes that buildings are consequently one of the main sources of pollution worldwide. International certification models that attest to the environmental sustainability of buildings adopt the environmental impact of construction on their life cycle as a key feature. These certificates currently meet local criteria (BREEAM, created in the UK, HQE in France, LIDERA in Portugal) or have universal reach, such as the American certification known as LEED. These certificates take into account the energy performance of the building as a fundamental characteristic, based on the construction process, building materials and their origin (being a long distance transportation concern, and amount of gas emissions generated, among others), as well as as energy uses for the execution and maintenance of the building.

### 1.2 RTQ-C Building Classification

Aiming at the energy classification of buildings based on the energy efficiency law (nº 10.295 / 2001), the National Institute of Metrology, Quality and Technology (INMETRO) presented revisions in 2010 the Technical Quality Regulation for the Energy Efficiency Level of Commercial, Service and Public Buildings (RTQ-C) (BRASIL, 2013; BRASIL, 2012). RTQ-C has a similar purpose as LEED and is applicable for certification of three types of buildings: I) conditioned buildings; II) partially conditioned; and II) unconditioned; these may be and mixed use, commercial, service and public (Ordinance No. 372, 2010).

Energy level labeling for a building by the RTQ-C system is based on prescriptive method analysis of simulations of a limited number of cases by regression or by the simulation method. Thus, RTQ specifies three levels of efficiency for buildings, ranging from level A (most efficient) to E (least efficient), presented in ENCE (National Energy Conservation Label), and are divided into three individual systems: Envelope, Artificial lighting

system and air conditioning system (Ordinance No. 372, 2010).

Based on the information provided in NBR 15220 and NBR 15515, RTQ “creates conditions for energy efficiency level labeling” for buildings, as shown in Figure 1 (BRASIL, 2013).



Fig.1 - RTQ-C National Energy Conservation Label

Source: Brasil (2010).

The evaluation of the individual systems, results in a final classification, which, for this,

“Points are assigned to each individual system and, according to the final score, a rating that also ranges from A (most efficient) to E (least efficient) presented on the ENCE - National Energy Conservation Label” is obtained (BRAZIL, 2013).

The development of RTQ analyzes can be developed using two methods: prescriptive and simulation. The Prescriptive Method is an analytical method based on a limited number of data. The Simulation Method uses a computer program to add the project variables, and based on the results, to classify the systems that make up the building (BRASIL, 2013).

Bavaresco et al. (2017), developed a metamodel for the thermal load calculation of five different commercial buildings, and the design of the thermal loads for comparison in the EnergyPlus program, comparing the two results in RTQ-C. The data presented by the metamodel presented satisfactory results and can be applied in RTQ-C in order to classify buildings (BAVARESCO et al., 2017).

Quevedo et al. (2017) analyzed by the prescriptive method, according to RTQ-C, a building for public use, located in the city of Florianopolis (Bioclimatic Zone 3). Entering the parameters resulted in an analysis of 12,000 cases, and a result in which 39% of cases achieved an "A" rating level. However, according to the authors;

Ease of achieving the highest level of energy efficiency is understood to be an incentive policy for labeling, especially during the implementation of a voluntary labeling program. It is suggested that the RTQ-C scale be adapted to provide a

distribution closer to the normal distribution where "C" would represent most of the constructed buildings (QUEVEDO et al., 2017).

## II. MATERIALS AND METHODS

### 2.1 Energy Efficiency Simulation

Based on the study developed by Spinelli et al. (2019, forthcoming), the study proposes to analyze the energy efficiency of educational buildings located in the city of Lajeado / RS (Figure 2).

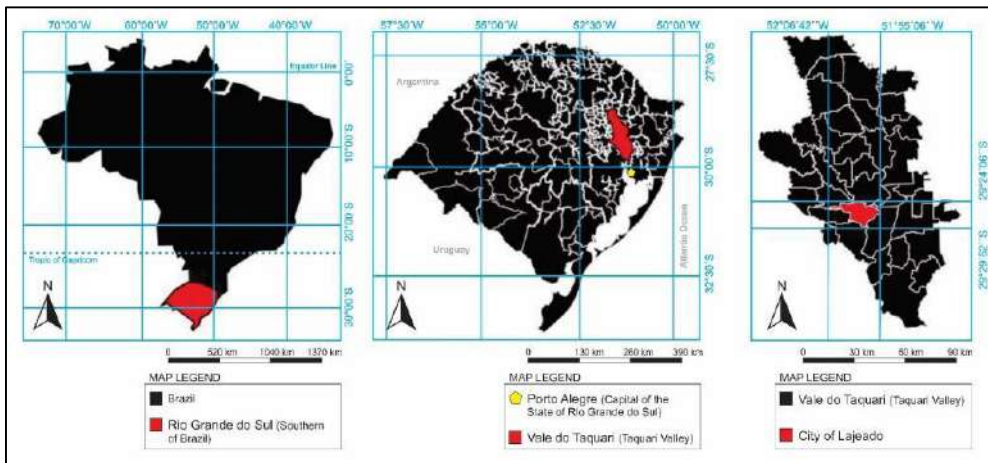


Fig.2 – Localization of the State Rio Grande do Sul in Brazil, of Vale do Taquari in the state Rio Grande do Sul, and the municipal area of Lajeado in Vale of Taquari.

Source: Spinelli et al., 2017.

By analyzing the bioclimatic chart (Figure 3) for the city of Lajeado / RS (Spinelli et al., 2017), it is observed that in 45.26% of the typical days of the year, the built environment is in thermal comfort. , if the building meets NBR 15.575 (2013). For 36.5% of the typical days of the year, the thermal inertia strategy should be used,

using thermal insulation to keep indoor environments at a comfortable temperature. By properly using bioclimatic strategies, together with the appropriate materiality for building execution, the possibilities for saving energy are increased, making them more energy efficient.

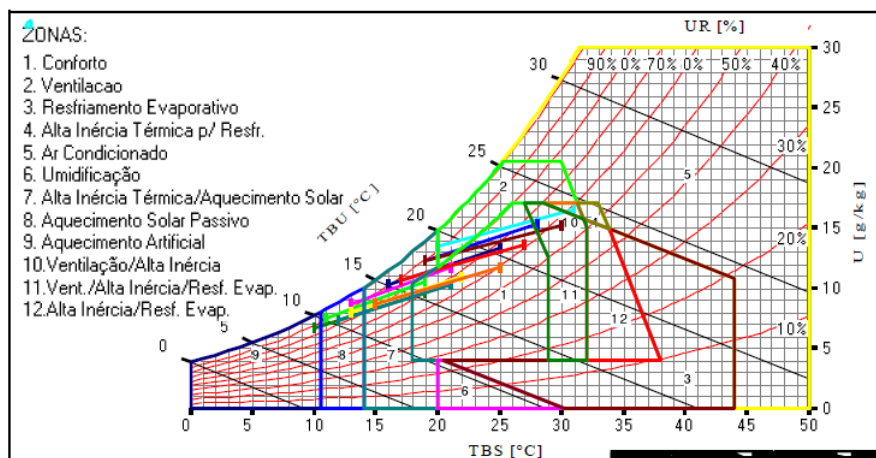


Fig.3 – Bioclimatic chart of the city of Lajeado-RS

Source: SPINELLI et al. (2017, p. 470).







This was selected for the development of the study because it is the oldest building of the institution and its building system is the most conventional, similar to most buildings built locally, with the constructive characteristics: I) masonry executed in solid ceramic block; II) use of simple glass in the frames; and III) covering in fiber cement tiles.

The floors of the building are made up of classrooms, offices, toilets, teachers' rooms, computer labs, circulation, among other spaces (Figure 5). Regarding equipment, all environments have a Split System for artificial climate control, elevator connecting the floors, and artificial lighting system using fluorescent tube lamps.

## 2.2 Prescription Method Energy Efficiency Simulation (RTQ-C)

Using the RTQ-C prescriptive method as a basis (BRAZIL, 2013), simulations with data insertion in a spreadsheet were developed, and the results converted to the indices determined by the RTQ-C. The development of the simulations will take place by the following steps:

- Analysis of the building envelope efficiency, calculating the thermal transmittance (U) for envelope, roof and glass, as determined by NBR 15220 (ABNT, 2005);
- Development of calculations for Height Factor (FA), Form Factor (FF), Percentage of Facade Openings (PAF), and Vertical (ASV) and Horizontal (ASH) Shading Angles;
- Calculation of the Consumption Index (CI) of the building, which relates the data presented in the Chart and local Bioclimatic Zone, with the indexes calculated in the previous step;
- Determination of the efficiency level of artificial lighting, calculating the installed power and illuminated area of the building, determination of threshold power and determination of the efficiency level related to the activity developed in the building (according to tabulated indexes in RTQ-C);
- Determining the efficiency level of the air conditioning system, analyzing from the weighting of equipment classification (Efficiency Seal) by their capacity (BRASIL, 2013);
- Bonus calculation for the energy efficiency index, determining the building elevator efficiency index, as specified in the VDI4707 standard (BRAZIL, 2013);

The first stage of the simulation for the building studied, evaluated and analyzed the data for energy

efficiency classification according to the original materials in which the building was executed. According to the requirements defined in the regulation, the efficiency level of the envelope, the artificial lighting system and the air conditioning system were calculated.

At the end of the pre-existence analysis, in a second moment new simulations were developed with the application of the characteristics of the materialities developed in the study by Spinelli et al. (2019, forthcoming). Thus, a set of materiality combinations was elaborated for the simulation in the building envelope, using as thermal insulation material air layer, Styrofoam, pine bark, soybean straw, corncob, slimstone and vacuum plate.

Regarding artificial lighting and air conditioning systems, the original characteristics were maintained and considered for analysis of the artificial lighting system: typology of lamps, model, power and quantity of lamps. For the HVAC system, the information for the development of the analysis were: manufacturer, system typology, capacity (BTU's), power and consumption (w / w).

After the simulations were completed by the prescriptive method, the Energy Efficiency Level of the Building was determined, classifying each system with index "A" for more efficient, until "E" for more inefficient, concluding with the determination of a general index for the building ( BRAZIL, 2013).

## III. RESULTS AND DISCUSSIONS

### 3.1. WRAP

The classification of the building envelope was analyzed and presented by the Thermal Transmittance Index (U) of the masonry and roof, so that each part of the building can be identified in the composition of an appropriate envelope classification to add the final classification. When the original building and its characteristics were analyzed, unsatisfactory results were obtained in relation to the original materials when compared to the classification parameters of the RTQ-C.

Table 2 shows the results of the analyzed building data according to their original envelope composition. The materiality of the masonry is external plaster, solid ceramic block and internal plaster. In the roof the original materiality is concrete slab, air bed and fiber cement tile. It is noteworthy that when analyzing the thermal transmittance (U) of masonry and roofing materiality compositions, and comparing the classification according to RTQ-C, Brazil (2013), both are classified as Level C and D for energy efficiency, in which For these cases the level D will be considered in the final calculation.

Table 2: Wrap classification of original building.

ENVELOPE COMPOSITION	THERMAL TRANSMITTANCE COMPOSITION (U)	TYPE	RTQ-C CLASSIFICATION LEVEL
ORIGINAL MASONRY (PLASTER+ MASSIVE CERAMIC BLOCK +PLASTER)	<b>3,34 W/m<sup>2</sup>K</b>	Wall transmittance	Level D $U \leq 3,7W/m^2K$
ORIGINAL COVERAGE (CONCRETE SLAB + AIR LAYER + FIBER TILE)	<b>1,83 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	Level C e D $U \leq 2,0W/m^2K$

To achieve better wrap classification levels in the RTQ-C, adjustments to the existing masonry were proposed. The option of complete replacement of the masonry was discarded due to the high cost, and its structural impossibility, since the building has structural walls without pillar, increasing the cost. Thus, it was decided to add internally in the masonry that have contact with the exterior, the application of a drywall partition, flush with the wall. The simulations continued with the application of insulation between the plasterboard and the existing masonry. The compositions were simulated with the thermal insulation materials researched by Spinelli et

al. (2019, forthcoming) such as Styrofoam (EPS), pine bark, soybean straw, corn cob, slimstone and vacuum plate.

As described in Table 3, it is observed that the most outstanding materials were Styrofoam, pine bark, soybean straw and corncob, obtaining A and / or B classification for wall and roof. When comparing the Thermal Transmittance indices, the composition containing Styrofoam had the best performance; however, the Thermal Transmittance results of the compositions with natural elements for thermal insulation, in relation to the RTQ-C index, stand out.

Table 3: Adapted building envelope classification (R1).

ENVELOPMENT COMPOSITION	THERMAL TRANSMITTANCE COMPOSITION(U)	Envelopment Type	LEVEL RATING RTQ-C
Original masonry + 5cm airtayer + internaldrywall	<b>1,75 W/m<sup>2</sup>K</b>	Wall transmittance	Level B $U \leq 2W/m^2K$
Original cover (concrete slab + airtayer + fibercement tile)	<b>1,83 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	Level C e D $U \leq 2,0W/m^2K$
Original masonry + Styrofoam (EPS) + 2cm airtayer + internaldrywall	<b>0,74 W/m<sup>2</sup>K</b>	Wall transmittance	Level A $U \leq 1W/m^2K$
Original Cover + Styrofoam (EPS)	<b>0,78 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	Level B $U \leq 1 W/m^2K$
Original masonry + Pinus bark 3cm + Layer Air 2cm + inner drywall	<b>0,95 W/m<sup>2</sup>K</b>	Wall transmittance	Level A $U \leq 1W/m^2K$
Original cover + Pinus bark 3cm	<b>1,02 W/m<sup>2</sup>K</b>	Transmitância da cobertura (climatizado)	Level B $U \leq 1W/m^2K$
Original masonry + soybean straw 3cm + layer air 2cm + inner Drywall	<b>0,93 W/m<sup>2</sup>K</b>	Transmitância da parede	Level A $U \leq 1W/m^2K$
Original cover + soy straw 3cm	<b>1,00 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	Level B $U \leq 1W/m^2K$
Original masonry + Corn COB 3CM +	<b>0,88 W/m<sup>2</sup>K</b>	Wall	Level A

layer Air 2cm + inner Drywall		transmittance	$U \leq 1 \text{ W/m}^2\text{K}$
Original cover + cob Corn 3cm	<b>0,94 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelB $U \leq 1 \text{ W/m}^2\text{K}$
Original masonry + Slimstone + Air layer + inner Drywall	<b>1,39 W/m<sup>2</sup>K</b>	Wall transmittance	LevelB $U \leq 2 \text{ W/m}^2\text{K}$
Original coverage + slimstone	<b>1,55 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelC $U \leq 2 \text{ W/m}^2\text{K}$
Original Masonry + Vacuum plate + air Layer + inner Drywall	<b>1,05 W/m<sup>2</sup>K</b>	Wall transmittance	LevelB $U \leq 2 \text{ W/m}^2\text{K}$
Original cover + Vacuum plate	<b>1,83 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelC $U \leq 2 \text{ W/m}^2\text{K}$

Thus, it was proposed to adapt them asonry compositions with natural elements of thermalinsulation, sizing the Thermal Transmittance without the air layer, but with expanding the thermalinsulation layer from 3cm to 5

cm. For the insulation of the roof, there vision is proposed by applying a double layer of insulating material, from 3cm to 6cm and 9cm, according toTable 4.

Table 4: Classificationofthebuilding envelope with natural materials (R2).

