

ISSN: 2349-6495(P) | 2456-1908 (O)



International Journal of Advanced Engineering Research and Science

(IJAERS)

An Open Access Peer Reviewed International Journal



Journal DOI: [10.22161/ijaers](https://doi.org/10.22161/ijaers)

Issue DOI: [10.22161/ijaers.5.3](https://doi.org/10.22161/ijaers.5.3)

AI PUBLICATIONS

Vol.- 5 | Issue - 3 | March, 2018

editor@ijaers.com | <http://www.ijaers.com/>

FOREWORD

I am pleased to put into the hands of readers Volume-5; Issue-3: 2018 (March, 2018) 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

Editor-in-Chief

Date: March, 2018

Editorial/ Reviewer Board

Dr. Shuai Li

Computer Science and Engineering, University of Cambridge, England, Great Britain

Behrouz Takabi

Mechanical Engineering Department 3123 TAMU, College Station, TX, 77843

Dr. C.M. Singh

BE., MS(USA), PhD(USA), Post-Doctoral fellow at NASA (USA), Professor, Department of Electrical & Electronics Engineering, INDIA

Dr. Gamal Abd El-Nasser Ahmed Mohamed Said

Computer Lecturer, Department of Computer and Information Technology, Port Training Institute (PTI), Arab Academy For Science, Technology and Maritime Transport, Egypt

Dr. Ram Karan Singh

BE.(Civil Engineering), M.Tech.(Hydraulics Engineering), PhD(Hydraulics & Water Resources Engineering),BITS- Pilani, Professor, Department of Civil Engineering, King Khalid University, Saudi Arabia.

Dr. Asheesh Kumar Shah

*IIM Calcutta, Wharton School of Business, DAVV INDORE, SGSITS, Indore
Country Head at CrafsOL Technology Pvt.Ltd, Country Coordinator at French Embassy, Project Coordinator at IIT Delhi, INDIA*

Dr. A. Heidari

Faculty of Chemistry, California South University (CSU), Irvine, California, USA

Dr. Swapnesh Taterh

Ph.d with Specialization in Information System Security, Associate Professor, Department of Computer Science Engineering, Amity University, INDIA

Dr. Ebrahim Nohani

Ph.D.(hydraulic Structures), Department of hydraulic Structures, Islamic Azad University, Dezful, IRAN.

Dr. Dinh Tran Ngoc Huy

Specialization Banking and Finance, Professor, Department Banking and Finance, Viet Nam

Dr. Sameh El-Sayed Mohamed Yehia

Assistant Professor, Civil Engineering (Structural), Higher Institute of Engineering -El-Shorouk Academy, Cairo, Egypt

Dr. Ahmadad Nabih Zaki Rashed

Specialization Optical Communication System, Professor, Department of Electronic Engineering, Menoufia University

Dr. Alok Kumar Bharadwaj

BE(AMU), ME(IIT, Roorkee), Ph.D (AMU), Professor, Department of Electrical Engineering, INDIA

Dr. M. Kannan

*Specialization in Software Engineering and Data mining
Ph.D, Professor, Computer Science, SCSVMV University, Kanchipuram, India*

Dr. Sambit Kumar Mishra

*Specialization Database Management Systems, BE, ME, Ph.D, Professor, Computer Science Engineering
Gandhi Institute for Education and Technology, Baniatangi, Khordha, India*

Dr. M. Venkata Ramana

*Specialization in Nano Crystal Technology
Ph. D, Professor, Physics, Andhara Pradesh, INDIA*

DR. C. M. Velu

Prof. & HOD, CSE, Datta Kala Group of Institutions, Pune, India

Dr. Rabindra Kayastha

Associate Professor, Department of Natural Sciences, School of Science, Kathmandu University, Nepal

Dr. P. Suresh

*Specialization in Grid Computing and Networking, Associate Professor, Department of Information
Technology, Engineering College, Erode, Tamil Nadu ,INDIA*

Dr. Uma Choudhary

*Specialization in Software Engineering Associate Professor, Department of Computer Science Mody
University, Lakshmangarh, India*