ENVELOPMENT COMPOSITION	THERMAL TRANSMITTANCE COMPOSITION (U)	Envelopment Type	LEVEL RATING RTQ-C
Original masonry + pine bark 5cm + Internal drywall	<b>0,82 W/m<sup>2</sup>K</b>	Wall transmittance	LevelA $U \leq 1 \text{ W/m}^2\text{K}$
Original cover + Pinus bark 10cm	<b>0,47 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelA $U \leq 0,5 \text{ W/m}^2\text{K}$
Original masonry + soybean straw 5cm + Internal drywall	<b>0,79 W/m<sup>2</sup>K</b>	Wall transmittance	LevelA $U \leq 1 \text{ W/m}^2\text{K}$
Original cover + soybean straw 9cm	<b>0,49 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelA $U \leq 0,5 \text{ W/m}^2\text{K}$
Original masonry + Corn cob 5cm + Internal drywall	<b>0,73 W/m<sup>2</sup>K</b>	Wall transmittance	LevelA $U \leq 1 \text{ W/m}^2\text{K}$
Original cover + Corn cob 9cm	<b>0,45 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelA $U \leq 0,5 \text{ W/m}^2\text{K}$
Original masonry + slimstone 3cm + layer air + inner drywall	<b>0,98 W/m<sup>2</sup>K</b>	Wall transmittance	LevelA $U \leq 1 \text{ W/m}^2\text{K}$
Original coverage + slimstone 10cm	<b>0,48 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelA $U \leq 0,5 \text{ W/m}^2\text{K}$
Original masonry + 5cm Vacuum plate + Air layer + inner drywall	<b>0,95 W/m<sup>2</sup>K</b>	Wall transmittance	LevelA $U \leq 1 \text{ W/m}^2\text{K}$
Original cover + Vacuum plate 16cm	<b>0,49 W/m<sup>2</sup>K</b>	Coverage transmittance (air-conditioned)	LevelA $U \leq 0,5 \text{ W/m}^2\text{K}$

It is verified in the presented results that the revision of the thickness of the insulating material layer represents in a new classification in the energy efficiency level of RTQ-C, but with very thick layers which can make the production of insulating material unfeasible. We highlight the results for the roof, which receives the most radiation, and the need for larger insulation layers, reaching 10cm thick for recycled material, and 16cm for vacuum plate, which can lead to under load of the building structure. For these cases, heat reflective material below the tile may be used and the air layer thermal resistance increased from 0.21 m.K / W to 0.61 m.K / W.

### 3.2. ARTIFICIAL LIGHTING

Based on the information in table 4.2 of the RTQ-C manual, which describes the acceptable maximum

illumination power density - DPIL limits for the desired efficiency level (Brazil, 2013), the lighting system analysis was developed. of the building, for the main activity of the building. In the survey developed in the environments, the artificial lighting components were verified and follows a standard for all spaces, being 40 W Fluorescent lamps. Thus, to measure the installed Power, the total number of lamps in each environment was quantified. their respective installed power.

Calculating the values of limiting artificial lighting power density (DPI) and their respective areas, we obtained the activity limiting power for each classification level according to the RTQ-C manual (BRAZIL, 2013), observing the classification of each room for Artificial Lighting, as shown in Table 5.

Table 5: Classification of the environments according to their artificial lighting.

		A	B	C	D
<b>Auditorium</b>	Total installed (w)	24400			
	Area (m <sup>2</sup> )	1350,66			
	DPI Limit (W/m <sup>2</sup> )	8,5	10,2	11,9	13,6
	Area X DPI Limit (W)	11481	13777	16073	18369
<b>Environment Classification</b>		<b>E</b>			
<b>Office – open Plan</b>	Total installed (w)	21880			
	Area (m <sup>2</sup> )	1256,29			
	DPI Limit (W/m <sup>2</sup> )	10,5	12,6	14,7	16,8
	Area X DPI Limit (W)	13191	15829	18467	21106
<b>Environment Classification</b>		<b>E</b>			
<b>Restroom</b>	Total installed (w)	1440			
	Area (m <sup>2</sup> )	128,24			
	DPI Limit (W/m <sup>2</sup> )	5	6	7	8
	Area X DPI Limit (W)	641	769	898	1026
<b>Environment Classification</b>		<b>E</b>			
<b>Restroom</b>	Total installed (W)	1440			
	Area (m <sup>2</sup> )	128,24			
	DPI Limit (W/m <sup>2</sup> )	5	6	7	8
	Area X DPI Limit (W)	641	769	898	1026
<b>Environment Classification</b>		<b>E</b>			
<b>Restroom</b>	Total installed (W)	1440			
	Area (m <sup>2</sup> )	128,24			
	DPI Limit (W/m <sup>2</sup> )	5	6	7	8
	Area X DPI Limit (W)	641	769	898	1026
<b>Environment Classification</b>		<b>E</b>			
<b>Restroom</b>	Total installed (W)	1440			
	Area (m <sup>2</sup> )	128,24			



	DPI Limit (W/m <sup>2</sup> )	5	6	7	8
	Area X DPI Limit (W)	641	769	898	1026
<b>Environment Classification</b>		<b>E</b>			
<b>Stairs</b>	Total installed (W)	320			
	Area (m <sup>2</sup> )	80,46			
	DPI Limit (W/m <sup>2</sup> )	7,4	8,88	10,36	11,84
	Area X DPI Limit (W)	595,404	714,4848	833,5656	952,6464
	<b>Environment Classification</b>	<b>A</b>			

Having developed the individual classification of each environment, it is verified that only the ladder has classification level A, not because of the type of lamp used, but because of the poor lighting installed. The other environments had a high installed load, and all were classified as E. This information was compiled in a table to classify the lighting system of the building according to

the manual RTQ-C. Taking into consideration the purpose of the environment to be classified, the comparative data took as reference the school / university data. When calculated, the values obtained a general classification for artificial lighting systems E (Table 6), exceeding the lower limits for classification D.

Table 6: Final classification of the building for the artificial lighting system.

		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>School/ University</b>	Total installed (W)	50680			
	Area (m <sup>2</sup> )	3449			
	DPI Limit (W/m <sup>2</sup> )	8,5	10,2	11,9	13,6
	Area X DPI Limit (W)	29318	35182	41046	46909
	<b>Classification</b>	<b>E</b>			

After the analysis of the original artificial lighting system, it was found that it is necessary to update the models of lamps used in the building, and reduce the installed power from 50,680 W to 22,806 W, thus providing a 65% saving in energy consumption, and achieving level A rating.

classification and rating of the equipment energy efficiency label performed by INMETRO, together with data and energy specifications of each of the models present in the building. For the building, there are a total of 48 equipment, distributed in five different models, described in Table 7, along with the weighting coefficient of each air conditioning system.

**3.3. ARTIFICIAL CLIMATIZATION**

The determination of the efficiency level of the artificial HVAC system should be considered the

Table 7: Air Conditioning Equipment Information.

Floor	Level	EqNum	Numberofequipments	Unit power (Btu / h)	Total power	Weighting	WeightingEqNum
1	B	4	13	42000	546000	0,25490196	1,019607843
2	B	4	7	60000	420000	0,19607843	0,784313725
2	B	4	9	36000	324000	0,1512605	0,605042017
3	B	4	7	60000	420000	0,19607843	0,784313725
3	B	4	12	36000	432000	0,20168067	0,806722689
<b>Total</b>			<b>48</b>	<b>234000</b>	<b>2142000</b>	<b>1</b>	<b>4</b>

When calculating the weighting, the numerical equivalent 4 was obtained, where this result was analyzed

and classified according to RTQ-C. Therefore, the system obtained level B for the Artificial Climatization System.

The standard of installed equipment was maintained, according to INMETRO's certification seal indicating B for all equipment.

### 3.4. FINAL EFFICIENCY LEVEL

At the conclusion of the analysis and individual classification of the systems, the final efficiency level for the building (Table 8), maintaining the original materiality,

the classification level according to RTQ-C was D, maintaining the original levels of classification of lighting and air conditioning systems, respectively E and B. When proposing the materiality changes in the envelope (R1), the simulated classification for the building was C, even though there was a significant improvement in the envelope classification for each of the simulations.

Table 8 - Final efficiency rating of Building 1.

Materials	Envelopment level R1	Final energy efficiency level R1	Envelopment level R2	Final energy efficiency level R2
CONVENTIONAL MATERIAL	D	D	D	D
MATERIAL CONV. + AIR LAYER + INTERNAL DRYWALL	B* D**	C	B* D**	C
MATERIAL CONV. + STYROFOAM + AIR LAYER + INTERNAL DRYWALL	A* B**	C	A* A**	C
MATERIAL CONV. + PINUS BARK + AIR LAYER + INTERNAL DRYWALL	A* B**	C	A* A**	C
MATERIAL CONV. + SOYBEAN STRAW + AIR LAYER + INTERNAL DRYWALL	A* B**	C	A* A**	C
MATERIAL CONV. + CORN COB + AIR LAYER + INTERNAL DRYWALL	A* B**	C	A* A**	C
MATERIAL CONV. + SLIMSTONE + AIR LAYER + INTERNAL DRYWALL	B* C**	C	A* A**	C
MATERIAL CONV. + VACUUM PLATE + AIR LAYER + INTERNAL DRYWALL	B* C**	C	A* A**	C

OBS.: \* Level of envelopment efficiency: walls; \*\* Level of envelopment efficiency: coverage.

When developing revised simulations (R2) for insulation materials, the final classification of the building was maintained at C. It is noteworthy here that the original classification level of the artificial lighting system (E) has a large participation in the final classification. of the building. By modifying the lighting classification level to level A, the final classification of the building would obtain Seal A for the simulations performed (R1 and R2).

## IV. CONCLUSIONS

The evaluation of energy efficiency and the application of constructive elements that make it possible for a new or refurbished building to become sustainable has been one of the fundamental alternatives in the construction sector. The development of new construction materials, in which production processes provide low energy consumption and reduction of polluting elements, has been increasingly viable (SPINELLI et al., 2019, forthcoming).

The application of innovative materiality in the building envelope proposed in this research, simulating from the

use of the RTQ-C prescriptive method for efficiency classification, highlights new possibilities for reduction in energy consumption. Analyzing the building in its original composition, the classification according to RTQ-C presents level D for the envelope, E for artificial lighting system and B for climate system.

The natural materials (tree bark, soybean straw and corn cob) were efficient when applied to the walls (Level A) and roof (Level B), for use as thermal insulation material. The innovative materials (slimestone and vacuum plate) were less efficient compared to natural materials, but with significant advance compared to the original materiality of the building, respectively Level B and C. However, maintaining the original efficiency levels of the artificial lighting and air conditioning system, the overall level of the building remained at C.

Even with a review of the thickness of the thermal insulation layers, the overall level of the building classification remained at C, highlighting that the lighting and artificial air conditioning systems have a high

percentage of influence on the final classification of the building, so that this level A, the building's lighting system needs to be modernized, reducing current consumption by 65%. Thus, it is emphasized that the insulation treatment should be considered in conjunction with all other systems, starting at the design stage. It is also proposed that the energy efficiency evaluations be developed using a computer simulation program to compare results between studies.

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# Schooling of Itinerant Children: Circus Families – A bibliographical Study

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**Abstract**— *This paper aims to evaluate the educational assistance of itinerant children, analyzing the dynamics of formal and informal education of circus children, considering the current legislation that regulates the guidelines of this group inside the Brazilian educational landscape. For this purpose, bibliographic research has been carried out, from the survey of theoretical references previously analyzed and published, to express and discuss the social and cultural context of people in situations of recurrent migration, particularly school-age children attended by various schools scattered throughout Brazil. The results found has shown that formal education is challenging to access and has several issues. In this respect, some topics are highlighted, such as the lack of vacancies, irregular documentation, and the hostile environment that itinerants face, as well as other limitations, inclusive the precise quantification of circus students and the indicative rate of school dropout.*

**Keywords**— *Circus, Education, Migration.*

## I. INTRODUCTION

It is known that education is a fundamental right of all, following the text of the 1988 Federal Constitution, and it is the duty of the State and the family. In other words, the verification of the effectiveness of this right is the object of a constant and broad interest in studies and debates of educational and social nature as well, from the perspective of recognizing the importance of its materialization for all individuals, as a benefit that is basic and indispensable to the human being. This right consists in man's search to understand his social role, and that is why he should be granted the guarantee of access to quality education, to corroborate his performance as a citizen in full enjoyment of rights and duties (HARGREAVES, 2004).

Education by itself has a long history of struggles to empower schools to meet the needs of the learner

efficiently and with quality. With the post-critical theories of the curriculum, we have seen the necessity to investigate not only the social reality of individuals but also ethnicity and culture, proper to human diversity and its history, even applying the study of minority groups – such as those who live in an itinerant way (SAVIANI, 2004).

According to the National Council for Education/Chamber of Basic Education (CNE/CEB) n° 3, dated May 16, 2012, children and young persons who live in groups inside this itinerant condition, “for cultural reasons; political, economic, health, such as gypsies, indigenous, nomadic peoples, itinerant workers, camped communities, circus, artists and/or workers of amusement parks, “mambembe” theater, among others” deserve special attention, since these populations face accentuated difficulties in relation to other social groups, and need



support and initiatives from the whole society to welcome them better.

Because of this situation, the problem hereby studied emphasizes how the public education network serves children in cases of itinerancy since they constitute a social group about which there are few practical educational actions and even shallow debates on how it has been served in the school situation.

More specifically, this paper aims to address the care of school-age children who live with their families in circus activities, consequently being forced to move from town to town, offering a specific product, which is the show (MAGNANI, 1984).

To respond to the research problem, this study aimed to analyze the educational service offered to children on the move, and it is essential to observe how the care of this public is provided concerning the educational process and its fair, egalitarian, and efficient implementation.

The research justifies the importance of study focused on minority groups, considering the relevance of understanding the social context in which they are inserted; as for the criterion of opportunity, it is firmly based on the possibility of provoking the interest of new perspectives on this theme, in order to achieve not only construction more scientifically based on the compiled data, but mainly to outline the possible solutions to the problems presented.

## II. AN ITINERANT DEMAND

By its definition<sup>1</sup>, the term *itinerant* means “traveling from place to place, especially covering a circuit.”

According to Souza (2014), in his research project entitled “Educação em movimento” the word *itinerant* binds everything that implies constant change of place, including people who usually travel to and fro to exercise their activities as a teacher, a preacher, a salesperson (street vendor), artist, and so forth.

That is to say, in every corner of the world, many social groups live moving from one place to another for several reasons, living in a situation of itinerancy – these are the so-called “nomadic people.”<sup>2</sup>

Nomadic people have always been socially labeled derogatively or negatively. Actually, according to Duarte (1995, p. 37), the definitions of the word *nomad* in dictionaries and encyclopedias of the nineteenth century convey expressions such as uncivilized, childish, vagabonds, which leave signs of destruction and abandonment wherever they walk in, being otherwise

those who suggest the unknown, the forbidden, the outcast.