Dr.Varun Gupta

Network Engineer,National Informatics Center , Delhi ,India

Dr. Hanuman Prasad Agrawal

*Specialization in Power Systems Engineering Department of Electrical Engineering, JK Lakshmi Pat
University, Jaipur, India*

Dr. Hou, Cheng-I

*Specialization in Software Engineering, Artificial Intelligence, Wisdom Tourism, Leisure Agriculture and
Farm Planning, Associate Professor, Department of Tourism and MICE, Chung Hua University, Hsinchu
Taiwan*

Dr. Anil Trimbakrao Gaikwad

Associate Professor at Bharati Vidyapeeth University, Institute of Management , Kolhapur, India

Dr. Ahmed Kadhim Hussein

Department of Mechanical Engineering, College of Engineering, University of Babylon, Republic of Iraq

Mr. T. Rajkiran Reddy

Specialization in Networking and Telecom, Research Database Specialist, Quantile Analytics, India

M. Hadi Amini

Carnegie Mellon University, USA

Dr. N. S. Mohan

*Professor, Department of Mechanical & Manufacturing Engineering, Manipal Institute of Technology,
Manipal Academy of Higher Education. Manipal, India*

Dr. Zafer Omer Ozdemir




Energy Systems Engineering KÄ±rklareli, Kirklareli University, Turkey








Bingxu Wang



2721 Patrick Henry St Apt 510, Auburn Hills, Michigan, United States







Vol-5, Issue-3, March 2018

Sr No.	Detail
1	<p><u>Increasing Students' Learning Effort Results by using Learning Pair Checks Model of Five Grade of SD Negeri 173299 Paniaran in Academic Year 2017/2018</u></p> <p><i>Author:</i> Robert Harianja</p> <p> DOI: 10.22161/ijaers.5.3.1</p> <p style="text-align: right;"><i>Page No:</i> 001-003</p>
2	<p><u>Reuse of the Concrete Mixer Truck Wash Water in the Production of Concrete - A Clean Production Proposal</u></p> <p><i>Author:</i> Julia Botton, Lindomar Lucas Stankievicz, Rafael Gheller, Josiane Maria Muneron de Mello, Francieli Dalconton, Sideney Becker Onofre</p> <p> DOI: 10.22161/ijaers.5.3.2</p> <p style="text-align: right;"><i>Page No:</i> 004-010</p>
3	<p><u>Fan Footing Soil Foundation to Safeguard High and Low Rise Buildings from Seismic Waves</u></p> <p><i>Author:</i> B. Bikas Maiti, Dr. Ajayswarup</p> <p> DOI: 10.22161/ijaers.5.3.3</p> <p style="text-align: right;"><i>Page No:</i> 011-021</p>
4	<p><u>Sensory quality and physicochemical evaluation of two brine pickled cucumber (<i>Cucumis sativus</i> L.) varieties</u></p> <p><i>Author:</i> T. G. G. Uthpala, R. A. U. J. Marapana, S. A. S. Jayawardana</p> <p> DOI: 10.22161/ijaers.5.3.4</p> <p style="text-align: right;"><i>Page No:</i> 022-026</p>
5	<p><u>Evaluation of Land Cover changes of Mangroves along Mandovi, West Coast of India using RS and GIS</u></p> <p><i>Author:</i> S. M. Parvez Al-Usmani</p> <p> DOI: 10.22161/ijaers.5.3.5</p> <p style="text-align: right;"><i>Page No:</i> 027-035</p>
6	<p><u>The Effects of Nitrogen Fertilization and Deficit Irrigation Practices on Tomato Growth and Chlorophyll Concentration</u></p> <p><i>Author:</i> Meryem Kuzucu</p> <p> DOI: 10.22161/ijaers.5.3.6</p> <p style="text-align: right;"><i>Page No:</i> 036-039</p>

7	<p><u><i>Geotechnical and Petrographic Characterisation of the Birimian Granitoids in Southern Ghana as an Aggregates for Sustainable Road Construction</i></u></p> <p><i>Author: Isaac Ahenkorah, Evans Mensah Awuah, Anthony Ewusi, Michael Affam</i></p> <p> DOI: 10.22161/ijaers.5.3.7</p> <p style="text-align: right;"><i>Page No: 040-049</i></p>
8	<p><u><i>Forecasting Oxygen Demand in Treatment Plant Using Artificial Neural Networks</i></u></p> <p><i>Author: Moein Gheytaspour, Omid Habibzadeh Bigdarvish</i></p> <p> DOI: 10.22161/ijaers.5.3.8</p> <p style="text-align: right;"><i>Page No: 050-057</i></p>
9	<p><u><i>Two Decades of Developmentalism: Bottlenecks and Plans of State Intervention in Brazil in the Second Half of the Twentieth Century</i></u></p> <p><i>Author: Sergio Francisco Loss Franzin, Fabrício Moraes de Almeida, Laura Borges Nogueira</i></p> <p> DOI: 10.22161/ijaers.5.3.9</p> <p style="text-align: right;"><i>Page No: 058-066</i></p>
10	<p><u><i>Strategic Planning: a model based on Systems Engineering</i></u></p> <p><i>Author: Herlandí de Souza Andrade, Geilson Loureiro</i></p> <p> DOI: 10.22161/ijaers.5.3.10</p> <p style="text-align: right;"><i>Page No: 067-071</i></p>
11	<p><u><i>Casting Design Optimization for Steam Turbine Emergency Stop Valve (ESV) Housing with Computational Casting Simulation Method</i></u></p> <p><i>Author: Agus Krisnowo , Khamda Herbandono , Rudias Harmadi , Budi Nofiantoro. F</i></p> <p> DOI: 10.22161/ijaers.5.3.11</p> <p style="text-align: right;"><i>Page No: 072-077</i></p>
12	<p><u><i>Social Innovation by Tourism Strategy in the Western Amazon</i></u></p> <p><i>Author: Sâmia Laise Manthey Benevides, Flávio de São Pedro Filho, Maria José Aguilar Madeira, Irene Yoko Taguchi Sakuno, Valeria Arenhardt</i></p> <p> DOI: 10.22161/ijaers.5.3.12</p> <p style="text-align: right;"><i>Page No: 078-092</i></p>
13	<p><u><i>Gentrification and Environmental Justice in Nigerian Cities</i></u></p> <p><i>Author: Ogonna Chukwuemeka Godswill, Aguguo Godlives Ukachukwu</i></p> <p> DOI: 10.22161/ijaers.5.3.13</p> <p style="text-align: right;"><i>Page No: 093-107</i></p>

14	<p><u><i>The Soil-Cement Brick on Construction with Structural Masonry – An Alternative in the Fight Against Housing Deficit and Environmental Pollution in the State of Rondônia*</i></u></p> <p><i>Author:</i> Carlos Augusto Maly, Izan Fabrício Neves Calderaro, Fabrício Moraes de Almeida</p> <p> DOI: <u>10.22161/ijaers.5.3.14</u></p> <p style="text-align: right;"><i>Page No:</i> 108-120</p>
15	<p><u><i>Integrated Waste Management Technology with Focus on the Brazilian Amazon</i></u></p> <p><i>Author:</i> Valéria Arenhardt, Flávio de São Pedro Filho, Waldir Schalch, Eduardo Egídio Vicensi Deliza, Rodrigo Buss Back</p> <p> DOI: <u>10.22161/ijaers.5.3.15</u></p> <p style="text-align: right;"><i>Page No:</i> 121-131</p>
16	<p><u><i>Analysis of the effectiveness of sanitizers for a low moisture footwear sanitization unit</i></u></p> <p><i>Author:</i> Abeywickrema S., Navaratne S.B.</p> <p> DOI: <u>10.22161/ijaers.5.3.16</u></p> <p style="text-align: right;"><i>Page No:</i> 132-135</p>
17	<p><u><i>Amaranth Starch Isolation, Oxidation, Heat-Moisture Treatment and Application in Edible Film Formation</i></u></p> <p><i>Author:</i> Ritu Sindhu, Bhupendar Singh Khatkar</p> <p> DOI: <u>10.22161/ijaers.5.3.17</u></p> <p style="text-align: right;"><i>Page No:</i> 136-141</p>
18	<p><u><i>Green Purchases and Sustainability in Amazon's Coffee Management</i></u></p> <p><i>Author:</i> Saiane Barros de Souza, Flávio de São Pedro Filho, Cleice de Pontes Bernardo, Rwrsilany Silva, José Moreira da Silva Neto</p> <p> DOI: <u>10.22161/ijaers.5.3.18</u></p> <p style="text-align: right;"><i>Page No:</i> 142-153</p>
19	<p><u><i>Preservation and storage of Lemon (Citrus Limon) Juice</i></u></p> <p><i>Author:</i> Ritu Sindhu, Bhupendar Singh Khatkar</p> <p> DOI: <u>10.22161/ijaers.5.3.19</u></p> <p style="text-align: right;"><i>Page No:</i> 154-158</p>
20	<p><u><i>Jumping Spiders (Araneae: Salticidae) of Satlasana Taluka</i></u></p> <p><i>Author:</i> B. M. Parmar, K. B. Patel</p> <p> DOI: <u>10.22161/ijaers.5.3.20</u></p> <p style="text-align: right;"><i>Page No:</i> 159-162</p>