Currently, however, the definitions reach new meanings, such as that established, for example, by Resolution No. 03, of 16 May, 2012, of the Ministry of Education (MEC), CNE, and CEB, which in its article no. 1 states:

*People belonging to social groups who live in such a condition for cultural, political, economic, health reasons, such as gypsies, indigenous people, nomadic peoples, itinerant workers, campers, circus workers, artists and/or workers of amusement parks, mambembe theater, among others, are considered in situations of itinerancy.*

Concerning itinerant people, it must be said that throughout history, they have been segregated for various reasons, such as society’s non-acceptance of their ways of life and culture, which are considered different because of their nomadic behavior – characterized by an absence of fixed residence or employment. At this point, the discriminatory acts were justified under the argument that the formal normalization and the existence of discipline would be forms of organization necessary for any people, for their social recognition.

*With the demographic explosion and the changes in population dynamics in the world, which occurred in the eighteenth century, there was an intensification of the migratory flow, the rise of complexity, and the high cost to the production apparatus of social “normalization” in the disciplinary process. To this end, it creates an ideological current of anti-nomadism, since fixing the population is fundamental for the implementation of the format of a disciplined society, that is, linked to the historical processes constituted in the economic, juridical-political and scientific spheres, which aim to order human multiplicities (FOUCAULT, 2004 p. 241-242).*

Therefore, it is believed that an ideal society would be established from the moment that a migratory population is banned. If it would occur, the itinerant groups should suffer persecution.

## III. THE CONTEXT OF THE CIRCUS AND THE CIRCUS IN BRAZIL

The history of the first societies highlights the arts as the primary form of entertainment of different peoples, having in the arena shows its most significant expression, such that, even today, on the circus show, the first and most immediate image evoked around the concept of the

<sup>1</sup> Merriam-Webster Collegiate Dictionary.

<sup>2</sup> According to Teixeira (2008) and Moonen (2011), they are the ones who hardly stay or take root somewhere.

word “circus” will always be built by the figures of clowns, the arena and the canvas.

However, the circus was not always like this, until the middle of the 17th century the circus had, most of the time, a structure armed with concrete and cement, as if it were a small stadium and the shows involved battles between gladiators and animals or even only between animals (SILVA, 1996).

In Ancient Rome, the mythical-religious notion prevailed, which, among other implications, anchored the “artistic, sports and political” practices as forms of expression of faith and worship of divinities (BOLOGNESI, 2003).

Despite this historical data, it is not known precisely how the circus emerged in its most current format. According to Silva (1996), in China, there were paintings with almost 5000 years showing contortionists, acrobats, and equilibrists. However, these activities were not related to art shows. Chinese warriors used acrobatics as a form of training since it required strength, flexibility, and agility.

There are records that in that country, in 108 B.C., during a party in honor of foreign visitors, there was an acrobatic presentation that also delighted the emperor, so much so that he determined that spectacles of this type would be repeated annually, which can be considered one of the factors of origin and dissemination of circus culture.

Pines-Junior and coworkers (2013) emphasize the emergence and development of nomadic artistic shows accompany the historical and philosophical process of medieval, modern, and contemporary societies.

Torres *in* Castro (1998) states the origin of the circus is connected to concepts and practices related to the sacred; but the circus we know with the structure of arena, canvas, masts, trapezoids, parades, exotic animals and cages, appeared only in the fifteenth century.

The “modern circus” was born in 1770, during the Industrial Revolution and the birth of capitalism, when Philip Astley opened the first European circus in London, the “Astley’s Amphitheater” (TORRES, 1998). For his innovative vision, Astley is considered by many the creator of this new show format, using a circular track, also called “arena” (TORRES, 1998).

In Brazil, since the 17<sup>th</sup> Century, we have registered the presence of artists from Saltimbancos, mostly from theater companies and acrobats from Europe. From the second half of the 18th century onwards, these jumps defined themselves as circus artists. In the nineteenth century came to Brazil famous foreign companies that left

here masters of circus arts, the first of them being “Circo Bragassi” (MAVRUDIS, 2011).

From the nineteenth century onwards, several circus families from Europe have been registered, bringing knowledge and transmitting their orality. The structure and organization of the circus and the itinerant form that we know were marked by the unique relationships established with the specific cultural and social realities of each region or country. This form lasts practically to the present day, particularly in itinerant circus groups (SILVA, 2009).

According to Silva and Gonçalves (2010), the traditional circus, recognized as a Brazilian circus, received this name because the family configuration allows the presence of orality and tradition in the transmission of knowledge. For Maxsuell (2012), this knowledge is transmitted in classes, rehearsals, and shows.

About the contextualization of the Brazilian circus, Torres (1998) comments that “the circus tropicalized some attractions”. Even the Brazilian clown has acquired his own characteristics, in which speaking loudly is part of the number, and in Europe, the number is made by mimes.

Whatever the origins or historical context, the circus has gradually undergone changes, which were not, however, able to prevent its attractions continue attracting people to the shows, regardless of the changes that occur along its historical trajectory, presenting itself currently with a new structure, without leaving the beauty and challenges of the original proposal (HENRIQUES, 2006).

Without a doubt, circus art has transformed and influenced the generation of new artistic movements; over time, this art has adhered to several areas, such as music, theater, and dance. The circus had to reinvent itself. According to Silva and Germano (2017, p. 08):

*With the emergence of other means of entertainment and the constant transformations of the modern world in the middle of the twentieth century, there was a significant reduction in the audience that attended the presentations. The circus had to reinvent itself to survive. Thus, from the 1910s, next to the arena, where the performances of extraordinary skills were made, a stage was installed to represent dramas. It was then that the theater entered the circus, being definitively absorbed by the circus tradition, as a new element belonging to this universe.*

An excellent example of this new clothing that was added to circus art is the fact that, from the 1980s on, the traditional Brazilian circus gained a new terminology and suffered a precise mixture of languages, being now called

a new circus. In this new model, troupes stand out, spreading the magic of the circus with the presence of elements from other entertainment media.

We must recognize that, despite the name “new”, the contemporary circus has the intention of, besides reformulating the shows according to the current situation, also recover lost knowledge, therefore, the real purpose of this new circus or contemporary circus would not be to erase the constitution of the traditional circus shows, but to recover part of what had been lost and reformulate the presentations, so that the circus would once again permeate the public’s imagination and the people would be interested in the magic of the circus show. As an illustration of this new reality, we can mention Cirque du Soleil, which is known worldwide (SILVA; GERMANO, 2017).

#### IV. THE FORMATION OF THE CIRCUS CHILD

According to the 1988 Federal Constitution, formal education is the duty of all, State and society, reflecting the dimension of importance of the educational training of children. It is essential to highlight that through Constitutional Amendment 59, of 11 November, 2009, the Ministry of Education, MEC, determines the compulsory nature of primary education from four to 17 years of age.

The Brazilian legal system foresees criminal sanctions for the responsible for the child that doesn’t give him the due access to schooling and in the scope of the infra-constitutional right, the Penal Code, in its article 246, points out that the parents that abandon the education of the children can have penalty of fine or detention from 15 days to one month; besides them, the managers of the schools can also suffer penalties in case of negligence, configuring the crime described above.

It should be noted that formal education can take place conventionally or unconventionally, in public or private institutions; there is still informal education, through which the transmission of knowledge takes place outside the classroom and at any time, as a complement to formal education.

#### V. FORMAL EDUCATION

In the conception of Libâneo (2009), formal education would be that structured, organized, intentionally planned, systematic. In this sense, conventional school education is typically formal. However, this does not mean that formal educational training does not occur in other types of intentional (or unconventional) education.

It is thus understood that where there is education (school or not), there is formal education. In this case, there is a reference to structured educational activities, for example, such as adult education, trade union education, and professional education, provided that they include intentionality, systematicity, and previously prepared conditions, attributes that characterize a pedagogical-didactic work, even if performed outside the school framework itself. On this topic, author Yamamura (2012) says that formal education is the one that develops learning in an organized manner and based on a curriculum.

Now, since FC/88 determines the compulsory nature of formal education, and considering that this is based on the attendance of the student at school, as a mandatory requirement, it is easy to see that there is a significant gap in the provision of this service to the circus populations.

This is clear from studies such as that of the Federal Government Art Foundation, FUNARTE<sup>3</sup> (2011), according to which there is no survey on the number of circuses in Brazil or even on how many young people of school age live in this activity.

It is only estimated that there are approximately 500 circuses around the country, of different sizes and under different financial conditions. From this information, it is understood that it is not possible to quantify how many young people are out of school.

According to the single paragraph of art. 29 of Law n° 6.533/1978<sup>4</sup>, the children of professionals of itinerant activities, aged between four and seventeen years, will have the transfer of enrollment and consequent vacancy in public schools and local private education institutions ensured, upon presentation of a certificate from the school of origin.

In the absence of the required documentation, the school is forbidden from registering, and it is up to the institution to assess the degree of development and experience of the candidate, to allow their enrolment in the appropriate grade or stage.

However, studies conducted by Yamamura (2012) reveal that schools do not comply with the law. In some cases, the representatives of the educational institutions allege the overcrowding of their classes in order not to receive the circus children, and end up not carrying out the school adaptation and mobilization established to welcome these students.

<sup>3</sup> Governmental body in charge of monitoring the circus activities in Brazil.

<sup>4</sup> It provides on the regulation of artists and technicians in entertainment shows and other provisions.

In the State of São Paulo, according to information from the House of Representatives (2012), the circus community has repeatedly made complaints that the legal provisions that determine the exceptional treatment of circus students are not complied with by schools. In this way<sup>5</sup>, one notices the lack of articulation between formal education and meeting the student learning needs.

Therefore, according to the 1988 Constitution, specifically in art. 205, it is the duty of the State and the family to guarantee the right to education and, as provided in the LDB (Law of Guidelines and Bases of National Education), there must be equal conditions for access to and permanence in school, and it is important to consider education as a tool for social inclusion and exercise of citizenship.

According to Duprat (2013), the populations that frequently move have the right to education and schooling. Still, unfortunately, there are weaknesses in the fulfillment of this duty and the implementation of this right because schools also face difficulties to adapt to the needs of this scenario, and it is not exclusively up to the school management to make decisions about the problem.

It is essential that there is a more massive, strategic, and governmental structure, geared to educational activities, to ensure the excellent implementation of the procedures urged to it.

On the subject, the Resolution CNE/CEB n° 03/2012, that defines guidelines for the attendance of school education for populations in the situation of itinerancy, disposes:

Art. 1 The children, adolescents, and young people in cases of itinerancy shall have guaranteed the right to enroll in public school, free of charge, with social quality, and that guarantees freedom of conscience and belief. II. Aiming at guaranteeing educational rights, the education systems must be adapted to the particularities of these students. III. The public and private establishments of Basic Education should ensure without the imposition of embarrassment, prejudice, or any form of discrimination, as this is a fundamental right, through self-declaration or declaration by the person responsible.

Another critical issue is the practical analysis of the school assessment procedures of circus children, in view

of the importance of knowing if they are diverse and if they are in agreement with the level of learning of these children, as well as the planning and procedure of classes to be performed, analyzing whether the school action is aiming to contextualize and facilitate the insertion of the reality of this community in the contents and their experience.

Luckesi (2002, p.33) defines that the evaluation can be characterized as a way of judging the quality of the evaluated object, a factor that implies taking a position on it, to accept it, or to transform it. Therefore it constitutes a value judgment on relevant manifestations of reality to make a decision.

It is then understood that the assessment should approach the reality of the student, its various contexts, especially the diverse local experiences lived by him and, thus, be a potential transformer of the environment, building its critical thinking to explore in the classroom its world view (LUCKESI, 2002).

Through the evaluations of the circus student, it is possible to provide an environment of cultural knowledge and uniqueness of this audience for other children, showing the importance of their culture and history in society.

In schools, the circus is commonly and extensively associated with physical education:

If we keep to the most frequently admitted image of the circus, it would only have to do with physical and sports education: from all the evidence, its tradition privileges performance and prowess, juxtaposing numbers that show virtuosity in various disciplines. For lack of records and competitions, it offers a well-established scale of difficulties in the design and execution of tasks. It keeps up to date history of innovations and progress in each of the techniques it highlights (ABIRACHED, 2009, p. 169).

Therefore, the circus should be explored in all disciplines, with creativity and criticality about the contents to be studied, so that it does not necessarily need to be worked only with the presence of some itinerant student in the classroom. We can even make a parallel with the school that has to adapt its physical space to receive wheelchair users even in the absence of enrollments of these, for example.

According to Paulo Freire (1999), it is necessary to adopt pedagogical guidelines that guide practice, providing a consistent methodology for the learning process.

<sup>5</sup> Faced with the lack of documentation, most schools refuse to enroll children and young people, although the right to education, in the range of four to seventeen years, is guaranteed by the Federal Constitution. (Chamber of Deputies of the State of São Paulo, 2012)



Edgar Morin (1986, p. 118) states that individuals make the society that prepares individuals so that individuals depend on the community that depends on them. Individuals and society co-produce themselves in a permanent recursive circuit, where each term, at the same time, is producer/product, cause/effect, end/middle of the other.

## VI. INFORMAL EDUCATION FOR CIRCUS CHILDREN

When one tries to conceptualize education, an association is automatically made with the school environment. However, it is known that the action of learning happens in different ways and at all times in different places, not being necessary the traditional school environment of the classroom, for Souza (2007), in the nineteenth century, the imperialism of the school was established, which started to synthesize and mean the totality of education, becoming synonyms the words education and school in the consolidation of a whole process of colonization of educational forms in exercise of school education.

However, education can be informal and happen in any context outside educational institutions, according to Libaneus (2010), informal learning would correspond to actions and influences exerted by the environment, by the sociocultural environment, and which develops through the relationships of individuals and groups with their human, social, ecological, physical and cultural environment, which result in knowledge, experiences, practices, but which are not explicitly linked to an institution, nor are they intentional and organized.

The author also reinforces, saying that we have an unintentional and informal education, referred to as the influences of the natural and social environment on man, interfering in his relationship with the social environment.

Indeed, other authors reinforce this idea:

(...) It is in the attitude of listening, of maturing, of comparing the new with what is already known that allows new learning, the acquisition of new knowledge, the construction of new knowledge (OLIVEIRA, 2007 p. 33).

The individual can learn in infinite ways related to the environment in which he lives to the stimuli to which he is exposed, his motivation, the methods applied in the transmission of information, among many aspects (YAMAMURA, 2012 p. 19).

In the circus environment, the transmission of knowledge and knowledge does not formally take place, but informally at all times.

Such education happens in a simple way when the teachings are contextualized with the experience of the circus. According to Yamamura (2012, p.25), the oral transmission of knowledge is one of the characteristics linked to the circus tradition. Silva (2009, p.25) reinforces that the content of this knowledge was and continues to be sufficient to teach how to arm and disarm the circus, prepare the numbers, the plays, and empower children and adults to perform them.

This content also tried to teach about life in the cities, the first letters, and the techniques of locomotion of the circus. Through this knowledge transmitted collectively to the following generations, it was guaranteed the continuity of a particular way of work and a specific form of organizing the show, reinforcing the idea that every individual has the knowledge to be explored and rich and cultural experiences to be explored.

Analyzing the history of these people, Silva and Abreu (2009) point out that the technical, artistic, and professional training of circus dwellers took place in parallel with their citizenship education, often in a shared way and with the participation of different subjects.

## VII. METHODOLOGY

This is a systematic review, considering as criteria for inclusion in the sample, articles from indexed journals published in the last ten years, available in full texts in the databases Latin American Literature and Health Sciences (LILACS) and Scientific Electronic Library Online (SCIELO).

As an inclusion criterion, we opted only for productions that dealt with the formal and informal education of itinerant children in Brazil, aiming at confronting these experiences with the Brazilian educational legislation.