21	<p><u>The Analysis of Creative and Innovative Thinking Skills of the 21st Century Students in Solving the Problems of “Locating Dominating Set” in Research Based Learning</u></p> <p><i>Author:</i> Firma Yudha, Dafik, Nanik Yuliati</p> <p> DOI: 10.22161/ijaers.5.3.21</p> <p style="text-align: right;"><i>Page No:</i> 163-176</p>
22	<p><u>Improve Performance of FLASE Alarm Detection by using CFAR and Low Pass Filter</u></p> <p><i>Author:</i> Anita Didel</p> <p> DOI: 10.22161/ijaers.5.3.22</p> <p style="text-align: right;"><i>Page No:</i> 177-182</p>
23	<p><u>Multiple-criteria stem bucking (Picea abies L. Karst.) for maximizing monetary value of timber trade</u></p> <p><i>Author:</i> Teijo Palander, Joonas Mutanen, Kalle Kärhä, Juha-Antti Sorsa, Tapio Räsänen</p> <p> DOI: 10.22161/ijaers.5.3.23</p> <p style="text-align: right;"><i>Page No:</i> 183-191</p>
24	<p><u>Analysis of Irregular High Raised RCC Buildings by Using Tuned Mass Damping System</u></p> <p><i>Author:</i> B. Siva Konda Reddy, A. Madhavi Latha, Ch.Srikanth</p> <p> DOI: 10.22161/ijaers.5.3.24</p> <p style="text-align: right;"><i>Page No:</i> 192-198</p>
25	<p><u>Integrated Management of Chronically ill Patients: Nurse-client interactions and follow-up care</u></p> <p><i>Author:</i> Edith N. Chiejina, Monica C. Makachi</p> <p> DOI: 10.22161/ijaers.5.3.25</p> <p style="text-align: right;"><i>Page No:</i> 199-206</p>
26	<p><u>Epistemological Character of Sustainability</u></p> <p><i>Author:</i> Jacira Lima da Graça, Flávio de São Pedro Filho, Antonio Vicente da Graça Filho, Marcelo Augusto Mendes Barbosa, Izabel Cristina da Silva</p> <p> DOI: 10.22161/ijaers.5.3.26</p> <p style="text-align: right;"><i>Page No:</i> 207-215</p>
27	<p><u>Reaction of Azo Dyes with Amino functionalized Multi walled carbon Nano Tubes</u></p> <p><i>Author:</i> Nasim Khoshlahjeh Motamed</p> <p> DOI: 10.22161/ijaers.5.3.27</p> <p style="text-align: right;"><i>Page No:</i> 216-221</p>
28	<p><u>Compressed Natural Gas Operated Two-Wheeler</u></p> <p><i>Author:</i> Kini Rohit, Gharat Amey, Patil Abhishek, Sawant Rupesh, Choudhary Dipak*</p> <p> DOI: 10.22161/ijaers.5.3.28</p> <p style="text-align: right;"><i>Page No:</i> 222-225</p>

29	<p><u><i>The Importance of Water use under Climate Change effects in Semi-Arid Agricultural Areas</i></u></p> <p><i>Author:</i> AyÅŸe GüneÅŸ</p> <p> DOI: <u>10.22161/ijaers.5.3.29</u></p> <p style="text-align: right;"><i>Page No:</i> 226-229</p>
30	<p><u><i>Phosphoric Acid Increases the Porosity and Extends the Contact Area of Dental Osseo integrated Implants</i></u></p> <p><i>Author:</i> Fernando Luzia França, Aline do Carmo França Botelho, Fernando Gabriel Souza Araújo</p> <p> DOI: <u>10.22161/ijaers.5.3.30</u></p> <p style="text-align: right;"><i>Page No:</i> 230-236</p>
31	<p><u><i>Condor: a reflection on a company's history, memory, and leadership</i></u></p> <p><i>Author:</i> Mário Neneve, Miguel Nenevé</p> <p> DOI: <u>10.22161/ijaers.5.3.31</u></p> <p style="text-align: right;"><i>Page No:</i> 237-246</p>
32	<p><u><i>Prevalent Leadership Profile: A Research on Management of Innovation in the Military Organization</i></u></p> <p><i>Author:</i> Sued Santos Rocha de Souza, Flávio de São Pedro Filho, Miguel Nenevé, Jose Moreira da Silva Neto, Thiago Pacife de Lima</p> <p> DOI: <u>10.22161/ijaers.5.3.32</u></p> <p style="text-align: right;"><i>Page No:</i> 247-254</p>
33	<p><u><i>Determination of Optical Energy Gap for Copper oxide at Different Temperatures</i></u></p> <p><i>Author:</i> Wasil Abdalgader Abdalla Alhassan, Ismael. A. Wadi</p> <p> DOI: <u>10.22161/ijaers.5.3.33</u></p> <p style="text-align: right;"><i>Page No:</i> 255-258</p>
34	<p><u><i>Hydric balance and climatic classification of the city of Porto Nacional, state of Tocantins, inserted in the Legal Amazon, Brazil</i></u></p> <p><i>Author:</i> Angelo Ricardo Balduino, Márcio Galdino dos Santos, Lucas Barbosa e Souza, Diogo Pedreira Lima, Aurean de Paula Carvalho</p> <p> DOI: <u>10.22161/ijaers.5.3.34</u></p> <p style="text-align: right;"><i>Page No:</i> 259-263</p>
35	<p><u><i>Study, Design and Test of a LENZ-type Wind Turbine</i></u></p> <p><i>Author:</i> André Heiji Nishioka, Odenir de Almeida</p> <p> DOI: <u>10.22161/ijaers.5.3.35</u></p> <p style="text-align: right;"><i>Page No:</i> 264-269</p>

Increasing Students' Learning Effort Results by using Learning Pair Checks Model of Five Grade of SD Negeri 173299 Paniaran in Academic Year 2017/2018

Robert Harianja

Dosen Koopertis Wilayah I Medan, dpk pada FKIP – UNITA

Abstract— *This study aims to determine whether there is an increase in student learning outcomes by using pair of learning models on the subject of fractions with the material change the fraction of the form of percent and vice versa in class V SD Negeri No.173299 Paniaran in academic Year 2017/2018. This study was conducted using Classroom Action Research. And the subject of this research is all the students of class V SD Negeri No. 173299 Paniaran totaling 36 people while the object in this study is the result of student learning. Before the test is used as a data collecting tool in this study, first test done to students of grade V SD Negeri No. 173299 Paniaran. The test results show that the test is valid because the coefficient is high and sufficient and has a high reliability of 0.794. Similarly, the differentiating power of each test item is very good, good, and sufficient and the degree of difficulty that is so that every test item is considered good to be tested. From the preliminary test results obtained that the results of student learning is lower because there are 27 students from 36 students have not achieved mastery learning with an average of 27.97 and 25% complete classical learning. After giving the action on the first cycle student's learning completeness level is 61% classical or there are 22 students who complete the study individually with an average value of 65.08. After the implementation on the second cycle students' learning completeness level to 88.89% or there are 32 students who complete the study individually with an average score of 70.83. Then it can be concluded that by using pair checks learning model can improve student learning outcomes.*

Keywords — *Learning Outcomes; Learning Pair Checks Model.*

I. INTRODUCTION

In the world of education and teaching of mathematics is a field of study studied by all students ranging from elementary to high school and even also in university, because mathematics is one of the fundamental knowledge that can foster students' reasoning abilities.