For the search in the selected databases were used the keywords: school attendance to itinerant children, itinerant children, formal and informal education for nomadic children, circus children, and circus history.

This research had as an object of study the collection of information on itinerant children attended by public and private schools in Brazil. To this end, a temporal cut was made, and the last ten years were defined, i.e., the period between 2007 and 2017.

A total of six articles were found that dealt with the history of the circus, three of them with case studies, including interviews with circus families, and three reports on school attendance for circus students, one end-

of-course paper on itinerant students, three dissertations on the context of the circus, a doctoral thesis on the reality of the circus, and an expanded summary (Table 01), in addition to the laws that ensure the right to education.

### VIII. RESULTS

The research pointed out that children are protagonists of interrupted learning, in transient and pedagogically inappropriate school relationships, being the self-exclusion very present, causing early school abandonment. Since each student has his or her own intellectual and cultural framework, the lack of such understanding through the school environment in some cases ends up pushing the student away from school. In this case, school practices must necessarily understand the political, historical, socioeconomic, ideological, and institutional dimensions that involve the student (PATTO, 1999).

The research also showed that the theme of school attendance to children in situations of itinerancy, such as those of circus families, brings some points that stand out, such as lack of places, irregular documentation, hostile environment.

Santana (2012) states that it is so difficult for parents to find schools that they are willing to accept circus children, because they say that, if they provide the child's place, this may negatively influence the income of other students, that sometimes it is necessary to seek a private institution, which even with obstacles, end up receiving the student.

In the reports found in testimonies of circus families, the discomfort concerning the discontinuity of activities at school is, in most cases, because of the need for the displacement of the circus reflected in the difficulties of finding schools with availability.

Santana and Bitencourt (2012) interviewed circus parents and these reported that their children were somehow discriminated against in schools for being circus, sometimes because they needed special care in the classroom or even in the use of educational material that often required to be copied, because the institutions do not release the books for fear of not being returned.

The author Yamamamura (2012 p. 28) reported in the end-of-course work, whose theme was "itinerant students", another difficulty, namely, lack of space:

There, the secretariat reported that there were no more vacancies in the high school class in the morning. Only after the applicant's insistence and explanation that the circus would attend school only for a

short time was another vacancy opened.

Despite the public disclosure of tables and estimated calculations, there is no quantitative evaluation, census, or official statistical document that guarantees the rigor that is required in the school attendance of these children or the quantification of the total evasion of these children in the school environment.

According to data published in the anal of the II Brazilian Circus Meeting, held in 2007 in Salvador, informed about a plan of the Brazilian Institute of Geography and Statistics (IBGE) to carry out a mapping of circus activity in Brazil, research that so far has not been conducted. According to Duprat (2013 p. 135), the lack of data on circuses, and therefore on their education, shows that the government is paying less attention to the cultural sector.

It is known that there are great difficulties in keeping this group in schools and that their dropout is not always quantified comprehensively or adequately

### IX. FINAL CONSIDERATIOONS

This study helped to clarify the problems faced by circus students in Brazil. It has been found that the lack of public policies implies a clear violation of the fundamental right to education.

The school is a multicultural environment. It must propose democratic policies of coexistence that contextualize the educational process to clarify the role of each agent: school, teacher, coordinator, and community so that there is coherence among those involved.

State intervention must generate a new demand for schooling, given the adaptation and support needed, guaranteeing the entire population, including the circus community, the right to enjoy all the benefits as a citizen, as well as being able to transform the environment in which they live and participate in all spheres of human life, including society, education, and politics.

Therefore, it is essential to show how the school has adapted for the inclusion of these children of school age, as outlined in Resolution No. 3 of the National Council of Education, CNE, published in 2012, which institutes the guidelines for educational assistance for those who are in a situation of itinerancy.

It is clear from the analysis of the selected material that there are several difficulties presented that end up limiting the research, one of them is the vulnerability of the data surveyed because it is not known exactly about the number of circus children in school age and how many of these do not attend school.

The school environment presents some limitations that

stand out, among them the lack of vacancies, the difficulty in the act of registration, the difficulty with the teaching material and the discontinuity with the relations of friendship, among so many problems presented in this scenario.

It is noted that the reality of school attendance for the public studied is not consistent with what is expected of it. Still, the State needs to be more effective regarding the rights of children who live in situations of itinerancy.

Thus, the study on minority groups related to the theme education for students who move always becomes vital for presenting demands previously unnoticed or even underestimated, and that needs to be noticed and well attended in schools. And more: to contribute to the formulation of policies that can collaborate in meeting the real needs.

Thus, the detailed knowledge of the dimensionality and characteristics of the group of children that is part of the study is an essential conjuncture for the progress of studies and the development of policies that meet the demand of itinerant students.

Educational measures and resources are expected both for those who are already in the school environment, as well as for those who are not yet inserted in it, given the need for adaptation of schools to the peculiarities of students.

Finally, it is expected that this research will serve as a subsidy for the planning of public policies regarding circus students. The work indicates the need for more studies aimed at students in a situation of inherence.

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Table.1: Statement of the productions recorded in this study.

Title	Author	Year of publication	Local of publication
Picadeiro, palco, escola: a evolução do circo n Europa e no Brasil.	HENRIQUES, C. H.	2007	Revista Digital EF Deportes
Reflexões sobre inclusão com responsabilidade.	MAZZOTTA, M.J.S.	2008	Revista @mbiente educação
O circo moderno, história, inovação e transição social.	PINES JUNIOR, A. R et al.	2013	The FIEP Bulletin
Acesso à educação escolar por crianças circenses: um estudo de caso realizado em Petrolina- PE.	SANTANA, S. Q. BITENCOURT, R.B.	2012	VII CONNEPI
A linha do tempo das Artes circenses.	SILVA, E.	2017	CIRCOCONTEUDO.COM
Entre lonas e picadeiros: um estudo sobre artes circenses.	SILVA, T. C. GERMANO, J. W.	2017	ANPOCS.COM
Educação em movimento: educação para pessoas em situação de itinerância.	SOUZA, S.	2017	Laboratório de Ensino de História do Recôncavo da Bahia UFRB-BA.
O velho-novo: um estudo de sobrevivência organizacional pela preservação de valores institucionais.	COSTA, M. M. F. da.	1999	Dissertação – Fundação Getúlio Vargas.
Realidades e particularidades da formação profissional circense no Brasil: rumo a uma formação técnica e superior.	DUPRAT, R. M.	2013	Tese - Universidade Estadual de Campinas.
As vozes do Circo Social	FEIGUEIREDO, C. M.S.	2007	Dissertação – Fundação Getúlio Vargas.
Alunos itinerantes	YAMAMURA, P. S.	2012	TCC – Universidade do Parnaíba.
O circo no risco da arte	ABIRACHED, R . In: WALLON, E. (org.)	2009	Autêntica Editora
Os circos não existem: família e trabalho no meio circense.	AFONSO, J.	2002	Imprensa de Serviços Sociais
El circo: un encadenamiento de sentido	FIDELA, S. C. S	2010	Atenea 502



# Delineation of the Matança River Basin by the TauDEM automatic demarcation tool

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**Abstract**— *The automatic delimitation of watersheds stands out as essential for the planning and management of water resources, and the delineation and layout of the hydrographic network influences conjunctures in this process. The use of natural resources such as water due to their use in agriculture, industry and urban supply was part of the growing scientific advance regarding the evolution in the scenario of cartographic representation currently dominated by digital cartography. In order to provide a data structure for further hydrological studies by morphometry, it is permissible to establish parameters that indicate the behavior of the river basin, such as flood potential. Therefore, this study had the objective to define the Hydrographic River Basin the Killing making use of TauDEM extension (Terrain Analysis Using Digital Elevation Models), appliance exclusive to hydrological analysis with membership of Digital Elevation Models (DEMs), which can be obtained from remote sensing products absorbed in a variety of free or commercial software such as ArcGIS and QGIS. Given the results obtained it can be attributed that the TauDEM tool is very efficient for automatic delimitation of river basins, mainly reducing the time spent in the process, giving incentives for the diagnosis and planning of watersheds. It is concluded in this study that the Matança River Basin has a flat and gently undulated relief, not susceptible to flooding.*

**Keywords**—*hydrographic basin; morphometry; TauDEM.*

## I. INTRODUCTION

The watershed is an area of natural rainwater catchment, resulting from the effect of precipitation that converges the flows to a single outlet point, called exutorio. The basin consists essentially of a set of strands surfaces and a drainage network of watercourses which channels lead to a bed in exutori the (Rachel Finkler, 2012).

According to Garcez, Alvarez (1988) Watershed is the set of areas with slope towards a given cross section of a watercourse, measured in the horizontal projection areas. Botelho (1999) understands that the concept of watershed is intuitively linked to that of watershed, differing only in the size of the drained area. A watershed may be either in a larger basin or may contain smaller ones. These smaller river basins are called sub-basins.

For birth; Villaça (2008) The river basin is an open system consisting of rivers that are interconnected hierarchically, with tributaries (springs) that develop and interconnect with other watersheds and progressively increasing their volume.

The middle Tocantins River has territorially larger basins, with low population density where most of the water bodies that flow into the reservoir are found. The main tributaries are: Ribeirão Santa Luzia, Ribeirão Água

Fria, Ribeirão São Joao, where the city of Palmas is located., Taquaruçu Stream, Conceição Stream, Lajeado River, Matança River, Crixás River, Carmo River, Mangues River, Dirty Water River, Sao Joao Stream and Areias River making up the 13 sub-basins (Tundisi, 2006).

The main sources of pressure on biodiversity in these basins and on the quantity (formation) and quality of water resources are the increasing replacement of native Cerrado vegetation by agriculture, the evapotranspiration of extensive soybean, corn and sugarcane crops, catchments. without the right of use, pollution due to the application of agrochemicals, removal of vegetation cover from wetlands and destruction of the ecological smoothness of riparian zones. In these basins, there is also no information available about the quantity or quality of water resources (FAPTO, 2016).

The Tocantins and Araguaia Hydrographic Region is the largest in the area of drainage totally contained in Brazilian territory and scene of agile process of socioeconomic development that should intensify in the next decades due to the national and international demands for commodities. As a strategic means for the country, water, agricultural, mineral, navigation and power generation potentials will be increasingly demanded.

The Tocantins and Araguaia River Basin District was defined by Law 9,443 / 97. This decision ended with the elaboration of its Strategic Water Resources Plan, following the criteria of the Integrated Water Resources Management System, which brings PNRH implementation in an integrated, decentralized and participatory way in the main Brazilian basins and regions. The strategic character is conferred by the search to minimize and anticipate future conflicts, establishing rules for the articulation of water use with other sectoral policies to ensure its sustainable use.

In Brazil, public agencies such as the National Water Agency and the Brazilian Institute of Geography and Statistics offer data for watersheds, however, much information about small watersheds is not available. Because of this, in many cases it is necessary to delimit watersheds at specific scales of interest.

GIS basin delimitation methods usually do not use parameters such as the basin outlet or basin order to define the extent of the boundary. Without parameters, the programs demarcate watersheds of varying proportions, and hardly watersheds, especially those with rivers of small order and length.

## II. HEADINGS

In the procedures employed in the delimitation of the Matança River BH performed through the Terrain Analysis Using Digital Elevation Models (TauDEM), version 5.3, which was installed in the QGIS® program, the Digital Elevation Model (MDE) was used. of a digital

representation of land surface relief, obtained from the Embrapa database, a free and open system, under the responsibility of the Ministry of Agriculture, Livestock and Supply. The relief MDE data map derived from the Brazil Radar Shuttle Topographic Mission used in this work was from Region SC-22-ZB (Mendes, 2018).

TauDEM is a toolkit for the extraction and analysis of hydrological information from topography as represented by a free, intuitive digital elevation model, which has Portuguese versions, developed by the Hydrology Research Group of Utah State University in the United States, available for free at <http://hydrology.usu.edu/dtarb/>. TauDEM is available for ArcGIS, QGIS and Mapwindow.

It works with vector and polygonal data, thus being able to integrate ground analysis into matrix bases for drainage network extraction and the assigned final basins of their geometric characteristics (Mendes, 2018).

The first step was to display the MDE for the Flat Coordinate System. The coordinates applied in this work were UTM / Sirgas 2000 Zona 22 Sul. With the MDE in the desired projection, the automatic basin delimitation processes were started, as shown in Fig 1. The first measure was the application of the remove depression function, from the Tools tab. Basic grid analysis, this tool removes the spurious depressions found in MDE. The next step was to generate the raster that indicates the water flow path using the Flow Directions function D8.

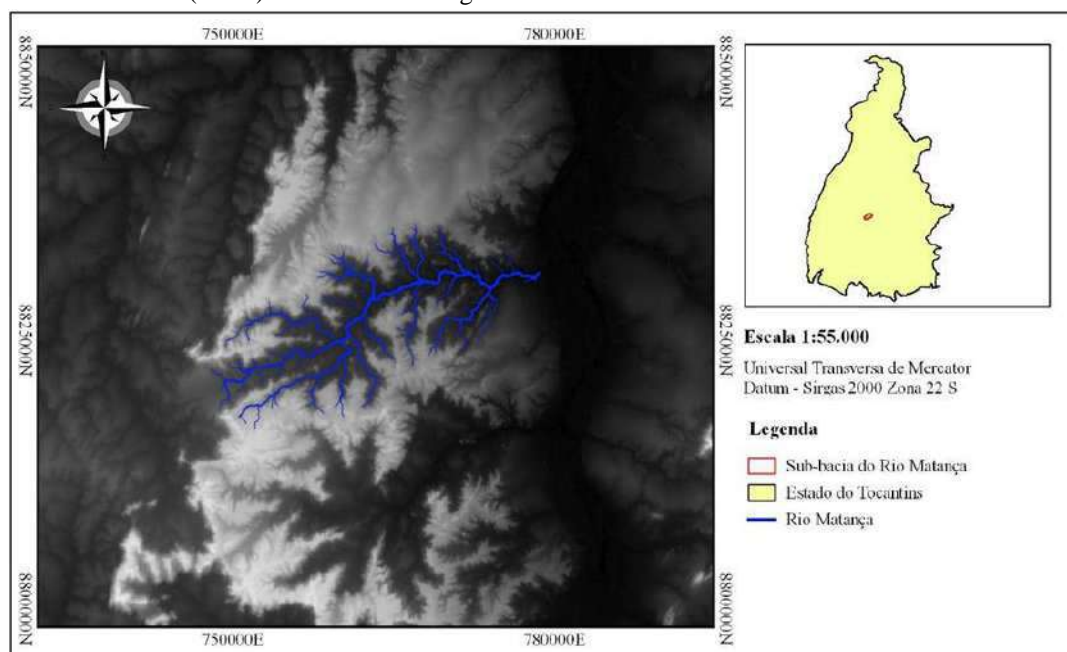


Fig.1: MDE da região da bacia do Rio Matança.

The algorithm generates two raster files: D8 Flow Direction Grid, which shows flow direction, and D8 Slope Grid, which reproduces slope. The next algorithm used was Contribution Area D8 to demarcate basin boundaries by flow directions. This procedure was performed twice, the first time generating a raster representing the overall contribution areas of the MDE, through which it is possible to view the sub-basins. After generating the raster D8 Contributing Direction Grid, which depicts the directions of the contribution flowing into the basin, it is necessary to define the exutory point by means of a shapefile file, later indicated with Outlets. In the second

execution of the algorithm was clarified positioning of the exutory and then generated a raster that indicates the Matança River basin.

The consequence of the execution of the algorithm was the creation of a raster containing the MDE drainage networks. The new stage was the delimitation of the basin. In this procedure we used the function Reach and flow of Watersheds as shown in Fig.2 originating the raster that represents the Watershed. After performing these steps, the polygonized river basin vectorized raster remained in polygons.

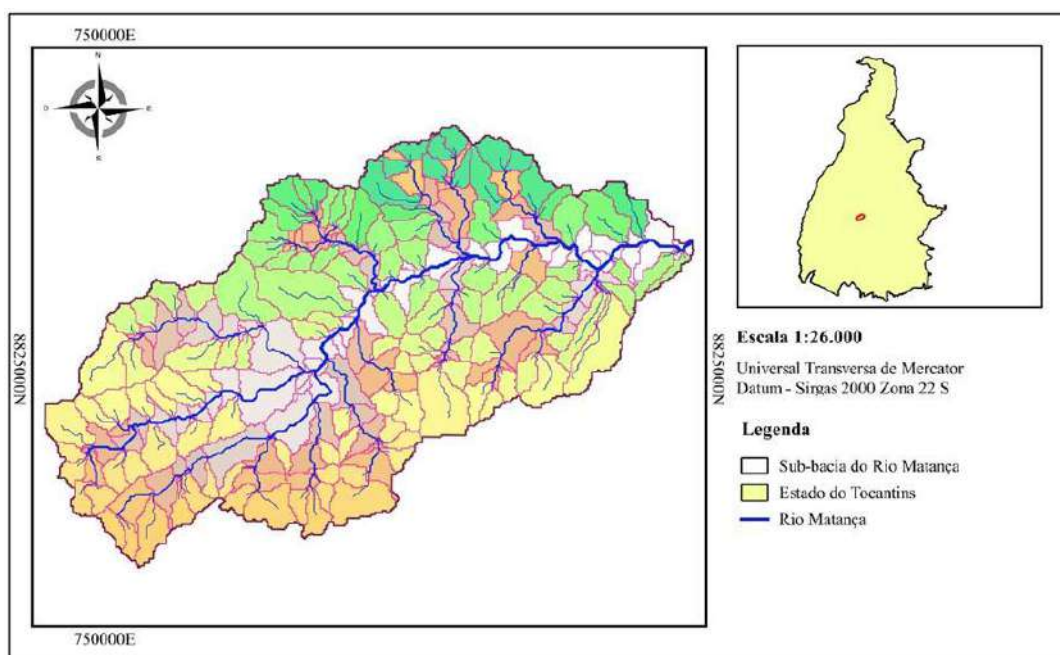


Figure 2: Bacia Hidrográfica do Rio Matança.

### III. RESULTS AND E DISCUSSION

#### Relief Morphometric Characteristics

The features associated with the relief are of great note as the relief is closely linked to the drainage and runoff characteristics. According to Carvalho e Silva (2006), the study of surface runoff may be for the engineer the most relevant of the phases of the hydrological cycle, precisely because it deals with the phenomenon of water transport on the terrestrial surface, given that most hydrological studies are involved in the

use of surface water and protection as the actions generated by the displacement of water.

Fig.3 shows the slopes of the Matança River Basin. Through this map the slope classes generated in six distinct intervals suggested by Embrapa are presented, it is clear that a good part of the basin is flat with slopes ranging from 0 to 3%. And that in the most steep areas it is expressed in red (strong mountainous), highlighting the high relief at the runoff points, thus drawing the course of the river basin on the flat terrain.

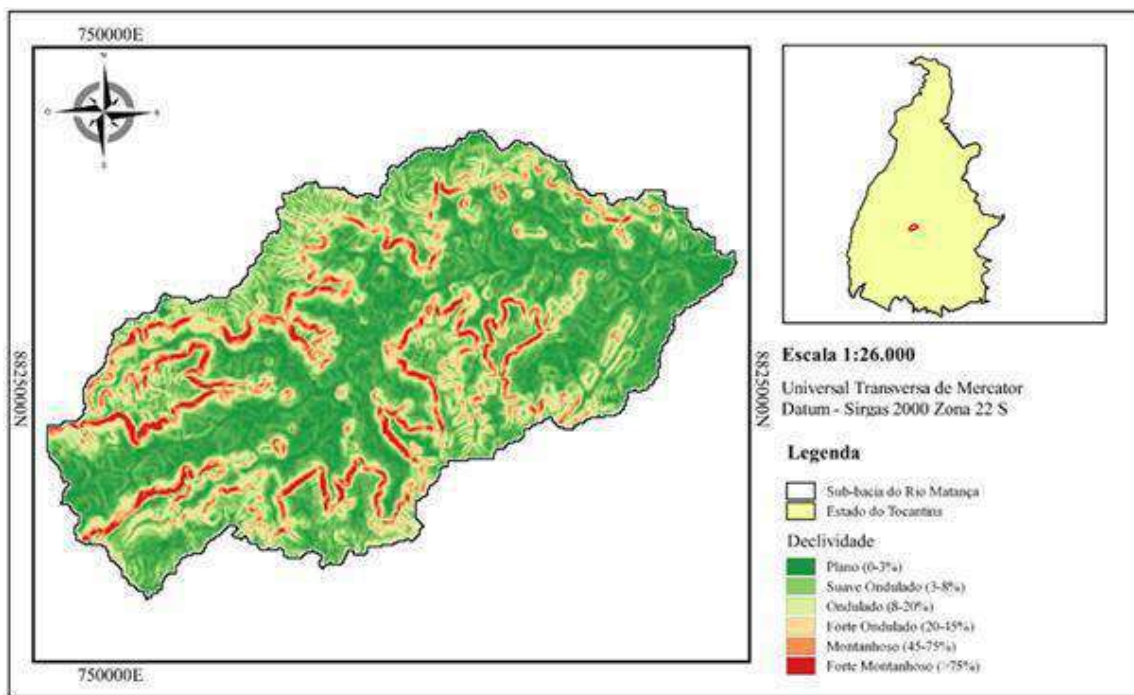


Fig.3: Declividades Bacia do Rio Matança.

Tabela 1: Relief Characteristic

Maximum altitude (m)	526
Minimum altitude (m)	228
Declivity	0 to 75%
Altimetric Amplitude	298
Relief Ratio	0,0092

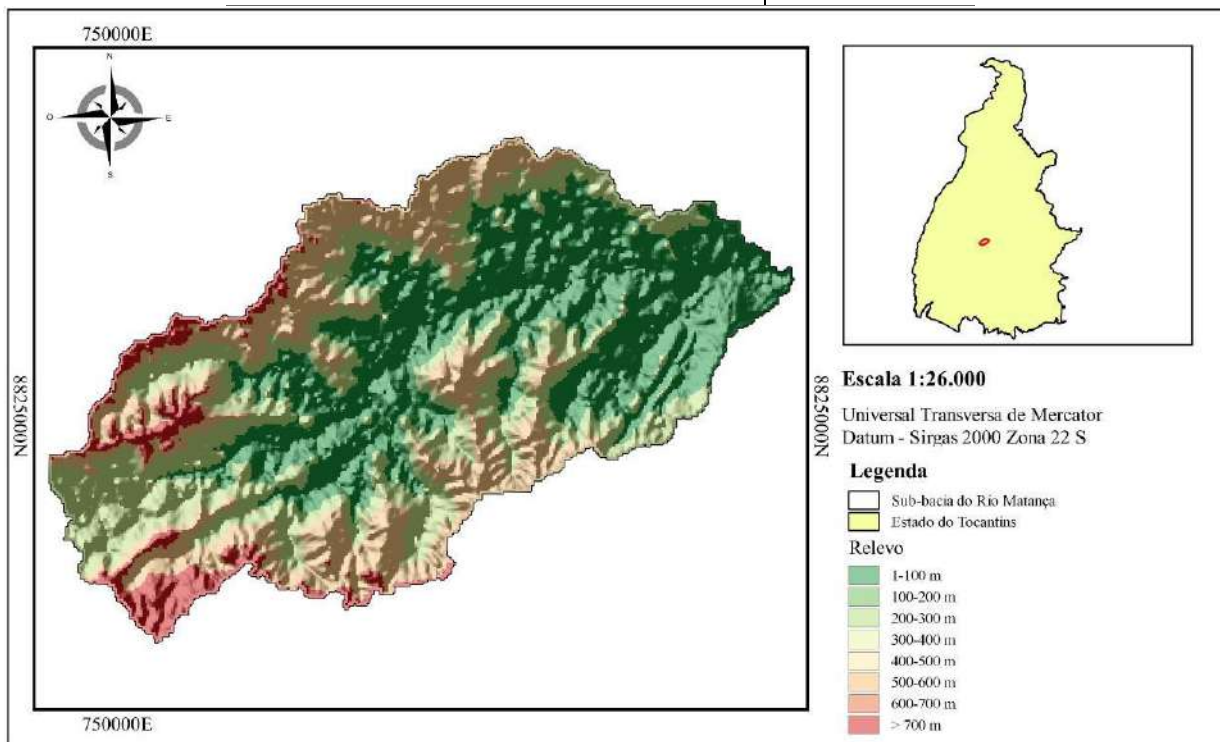


Fig.4: Mapa Hipsométrico da Bacia do Rio Matança.



Relief Ratio is a specification that involves the altimetric amplitude and the length of the main channel, and indicates the relationship between the maximum and minimum altitude difference in the basin and the total length of the main channel (Lana; Alves; Castro, 2001).

The Matança River basin demonstrated a relief ratio of 0.0092 (Table 1). The low value of the relief ratio is a result of the low altimetric amplitude and consequently a low average slope characterizing the relief as smooth wavy.

The values presented indicate that the Matança River Basin has a medium capacity to generate new watercourses, a fairly low and a small surface runoff, but some mountainous areas justify the existence of 237 river channels and approximately 262 km in length. the channels.

Tabela 2: Quantity of River Matança River Channels.

Order	# Of Channels
1st	119
2nd	65
3rd	27
4th	26

Table 2 presents the data resulting from the DEM in the TauDEM tool. In turn, it was possible to analyze that 50.21% of the fluvial channels are first order; 27.43% of the second order; 11.39% third order; 10.97% of the fourth order.

The study showed that the Matança river basin is largely formed by low altitudes and therefore a median altimetric amplitude. A relevant consideration for river channels is their longevity. According to Marcuzzo and Goularte (2013) in Tocantins the hydrological year presents a well-defined personality characterized by two periods: dry and rainy. Where the humid lasts longer, from seven months, from October to April. And the five-month extending from May to September. In addition, during the rainy season in the state precipitates approximately 90% of the entire volume of the Tocantins hydrological year.

The morphometric analysis represents a methodology for water functioning estimates in the absence of monitoring of climatic variables. For the morphometric characterization of this basin, it was necessary the hypsometric delimitations of maps with basic properties, to consider area, perimeter, axial length of the basin. From these properties the shape indexes of the basins

were calculated, translated into the values of compactness coefficient (Kc), form factor (Kf) and circularity index (Ic).

The compactness coefficient (Kc), which is the relationship between the perimeter of the basin and the circumference of a circle of equal area to the basin, was calculated from the equation:

$$Kc = 0,28 \frac{P}{\sqrt{A}} \quad (1)$$

Where, P is the perimeter in km and A is the basin area in km<sup>2</sup>. This coefficient is a dimensionless number that varies with the shape of the basin regardless of its size, so the more irregular it is, the greater the compactness coefficient, is the closer to the unit, the more circular the basin will be and the more subject it will be flooding (Villela & Mattos, 1975).

The form factor (Kf) is the ratio between the average width and the axial length of the pelvis. It was calculated from the equation:

$$Kf = \frac{A}{Lx^2} \quad (2)$$

Where Kf is the form factor, A is the basin area in km<sup>2</sup> and Lx is the axial length of the basin in km. A basin with a low form factor indicates that it is less subject to flooding than another of the same size but larger in form factor (Villela & Mattos, 1975).

#### IV. CONCLUSION

With regard to the TauDEM tool, it can be concluded that it has shown to be an adjusted basis for the automatic delimitation of watersheds, thus being able to contribute to morphometric, hydrological and conservationist studies of these areas. Automatic delimitation of watersheds is a procedure chosen because it ensures less subjectivity and faster process, facilitating decision making regarding water resources planning.

It was also noted that in the Matança River the relief distribution varies in an amplitude of 298 m, with a maximum elevation of 526 m and a minimum of 228 m.

Based on the morphometric characteristic of the Matança River, it was possible to conclude the analysis that the basin with respect to the compactness (Kc) and shape (Kf) coefficients was 5.78 and 0.035 respectively, and according to Villela and Mattos. (1975), that the more irregular the basin, the higher the compactness coefficient, ie not subject to major flooding. For coefficients above one, the basin will show low susceptibility to flooding; In turn, the lower the value of this coefficient near zero, the greater the propensity to flood, the more rounded the basin and the more subject to flood it will be. For the form coefficient Villela and

Mattos (1975) report that a basin with a low form factor is less susceptible to flooding. These coefficients are of a dimensionless value that varies with the shape of the basin without its size.

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# Wettability x Roughness: A Study of Ti-CP Surfaces

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**Abstract**— Commercially pure titanium has characteristics that define it as an excellent biomaterial, and for presenting these properties, it is widely used for biomedical purposes. In view of this information, studies are being conducted on titanium in order to improve its biocompatibility and adaptation with human tissue. Several types of topographic, chemical and surface analysis are proposed in order to make Ti CP an increasingly biocompatible material. The present work aimed to analyze the surface roughness and wettability of Ti CP, as well as the correlation of these properties. Twelve titanium discs with different Ra roughness grades and different orientations of this roughness were used and then a wettability analysis was performed using the sessile drop technique using water. Relationships between wettability and roughness can be made from the results obtained.

**Keywords**— Titanium, Roughness, Wettability.

## I. INTRODUCTION

Actually, with the increasing number of injuries associated with accidents and factors related to longevity, the use of implants is necessary, where they are made from biomaterials. Thus, the use of biomaterials is extremely important to provide a better quality of life for the population as a whole[1].

From this perspective, biomaterials comprise a significant fraction of the products used in both Health and Engineering, being estimated at 300,000 prostheses in about 10 years[2]. Thus, the problem of obtaining prostheses as close as possible to natural bone tissue is widely studied in the field of materials science.[3].

However, for a direct structural and functional connection between the living organized bone and the implant surface, Osseointegration [4], elements such as commercially pure titanium (Ti-CP), is widely used for the broad corrosion resistance, conformability, ductility and strength of a specific application[5], reducing rejection phenomena in the long run[6].

Ti-CP surface characteristics such as surface energy, roughness, wettability and topography are essential conditions for osseointegration [7]. Considering the parameters, a material subjected to superficial modifications may present a reduction in the biological response time, in order to have a greater effectiveness in the adaptation of the implant with living organisms[8].

Thus, when there are changes in the roughness of Ti CP, consequently there will be a variation in the

surface energy as well as its topography and wettability[9].

Roughness can be defined as a set of irregularities on the surface of a sample, including peaks and valleys relative to a reference plane or imaginary plane[10]. There are fundamental parameters indicating roughness, which can be cited: Ra, Rq, Rz e Ap e Av.