Mathematics in schools is part of the chosen field of study based on the interests of developing the ability and personality of learners and the development of science and technology, in line with the demands of the interests of learners in the face of the future. From this it means that some mathematical things need to be learned by the whole Indonesian nation, both the application and the mindset. The phrase shows that mathematics has a very important role in every aspect of life. Correspondingly, Concroft (in Abdurahman, 2012: 204) suggests the need to learn mathematics:

- a) Always used in all aspects of life
- b) All fields of study require appropriate mathematical skills
- c) It is a powerful, short, and clear communication tool
- d) Can be used to present information in various ways
- e) Improve the ability to think logically, precision, and awareness of the room and providing satisfaction to solve challenging problems". But in fact, mathematics education in Indonesia is still apprehensive when viewed from the low student learning outcomes.

II. LITERATURE REVIEW

Cooperative Learning

The low learning outcomes and the ability of mathematics is due to the many students who have difficulty in learning mathematics, less interest, and always regard mathematics as a difficult science, causing fear to learn mathematics. This is in accordance with the opinion of Abdurahman (2012: 202) which states that "From the field of study taught in school, mathematics is a field of study that is considered the most difficult by both students who are not learning disabilities and moreover learning disabilities". Difficulties in learning mathematics can also be caused by the view that mathematics is a set of facts that must be memorized. Cooperative learning has been developed intensively through various studies, aimed at improving cooperation between students, building positive relationships, develop self-confidence, and

improve academic skills through group activities. In cooperative learning positive interdependence among students to achieve learning objectives. Every student has the same chance to succeed. Student-centered learning activities in the form of discussions, doing joint tasks, supporting each other in solving problems. Through effective learning interactions, students are more motivated, self-confident, able to use high-level learning strategies, and able to build interpersonal relationships. The cooperative learning model enables all. Students can master the material at a relatively equal or parallel level of mastery. Learning system Cooperative learning can also be defined as a structured group learning system where in cooperative learning students can be expected to discuss lessons with friends in their respective groups in relation to the Lie (2004: 12) states that "cooperative learning is a system of lessons that give students the opportunity to working with fellow students in a structured task ". Learning in small groups is part of cooperative learning. Thus in the learning group students are expected to actively express opinions so that in solving problems they can dialogue not only with teachers but also their fellow. Characteristics of cooperative learning model according to Sanjaya (2011: 247) are:

- a) Learn with friends.
- b) During the learning process occurs face to face between friends.
- c) Listen to opinions among group members.
- d) Learn from your own friends in groups.
- e) Learning in small groups.
- f) Speaks productive or mutual opinion.
- g) The decision depends on the student itself.
- h) Student is active.

Cooperative learning aims to harmonious and dynamic cooperation between teachers and students or among fellow students involved in the learning process.

Learn about Fractions by Using the Pair Checks

Learning Model

- a) The teacher formed a pair of two students. The teacher gives practice questions about the subject of fractions to the students, and each partner does the fractional exercise problem, the couple checks the teacher's practice.
- b) After 20 minutes, the teacher checks the answers about the fractions made by the students. Then if the student is right, the teacher gives the coupon or the value. All couples who have not worked on fractions swap roles and repeat steps a-c.
- c) After all the teams completed the exercises on the fractional subject, the entire team paired up and compared their respective answers.
- d) After all is done, the teacher directs the answers / ideas according to the concept of a fractional subject.