The Ra parameter indicates the average variation between peaks and valleys of the imaginary surface mean line. Already Rq, the mean square value of the roughness profile deviations and Rz the mean value of the unit roughness obtained in five measurement lengths. Ap and Av are the areas of the peaks and valleys[11].

Surface wettability can be studied through the contact angle of the liquid with the solid surface. Thus, the higher the wettability, the greater the interaction of the surface with the biological environment[12]. In the study of wettability, wetness is the ease that gout has to spread and can be classified into two types: physical and chemical. The first can be classified as interfacial solids interactions as Van der Waals force[13], and the second type of wetting can be defined as the chemical reactions between a solid and a liquid, or surface tension decrease and greater wetting[14].

The contact angle calculated by Young's equation:

$$\cos \theta_r = \frac{(\gamma_{sv} - \gamma_{sl})}{\gamma_{lv}} \tag{1}$$

Were:  $\gamma_{sv}$ (solid-gas),  $\gamma_{sl}$ (solid-liquid),  $\gamma_{lv}$ (liquid-gas)[15]. The surface characterization of solids with respect to hydrophobic and hydrophilic surfaces can be determined from their respective contact angles[16]. Where, according to Young's equation, for  $\theta_r < 90$  one has a hydrophilic surface and for  $\theta_r > 90$  a hydrophobic surface.

Wenzel's model studies the contact angle for a micro and nanoscale surface. Thus, on a smooth surface when we add a roughness to it, there is an increase in surface area, so that its initial contact angle values change, tending to increase. The phenomenon occurs because with the roughness, the material gains what Wenzel calls the roughness factory  $r_w$ [15].

In 1932, Wenzel proposed his relatively simple model for rough surfaces[17]. With it, one can observe how roughness affects wettability due to the increase of contact angle. The contact angle of the Wenzel equation is described as follows:

$$\cos \theta_w = r_w \frac{(\gamma_{sv} - \gamma_{sl})}{\gamma_{lv}} = r_w \cos \theta_r \tag{2}$$

$\theta_w$  is called Wenzel's apparent contact angle, as opposed to the actual contact angle  $\theta_r$  to Young's equation for a smooth surface[15].

## II. MATERIALS AND METHODS

Initially we worked with 12 samples of Ti CP, where they were submitted to the metallographic preparation of sanding with silicon carbide sandpaper with granulometry ranging from 220# a 2000# and polishing using alumina of 1  $\mu m$ , 0,5  $\mu m$  e de 0,03  $\mu m$  respectively, making them all the same.

After the discs were homogenized, they were divided into three groups according to the direction of the grooves that were made with the sandpaper, was used a sandpaper of 80#, 220#, 600# e 1200 #. To measure the final roughness a standard roughness meter was used Time Group Inc., model TA 630 and Ra parameter.

After roughness analysis, the samples were subjected to the determination of the contact angle, which was made by the sessile drop method using water as wetting liquid. The contact angle value was measured using the SurfTens DEMO software.

## III. RESULTS

Figure 1 shows the roughness results for different working groups. A decrease in Ra roughness was observed as the sanding grain size was increased, as expected since 1200 # sandpaper is thinner than 80 # sandpaper for example.


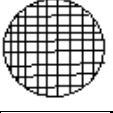

	Orientation	Sandpaper 80 #	Sandpaper 220 #	Sandpaper 600 #	Sandpaper 1200 #
Group 1	 1	1- 1,656 $\mu m$	4- 0,698 $\mu m$	7- 0,289 $\mu m$	10- 0,186 $\mu m$
Group 2	 2	2- 1,734 $\mu m$	5- 0,713 $\mu m$	8- 0,232 $\mu m$	11- 0,209 $\mu m$
Group 3	 3	3- 1,201 $\mu m$	6- 0,404 $\mu m$	9- 0,289 $\mu m$	12- 0,159 $\mu m$

Fig.1 – Roughness orientation for different groups

Comparing the three groups, it can be observed that group 2 had higher Ra roughness than the others, except for condition 7. This difference can be attributed to the pressure variation used during mechanical and manual sanding.



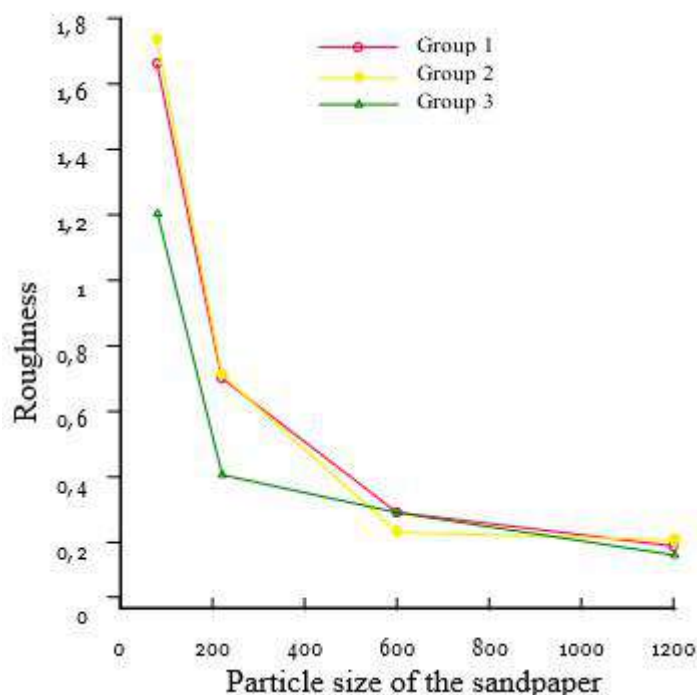


Fig.2 –Roughness x different particle size of the sandpaper.

Figure 2 shows a new representation of the data in Figure 1, where it can be seen that group 3, group in which the surface treatment done by an automatic sander had an initial disparity in relation to groups 1 and 2, which had their roughness orientations done manually, but for the sandpaper 1200 all had similar roughness.

Figure 3 shows the contact angle values for all conditions analyzed. A relationship between the contact

angle values and those of the Ra roughness was observed, this relationship is justified based on Wenzel's theory which shows that when a sample has different roughness its surface area increases, and from Young's equation for energy. This new area tends to receive a roughness factor, making the larger this factor, the wetter the material becomes.


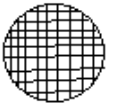

	Orientation	Sandpaper 80 #	Sandpaper 220 #	Sandpaper 600 #	Sandpaper 1200 #
Group 1	 1	1- 23,18°	4- 28,12°	7- 24,7°	10- 32,38°
Group 2	 2	2- 21,44°	5- 25,18°	8- 32,12°	11- 34,16°
Group 3	 3	3- 23,96°	6- 19,16°	9- 26,96°	12- 26,24°

Fig.3 - Contact angles for different groups

From the roughness and contact angle data, the graph of figure 4 was constructed, where the contact angle with the roughness was related for the three different topographies analyzed.

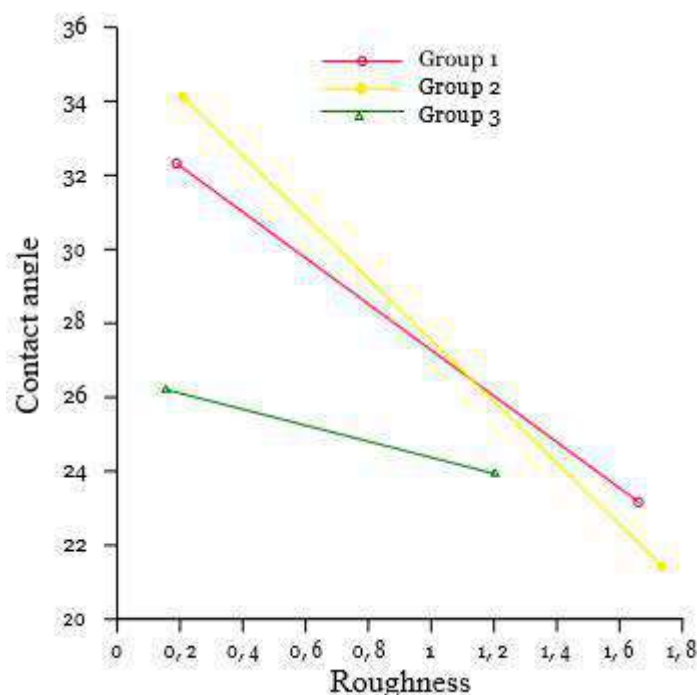


Fig.4 - Analysis of the contact angle relationship as a function of roughness for the different groups analyzed.

In figure 4, it was observed that the group 2 presented the best results of roughness as well as wettability, because for higher degree of roughness had greater wettability and for lower roughness values, consequently the samples wet less. Among the analyzed groups, group 3 was again quite different from the others, thus it was observed how the mechanical surface treatment affected the analyzed samples from group 3.

#### IV. CONCLUSIONS

It was observed that we can relate the roughness and wettability of a material through the Young and Wenzel equations, and thus, it can be observed that samples with different degrees of roughness tended to have larger and smaller contact angles, directly correlating to roughness with wettability.

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# Irregularity in the applications of Environmental Legislation in Enterprises in the urban area of Manaus

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**Abstract**— This shows an analysis of the New Forest Code with two enterprises in the city of Manaus /AM located around a Permanent Preservation Area (APP) with the purpose of comparing environmental standards with the execution of the enterprises. The results indicate that the enterprises do not follow the laws in force, thus being contributing to the degradation of the area. The presence of these large enterprises causes difficulties in the application of laws that preserve THE PAPs, causing the degradation of the same.

**Keywords**— Permanent Preservation Area (APPs); Environmental Legislation; environmental degradation.

## I. INTRODUCTION

Population growth over the past few decades has been responsible for environmental degradation. In addition, this growth is one of the factors that contribute to changes in the ecosystem and becoming a threat to the life of various species of fauna and flora on the planet. Likewise, Bilac and Alves (2014) showed that the urban environment is related to environmental problems and that this expansion increasingly accelerated and disorderly.

In view, the problems caused by the anthropized action to the environment arose the need to create affective environmental legislation, which has the principle of protecting vegetation, water and soil for the common good of society. According to Borges et al. (2011), laws protecting permanent preservation areas (APP) arose as a result of protecting areas of a wide variety and richness in biodiversity, besides assisting in the permanence of man on earth. Additionally, Freitas et. al., (2013) clarifies that the legislation has the mission of conserving these areas, because most APs are located in areas of spring or water body. Thus, with the preservation standards these areas can be delimited and protected.

Protected areas can be monitored in several ways, as shown by the results of Nascimento et. al., (2005). The authors applied geoprocessing techniques in the applicability of legislation, thus delimited to the areas of permanent preservation, in the alegre river/ES river basin. While Carmo et. al., (2014), conducted the study on areas of permanent preservation around springs and the gaps and alternatives of Brazilian environmental legislation.

With environmental degradations becoming increasingly aggressive, especially in APP's, it was necessary to reformulate the Forest Code, Law No. 12,651 of 25 May 2012. Thus, the reformulation of the law portrays THE APP's as legally protected territorial spaces, environmentally fragile and vulnerable, and may be public or private, urban or rural, covered or not by native vegetation, but decreasing the ciliary forest area.

Second, The function of areas of permanent preservation not only has the function of ensuring vegetation and biodiversity, going beyond that, its purpose is to protect important spaces for the quality of environmental life, preserving water resources, ensuring a balance with the landscape bringing harmony, and thus protecting the soil and ensuring the well-being of the population (SCHÄFFER *et. al.*, (2011).

Thus, this work aims to evaluate the applications of the laws in force that protect app's, comparing them with two authorized ventures. In the analysis will be verified compliance with the standards of the Forest Code for watercourses. Since one of the ventures was used as a form of mitigation to minimize the impacts caused by the construction of the main venture.

## II. METHODOLOGY

The research was developed in an APP area in the city of Manaus/ AM, located in a region with several residential and commercial developments. This APP is divided into two sections, having different characteristics regarding the processes that interfere with its maintenance.



The first stretch is located in a stretch of the mindu stream, between Djalma Batista Avenues and Constantino Nery, called "A" enterprise. While the second, it is the part of the

APP directly linked to the Billiard Park on Constantino Nery Avenue, called "B".

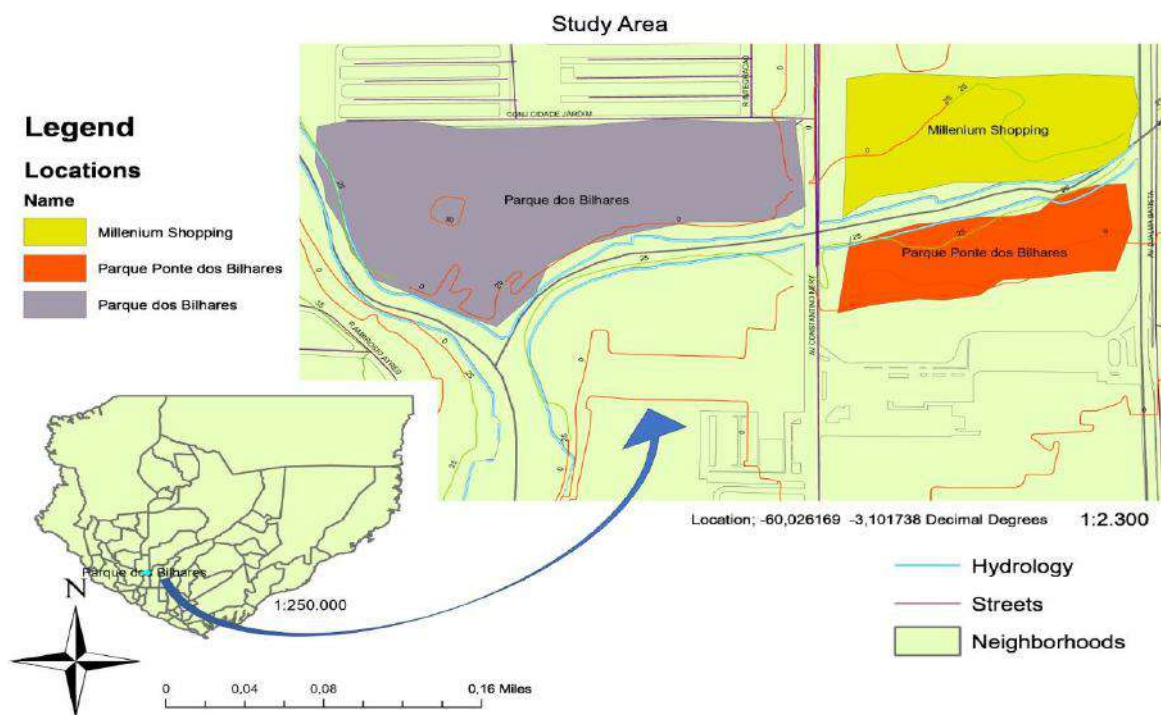


Fig.1: Location of the evaluated enterprises.

The criterion of choice and division of the contiguous areas of the APP's was the presence of large enterprises in the range of the reserve, and also the format of interference, which hinders the applicability of environmental legislation focused on preservation, with the purpose of relating environmental laws and norms with the execution of the two enterprises, in focus.

Initially, visits were made to the site in order to obtain the relationship between the enterprises, their respective measures, and the preservation areas. One of the criteria uses the sites were measured with the highest flow rate. In addition, measures were also used via the GPS of the Google Earth tool, in order to confront the measurements of some stretches (Table 1).

Table 1: Excerpts from data collections

Data collection	Excerptsobserved
Length (m)	Margin of the stream of the largest flow to the enterprise; Margin of the stream of the largest flow rate to the end of the vegetation; Margin of the stream of the largest flow until the beginning of the vegetation;

### III. RESULTS AND DISCUSSIONS

In this section, the most relevant results of the comparative analysis of the environmental preservation law will be shown in two projects located in the south zone of Manaus/AM. The severity of the problems caused by environmental degradation puts at risk the survival of an entire ecosystem, besides affecting the health of those living in the surroundings. According to Article 225, the Brazilian Federal Constitution of 1998, establishing that: "Everyone is entitled to the ecologically balanced environment, as well as common and essential use to sound quality of life, imposing on the Public Power and the collective, defend it and preserve it for present and future generations".

The same decree defines the minimum widths between the APPs and nearby activities, in relation to the gutter and riverbed (Table 2).

Table.2: APP footage of the New Forest Code

D' WATER COURSES (WIDTH)	MINIMUM WIDTH
Less than 10 (ten) meters	30 meters
10 to 50 meters	50 meters
50 to 200 meters	100 meters
200 to 600 meters	200 meters
Over 600 meters	500 meters

From this description, it is noted that the fitting of the creek course within the first track. However, there should basically be diversity of fauna, flora and other environmental components, which was not observed and thus not met this criterion. The minimum width of 30 m, corresponds to the design of the structure of the building, together with asphalt (Enterprise A), indicating the non-compliance with the legislation. At the time of carrying out the work there were several embargoes of the Public Prosecutor's Office, but not making it impossible. This value is also observed and reiterated if we take into account the surroundings, described in Table 3.

*Table.3: The minimum widths for areas around lakes and natural lagoons.*

100 (one hundred) meters, in rural areas, except for the body of water with up to 20 (twenty) hectares of surface, whose marginal range will be 50 (fifty) meters.

30 (thirty) meters, in urban areas.

The areas around perennial springs and water eyes, whatever their topographic situation, at least 50 (fifty) meters.

According to the new Brazilian Forest Code, the balance between the urban area and the natural ecosystem must be maintained through the creation of permanent preservation areas. Despite the attempt in the areas analyzed, there was no movement of the enterprises around the preservation area, as a way to obey the new descriptions of the established laws. An example of the applicability of the laws was verified in Ribeiro's study (2011), where the author suggested that a limit should be used for activities that are developed around them. Thus, Table 4 presents the predetermined minimum widths along rivers or any watercourse. (Table 4).

*Table 4: App Footage of the Old Forest Code*

D' WATER COURSES (WIDTH)	MINIMUM WIDTH
Less than 10 (ten) meters	5 (five) meters
Equal to half the width of the courses	10 (dec) to 200 meters
Over 200 meters	100 meters
200 to 600 meters	200 meters

It is understood that the law enforcement process in urban areas is difficult to apply, due to the fact that the process of expansion of cities often do not fit the standards of activities in areas of preservation. The measurements showed that the two ventures did not obey the legislation.

In addition, one of the projects analyzed was sanctioned, including the creation of a park as a form of liability. However, the activities developed, the lack of effective public policies, lack of regulatory bodies and supervisors acting, end up not conducting the activities in order to comply with current legislation.

However, the enterprise represented in Figure 1 by orange color should be 50 meters from the APP, because measures showed that the localized water course has a width of 30 m. In addition, this space has a public route for the passage of cars. However, it is observed that the required measures are not in accordance with the provisions of the law. Furthermore, the width between the edge of the creek and vegetation are areas with a wide variety of flora, but in the case observed, they do not agree with the legislation, as it has a small area of 08 (eight) meters of vegetation.

Venture B was an attempt to try to reduce the impacts and degradation process caused by venture A, which led to the construction of the Billiard Park, created with the purpose of reducing the population occupation of the area. But over the years the Park was abandoned by the creators of it and the population due to lack of security. Currently, venture B is not in agreement with the law, because due to the presence of waste released in the creek, causing degradation of water resources, altering the morphological characteristics of the creek.

#### IV. FINAL CONSIDERATIONS

The design of environmental laws is to directly protect water resources, fauna and flora thus maintaining the balance of the environmental area and the quality of life of society. Thus, this work showed the applicability of environmental laws to two enterprises located very close to one APPs. Measurements were made that revealed that the two enterprises do not follow environmental legislation, and there is no monitoring of the organs to adapt the law. For the "A" project the construction of the park could minimize the impacts, but after a few years, with the accumulation of waste, waterways and the preservation area were affected.

The maintenance of the area could mitigate these impacts bringing quality to the environment and the population that frequent the site. To this end, inspections are extremely indispensable and may thus preserve natural resources and prevent serious problems.

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# Effect of biofertilizer produced from cow dung and conventional fertilizer on Plant Growth

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**Abstract**— This experimental research work is on the production of biofertilizer from cow dung and the comparison of plant growth rate using biofertilizer and chemical fertilizer. It was conducted first with anaerobically degeneration of cow dung in a minifloating bioreactor for a period of 30 days to produce biofertilizer, a liquid with soil enriching property hence suitable for plant growth, then test of the effect on growth rate using the biofertilizer and chemical fertilizer on cultivated maize in nurseries for a period of 30 days. Laboratory test of biofertilizer recorded pH of 4.9, N<sub>2</sub> of 0.026mg/l, K of 650mg/l, while chemical fertilizer had pH of 5.1, N<sub>2</sub> of 0.00124mg/l, K of 3416.66mg/l. Test results based on performance of the fertilizers on the growth rate of maize shows the height of stem for the biofertilizer and chemical fertilizer to be 26.2cm and 25.3cm respectively, the length of roots to be 11.4cm and 10.3cm for the biofertilizer and chemical fertilizer respectively, and the length of the broadest leaf to be 25.8cm and 25.2cm for the biofertilizer and chemical fertilizer respectively. The results from all the research shows that cow dung can be converted through, anaerobic biodegradation to biofertilizer amongst other useful products and the biofertilizer produced is richer in nutrients than the chemical fertilizer, hence it is more suitable and have a better effect on growth rate.

**Keyword**— Biofertilizer, Chemical fertilizer, Plant growth rate.

## I. INTRODUCTION

To the uneducated man, to fertilize means to improve fertility or production of a substance and this can stand even in the education sector as the simplest definition of a fertilizer. Before we talk about this, we would first want to know what a soil is because that is what we would be trying to improve. The soil is a natural body of finely divided rocks, minerals and organic matter. The sand, silt, clay and organic matter in the soil helps provide tilth, necessary aeration and favorable water intake rates but they rarely maintain adequate plant food to sustain continuous healthy plant growth – this is why we fertilize it.

Management of soil fertility has been the preoccupation of farmers for thousands of years. Egyptians, Romans, Babylonians, and early Germans are all recorded as using minerals and or manure to enhance the productivity of their farms (Heinrich, 2000). The modern science of plant nutrition started in the 19th century and the work of German chemist Justus Von Liebig, among others. John Bennet Lawes, an English entrepreneur, began to experiment on the effects of various manures on plants growing in pots in 1837, and a year or two later the experiments were extended to crops in

the field. One immediate consequence was that in 1842 he patented a manure formed by treating phosphates with sulfuric acid, and thus was the first to create the artificial manure industry. In the succeeding year he enlisted the services of Joseph Henry Gilbert, with whom he carried on for more than half a century on experiments in raising crops at the institute of arable crops Research (Chisholm, 1911).

Fertilizer refers to any compound that contains one or more chemical elements, organic or inorganic, synthetic or natural, that is placed on or incorporated into the soil or applied to directly onto plants to achieve growth (McKenzie, 1998). Proper nutrition is essential for satisfactory crop growth and production. Some of such nutrients includes carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, boron, chlorine, copper, iron, manganese, molybdenum and zinc. The profit potential for farmers depends on producing enough crop per acre to keep production cost below the selling price – therefore a need for productivity to increase is paramount and this gives rise to the need for a fertilizer (Mackenzie, 1998). Almost all biological wastes can be used to fertilize the soil, when used they are referred to as manures.



Manure can be said to be a mixture of animal faeces, urine, livestock bedding, additional water and wasted feed. Factors like the livestock type, stage of growth and feeding practices (all of which determine nutrient excretion rates) as well as the amount of bedding or water added to the manure, type of manure storage, time that the manure spends in storage and weather conditions affect nutrient composition of manure. Cow dung falls under this category of soil enrichers but however the use of cow dung like almost all other untreated manures are harmful in the long run, as they provide both the elements the plant needs for growth and elements that are harmful to the soil and plant growing on it.

The need for other methods to provide soil nutrients gave birth to fertilizers. There are two main types of fertilizers; chemical fertilizer and biofertilizer. Chemical fertilizers are defined as any inorganic material of wholly or partially synthetic origin that is added to the soil to sustain plant growth while biofertilizers are substances which contains living microorganisms with the ability to colonize the rhizosphere or the interior of the plant and promote growth by increasing the supply or availability of primary nutrients to the host when applied to seeds, plant surface or soil.

General, the chemical fertilizer is more readily available and would be the best option for soil enrichment but a lot of artificial fertilizers contain acids, such as sulfuric acid and hydrochloric acid, which tend to increase the acidity of the soil, reduce the soil's beneficial organism population and interfere with plant growth. Chemical fertilizers may also affect plant health. For example, citrus trees tend to yield fruits that are Generally, healthy soil contains enough nitrogen-fixing bacteria to fix sufficient atmospheric nitrogen to supply the needs of growing plants lower in vitamin C when treated with high nitrogen fertilizer.

On the other hand, organic fertilizer (biofertilizer) adds nutrients to soil, increases soil organic matter, improves soil structure and tilth, improves water holding capacity, reduces soil crusting problems, reduces erosion from wind and water, improves water holding capacity and improves buffering capacity against fluctuations in pH levels. Bio-fertilizer is a dark brown in color whether in its solid or liquid state, it is made from biodegradable organic matter, vegetable waste, etc., through microbial conversion process. It is free from foul smell, live weed seeds, plastics, glass, and also free as a source for spreading pests and diseases. Its moisture content is about 25% with a bulk density of 0.64 gm / c.c. (Shovon *et al*, 2013).

Bio-fertilizers such as Rhizobium, Azotobacter, Azospirillum and blue green algae have been in use a long time ago. The knowledge of applied microbial inoculum is a long history which passes from generation to generation of farmers. It started with culture of small-scale compost production that has evidently proved the ability of bio-fertilizer (Khosro and Yousef, 2012).

This is recognized when the culture accelerates the decomposition of organic residues and agricultural byproducts through various processes and gives healthy harvest of crops (Abdul-Halim, 2009). The commercial history of bio-fertilizer began with the launch of "Nitragin" by Nobbe and Hilther in 1895. This was followed by the discovery of Azotobacter and then Blue-green algae and a host of other microorganisms which are being used till date as bio-fertilizer (Kribacho, 2010).

Manure can always be converted to biofertilizer, a process during which microbes break down the feed (manure) removing excess of unwanted elements and leaving the essential microbes and elements. The production of bio-fertilizer involves 3 biochemical steps which include the breaking down of complex materials into simpler substances in a process known as anaerobic digestion. Anaerobic biodegradation is a process whereby microorganisms' breakdown biodegradable materials in the absence of oxygen (Ezigbo, 2005). This process generates a product called biogas that is primarily composed of methane, carbon dioxide and the bio-fertilizer suitable as soil conditioners (Owamah *et al*, 2014).

Cow dung one of the organic wastes that can be converted to biofertilizer is the waste product of bovine animal species (cow, buffalo, yak, etc.). It can also be said to be the undigested residue of plant matter which has passed through the animal's gut. When cow dung is decomposed, it has been experimentally proven that its slurry is composed of 1.8-2.4% nitrogen, 1.0-1.2% phosphorus, 0.6 - 0.8% potassium and 50-75% organic humus (Shovon *et al*, 2013). The moisture content (wet basis) was measured by drying at 105°C for approximately 24 hours. For the water holding capacity, a wet sample of known initial moisture content was weighed ( $W_i$ ) and placed in a beaker. After soaking in water for 1-2 days and draining excess water through 2 filter papers, the saturated sample was weighed again. The amount of water retained by dry sample was calculated as the WHC. Bulk density was measured using an approximately 10 liters' volume container. The container was filled with material, and then the material was slightly compacted to ensure absence of large void spaces. The bulk density was calculated by dividing the weight of the material

by the volume of material in the container (*Shovon et al, 2013*).

## II. METHODOLOGY

The biodigester used for this process is a mini floating biodigester which was locally made from;

1. plastic drums
2. pipes
3. tap heads
4. gum and other fittings.

Two drums of different sizes were employed for the preparation of the biodigester, the larger drum was 220 liters in volume and this was where the cow dung was loaded after mixing with water, the smaller drum also known as the gas holder, its volume was 180 liters. The gas holder served two purposes; as a cover to avoid air penetration (facilitating anaerobic fermentation) and also as a trap for the biogas (the gaseous emission from the anaerobic degeneration of an organic matter be it plant or animal) that was going to be produced by this process, a gas outlet was fixed on top of the gas holder. Inlet and outlet pipes were fixed at the bottom of the big drum (outlet for the removal of the liquid biofertilizer and inlet for introduction of liquid waste, water during the process). These pipes were made of PVC of diameter 64mm, the length of the outlet pipe was 100mm and that of the inlet was 1310m.

A biodigester is not required to be in direct contact with sunlight but it kept in a place that has a temperature of about thirty-four degrees Celsius during the day. Process performance depends on climate condition, the rate of subtraction of substance from the digester, the materials used in construction, etc.

This process can be subdivided into various stages from the preparation of feed to collection of liquid, they are as follows;

The digester is an incubator that mixes all the constituents and allows it to ferment under anaerobic conditions. Cow dung was mixed with water in a container of volume 20 liters. 12kg of cow dung was mixed with 30 liters of water instead of 40 liters as originally planned this was because I used fresh cow dung i.e. the cow dung still retained some of its moisture. The mixing process was done by hand because there was no provision for a stirrer during the construction of the biodigester.

The fine mixture of cow dung and water formed a thick brown slurry which was then charged into the system. The smaller drum (gas trap) was then inserted upside down into the bigger one to act as a cover.

On top of the gas trap is a hole where an iron pipe is melded to allow the passage of gas, a regulator or tap head is connected to regulate this flow. Two holes of about 60mm was cut at the right and left side of the layer drum before loading the mixture of cow dung and water, they act as the inlet and outlet lines. Two PVC pipes of diameter 75mm is connected to these holes. The length of the inlet pipe is 1,310m while that of the outlet is 100mm. The fermentation process was allowed for 30 days, formation of gas was observed after the third day and it was evident from the rise in level of the gas trap (smaller drum). To avoid excess pressure, build up in the system which could be caused by lack of space for the gaseous compound formed, the gas trap was opened for thirty minutes on day 10, 20, and 30 for the gas to escape. Although, this is environmentally wrong, it was the safest means of given off the gas since there was no provision in the design stage for gas collection.

After 30 days, the outlet line was opened and the biofertilizer was collected through the outlet line.

The chemical fertilizer was gotten from Indorama, a fertilizer producing company in Nigeria. The one selected for use was labelled N:P:K 20:10:10. The chemical fertilizer came in very fine white crystals so to compare it with the liquid extracted from the biodigester, there was a need to put both of them in the same physical start. To achieve this goal, 50 grams of the chemical fertilizer was weighed and then dissolved in 500ml of water resulting in a solution which was used as the chemical fertilizer. The properties of this solution were also sent to the laboratory for tests to be run on them.