III. FRACTIONAL MATERIALS

A fraction is a number representing the whole, part of an area, part of an object, or part of a set. Fractions may also be denoted by a / b denoting a pair of integers or consecutive integer pairs, and representing rational number. This is reinforced by Underhill (Malau, 1995: 10) defines the rational number as the division of two integers a / b, b ≠ 0. At a / b fractions, a is called the numerator and b is called denominator, has different values. Generally, the names for rational numbers are fractions and fractions are generally associated with non-negative rational numbers, since negative rational numbers are generally absent in basic mathematics. N, C is the set of nonnegative integers and N is the set of natural numbers. ∈ C, b ∈ the fraction of the form a / b, this fraction is called an ordinary fraction. Example: $\frac{3}{4}$, $\frac{19}{3}$, $\frac{1}{6}$ is an example of a fraction in the above sense, whereas $-\frac{3}{4}$ is a fractional number that is not introduced in SD. From the above description can be concluded that the fraction is a rational number, but any rational number should not be partial. Example $\frac{0}{5}$, $\frac{8}{8}$.

1. Various forms of fractions, are as follows

Ordinary fractions: $\frac{a}{b}$, Usually a < b.

Example : $\frac{2}{3}$, $\frac{3}{5}$, ...

2. Fractional mixture: a $\frac{b}{c}$, a Integer, b Numerator, c

Denominator

Example : $3\frac{2}{5}$, $4\frac{2}{3}$, ...

3. Fractional decimal is a fraction with the decimal name, with the writing a, b (a comma b), where a and b are chunk numbers.

Example :1) 6,5 3) 0,50

2) 0,32 4)0,165 and etc.

IV. METHODOLOGY

In accordance with the title of research, the location of this study was conducted in SD Negeri No. 173299 Paniaran in academic year 2017/2018. The reason for choosing the location of this research because in SD Negeri no. 173299 Paniaran has never done research on Pair Check learning model on fractional subject. Subjects in this study were all students of class V SD Negeri No 173299 Paniaran, total students are 36 students. Objects in this study is the result of student learning and students activity in learning mathematics by using Pair Checks learning model on the subject of fractions in class V SD Negeri No. 1.323299 Paniaran. This type of research is a classroom action research that is learning by using Pair Checks learning model on fractional subject. The result of

mathematics learning in this study is the score achieved by the students in each cycle. Learning is designed using the Pair Checks model implemented from simple to more effective levels to deliver more optimal results. At the end of the learning test. After the completion of learning activities, reflections on the implementation of learning and overview results. Observations were made to see how student activity during the learning took place and how the results of the tests were obtained. From the reflection results of the teacher, cycle I design more effective lessons for further learning, and so on for the next lesson.

V. RESULT AND DISCUSSION

This research is used classroom action research (PTK) conducted with two cycles that include planning, implementation, observation, and reflection. Each cycle consists of two meetings and contains one topic. This research was conducted in class V SD Negeri No. 173299 Paniaran. Before conducting cycle I, the first researcher gives explanation to the principal and teacher of mathematics on how to implement the learning on fractional subject with pair check learning model. Can be concluded mastery / success of student learning in fractional learning, that is there are 32 students got 88, 89% who finish the study, and 4 students from 36 students got 11,11% who have not completed research.

Table.1.1: A Brief Summary of Student Learning Element Classically

No	Percentage of Criteria	Level of Criteria	Number of Students	Number Percentage of Students
1	< 65	Unfinished	4 Persons	11,11%
2	> 65	Finished	32 Persons	88,89%
Amount			36 Persons	100%

VI. CONCLUSION

- Based on the results of the discussion of research data, it can be concluded that: The result of student's mathematics learning by using pair checks learning model in class V SD Negeri 73299 Paniaran on fractional subjects in the first cycle had an average of 65.08 individuals and a classical student graduation rate of 61% or 22 of 36 students solved separately. While in the second cycle of student achievement level becomes 88.89% classically or there are 32 of 36 students who completed the study individually with an average score of 70.83. So in the second cycle can be stated to have fulfilled the completeness criteria that have been determined by the researcher.
- Student learning activities in solving math problems on fractional subjects in class V SD Negeri 173299 Paniaran, in the first cycle with an average score of 47.25 individuals and the level of classical mastery learning activity 50% whereas in the second cycle the average score of activity score increased to 62.5 individually and the percentage of student learning activities by 80% Classical so that it can be concluded that the completeness criteria of individual and classical student learning activities determined by the researcher has been achieved.