The process chosen for this test, was to plant maize in three nurseries after enriching two of the samples with chemical fertilizer and the liquid collected from the biodigester. Steps involved in this process include;

Loamy soil selected as the soil to be used for this process, it was first collected from a farm around Rumuochakara in Choba community of Rivers state. then tiled to remove rocks and other contaminants. Then 1.2kg of the soil was put into three transparent buckets, labelled nursery 1, 2 and 3 respectively.

The nurseries were made from transparent 5liter buckets. Nursery one was enriched with 250ml of the chemical fertilizer, nursery two was enriched with 250ml of the liquid collected from the biodigester while nursery three was kept as a control sample.

A day before the application of the fertilizer, five maize seeds were buried in each nursery. The soil samples were observed over a period of forty days, physical changes

in the soil samples and growing plant observed daily over this period of time was recorded.

After the thirtieth day, the germinated crops were harvested from their nursery beds for further experiments to be carried out on them. Height of all three samples as well as weight and size of the broadest leaf was measured, number of flowers and fruits or seeds produced was also counted and recorded. The values gotten from these measurements was used as a yardstick in drawing a conclusion, values like;

1. Height
2. Weight
3. Length of broadcast leaf
4. Length of the roots

### III. RESULTS

Fig.1 – Fertilizer samples results

	Biofertilizer	Chemical fertilizer
pH	4.9	5.1
Nitrogen	0.026mg/l	0.00124mg/l
Phosphorus	3.45mg/l	3.07mg/l
Potassium	650mg/l	3,416.666mg/l
Calcium	325mg/l	11.65mg/l
Sulphate	1.11mg/l	1.10mg/l

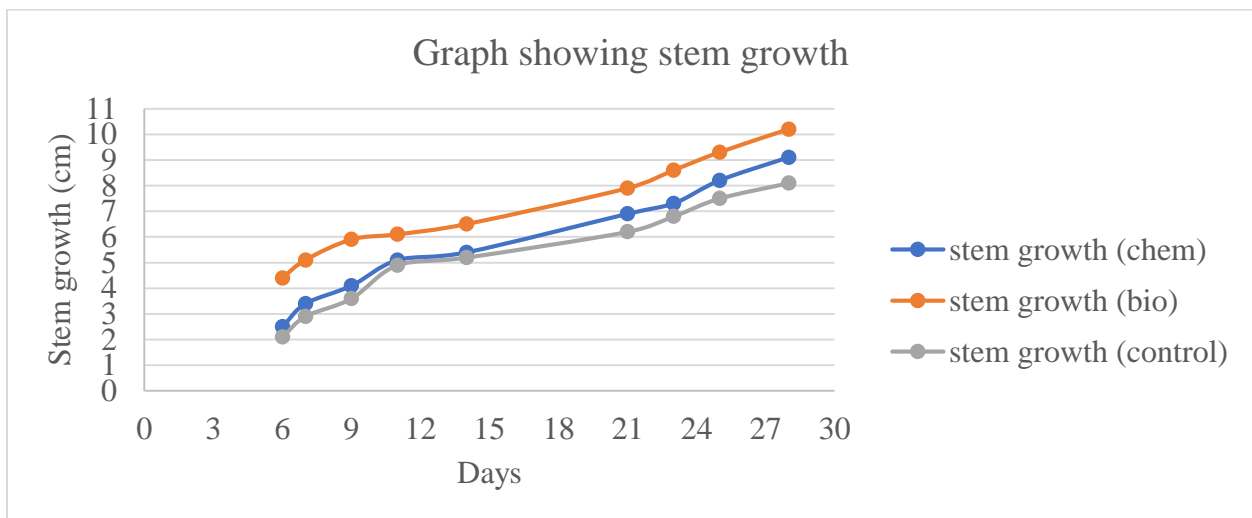


Fig.2 – Graph showing stem growth

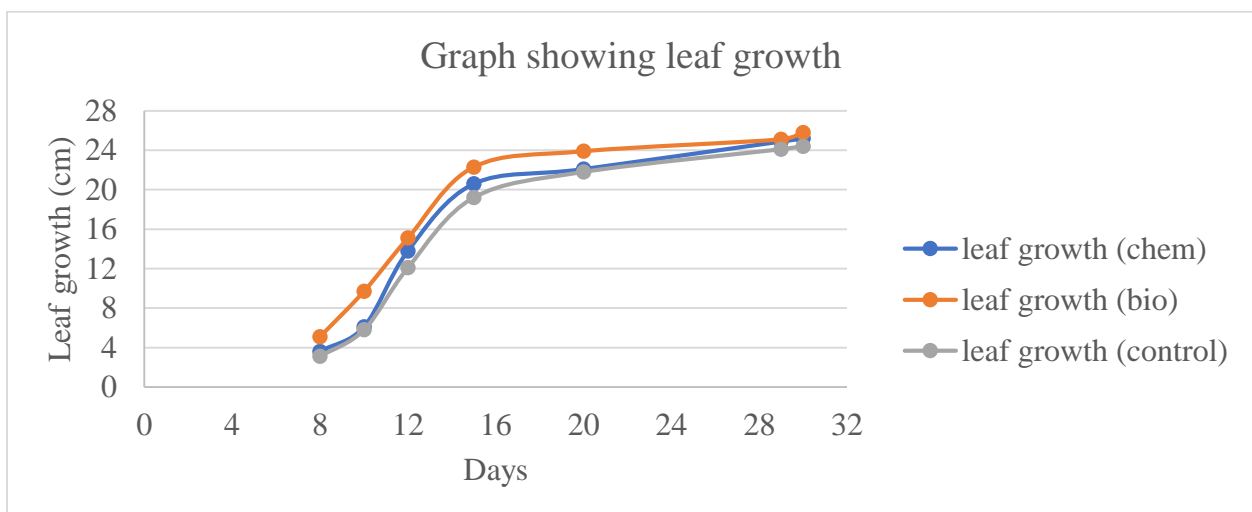


Fig.3 – Graph showing leaf growth

Fig.4 – Table showing the final measurement of harvested crop at after 30 days

	Height	Weight	Length of broadest leaf	Number of flowers present	Number of seeds present	Length of the roots
Chemical	45.4cm	3.40grams	25.2cm	None	None	10.3cm
Biofertilizer	47.6cm	4.82grams	25.8cm	None	None	11.4cm
Control	43.2cm	2.55grams	24.4cm	None	None	10.1cm

#### IV. DISCUSSION

The conversion process of cow dung to biofertilizer gave rise to three products namely;

1. A colorless gas with a foul smell
2. A dark brown liquid which also had a foul smell and had traces of living microorganisms in it.
3. A thick slurry which was composed mainly of the moist fermented cow dung.

The results from figure one show that the biofertilizer is rich in potassium, calcium and phosphorus; this means that when it gets into the soil there would, be an increase in the availability of these nutrients which will go a long way to plants with higher root development rate, stronger stems with more water movement ability hence, promoting the formation of seeds, flowers and fruits with a slightly acidic pH. For the chemical fertilizer, the potassium content is very high but nitrogen relatively low. This may give rise to a plant with enhanced root and stem development but not so strong leaf growth rate. The pH of the chemical fertilizer was just a little bit neutral when compared to that of the biofertilizer.

The seed which germinated the fastest out of the six planted was used the main focus of observation. The tallest of all growing crops in each soil sample after day 15 was chosen to be the fastest germinating seed.

For nursery one, not all the seeds germinated but this was more of a seed problem and not an issue with the fertilizer applied. The growth rate process increased properly until it got to a point when some of the leaves began to wither away but only one of the plants completely died although almost all the growing plants had leaves that withered. The weed formation rate for this nursery was relatively slow when compared to that of the chemical fertilizer. This nursery had the best look in terms of color at the start but began to slowly lose part of its color towards the end of the study.

The biofertilizer nursery was swift to outrun the other nurseries in terms of stem height and leaf formation and growth rate. The coloration of leaves and stem began slowly

but eventually outshined the chemical fertilizer and the control. A few leaves withered but this was towards the end of the observation period, which was assumed to be as a result of over nutrition on the nursery.

The control nursery, as expected followed the fertilized nurseries behind in terms of stem growth and leaf formation rate, there was a very low occurrence of withering in the nursery and this goes to affirm the assumption for the reason for the withering of leaves.

Overall, it was observed that plants absorbed sunlight for photosynthesis and growth but the visible growth process was always late in the night or early in morning when water movement was really visible. Soil in each nursery weighed 2 grams and the withering of leaf goes to show that, 250ml of any fertilizer is to a large extent too much for that portion of soil.

Figure 2 showed that the biofertilizer led the other nurseries in stem growth rate. Towards the end of the observation time, the control moved closer to the chemical fertilizer but the chemical fertilizer soon began to outshine its growth rate but never was any close to the biofertilizer.

Figure 3 shows the leaf growth and although the biofertilizer leads the charts in this graph, they all tend towards having a uniform value. The acceleration also decreased as the days went by while leaf formation rate increased; this may be as a result of the leaves getting close to their highest length for that said period of time. The low boost in the rate of growth of leaves in all nurseries was also assumed to be because of the lack of adequate nitrogen in any of the fertilizers.

Low observation time did not allow the process of seed and flower formation to be documented. The observed increase in stem diameter and weight of the biofertilizer nurseries as compared to that of the chemical fertilizer, shows that the biofertilizer will produce a stronger and more durable crops. Root, stem and leaf growth were all led by the biofertilizer nurseries which suggested that it is indeed a better growth enhancer than the chemical fertilizer.



## V. CONCLUSION

The result of the tests on the liquid product of the anaerobic degeneration of cow dung in a biodigester means that agricultural wastes such as cow dung can be utilized to produce other useful products such as biogas and biofertilizer which can be used as an alternate source of energy and another technique in waste management. Also, it told us that the slurry (byproduct) of the anaerobic degeneration of cow dung or any other biological waste can serve as a very good manure for the average agriculturist. The liquid gotten from the anaerobic degeneration of cow dung was made up of 0.026mg/l Nitrogen, 3.45mg/l Phosphorus, 650mg/l Potassium, 325mg/l Calcium, and 1.11mg/l.

The properties of the crops that germinated from the three different soil samples used meant that the chemical fertilizer increases growth rate of crops but at the same time is harmful to the soil and the crops been grown on it – this gives rise to the growth of leaves, flowers and fruits that tend to deviate from the norm and in some worst case scenarios, it may lead to death of the plant. It further should that the liquid from the anaerobic degeneration of cow dung now known as liquid biofertilizer has been tested to be very good for plant and soil nourishment. The liquid from the anaerobic degeneration of cow dung does not just possess nutrients for soil nourishment but also has living microorganisms that aids the reactions that occur naturally in the soil, hence making its effect stronger than that of the chemical fertilizer.

## VI. RECOMMENDATION

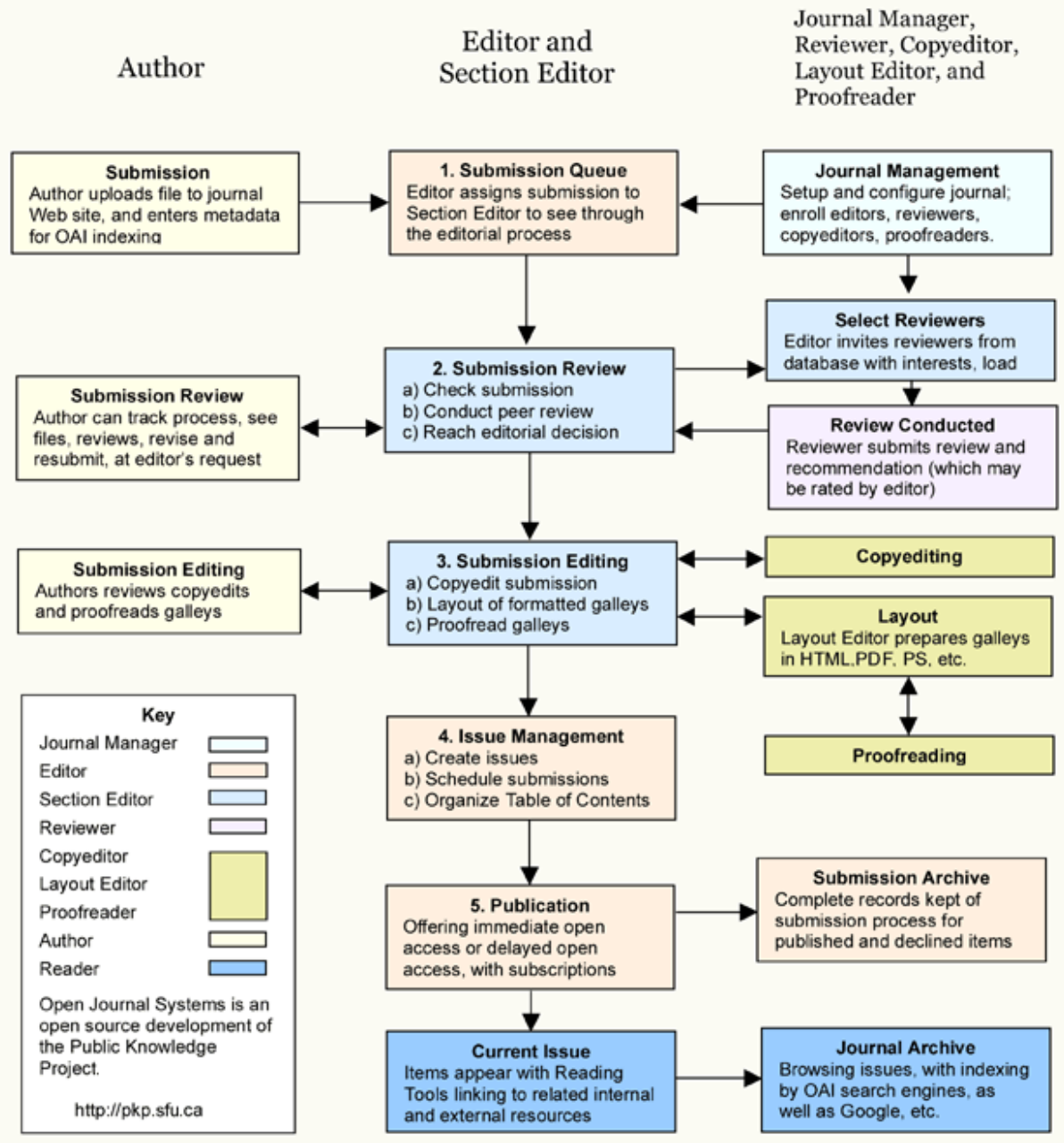
It is recommended that;

- a) Low cost designs should be encouraged so as to facilitate biofertilizer production
- b) Orientation program on how to turn waste (plant and animal) into wealth should be given to farmers.
- c) Government should create policies that forces producers of chemical fertilizers to spell out the harmful effect their product has on the soil, the farmer and his crops.
- d) There should be research and development programs to create microbial catalyst so as to help increase the rate of anaerobic degeneration in the biodigester.
- e) Further research should be carried out in this field to check not just the growth rate but also productivity time and yield to give a better conclusion as to which source of fertilizer is the best.
- f) For large commercial purpose, there is a need to develop a process for the purification of the liquid biofertilizer – most importantly for the removal of its foul smell.

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