REFERENCES

- Abdurahman, Mulyono., 2012, *Pendidikan Bagi Anak Berkesulitan Belajar*, Rineka Cipta, Jakarta.

- Arikunto,S., 2009, *Dasar-dasar Evaluasi Pendidikan*, Bumi Aksa
- Jakarta.Djamarah., 2011, *Psikologi Belajar*, Rineka Cipta,Jakarta.
- Hudojo, Herman., 1988, *Mengajar Belajar Matematika*. Depdikbud Diklat P2LPTK, Jakarta.(http://respository.upi.edu/operator/upload/s_a0151_06008_chapter2.pdf)
- Lie, Anita., 2008, *Cooperatif Learning, Mempraktekkan Cooperatif Learning di Ruang-ruang Kelas*, Grasindo, Jakarta.
- Maufur, Hasan Fauji., 2009, *Sejuta Rumus Mengajar Mengasikkan*, PT. Sindur Press, Semarang.
- M. Khafid, Suyati., 2006, *Pelajaran Matematika untuk Sekolah Dasar Kelas V*, Penerbit Erlangga, Jakarta.
- RJ. Soenarjo., 2008, *Matematika 5 untuk SD kelas V*, Visindo Media Persada, Jakarta.
- Sagala,Syaiful., 2009, *Konsep dan Makna Pembelajaran*, Alfabeta, Bandung.

Reuse of the Concrete Mixer Truck Wash Water in the Production of Concrete - A Clean Production Proposal

Julia Botton, Lindomar Lucas Stankievicz, Rafael Gheller, Josiane Maria Muneron de Mello, Francieli Dalconton, Sideney Becker Onofre

Universidade Comunitária da Região de Chapecó - UNOCHAPECÓ - Graduate Program in Technology and Innovation Management - PPGTI - Av. Sen. Atilio Fontana, 591 E - Efapi - 89809-000 - Chapecó – Santa Catarina – Brazil.

Abstract—Concrete is a material used on a large scale in civil construction. In concrete plants, it is manufactured by concrete mixer trucks and this process consumes a large quantity of drinking water. In addition to the production of concrete, the water used to wash the concrete mixer trucks should also be considered, since this also generates a considerable amount of residual water that cannot be disposed of without prior treatment. As such, the objective of this study is to reuse the waste water generated by the washing of the mixer trucks in the production of concrete, thus avoiding the consumption of drinking water, considering that the reuse of this waste water doesn't require chemical treatment. Three compositions were developed: A reference composition produced with drinking water; a composition with 50% drinking water and 50% residual water; and a composition with 100% of residual water. To analyze the concrete, its properties were checked in the fresh and the hardened state, assessing the workability through the slump test and its compressive strength at 14 days and 28 days. In total, 9 test specimens were molded in accordance with age, which meant 3 specimens per composition. The results showed that the concrete produced with the residual water presented the same compression strength as the concrete that used drinking water. It is estimated that a replacement of up to 50% should be used, since the composition containing 50% of residual water showed the greatest gains in strength in relation to the other compositions.

Keywords—Residual Water, Concrete Mixer Truck, Concrete Production, Reuse.

I. INTRODUCTION

Concrete is by far the most often used construction material, considering that more than 10 billion tons are produced worldwide each year. The reasons for this popularity are well known. If properly produced, concrete has excellent mechanical properties and durability, being moldable, adaptable, relatively resistant to fire, and with

the capacity to be designed to meet virtually any set of specifications, more than any other material currently available (Meyer, 2009).

Meyer (2009) also states that because of the large volumes produced each year, concrete has a huge impact on the environment. First, large amounts of natural resources are needed to produce the billions of tons of concrete each year. Second, the cement industry is estimated to be responsible for about 7% of all CO₂ emissions generated. Third, the production of concrete requires large quantities of water, using approximately 1 trillion gallons of water per year throughout the world, not including the wash water for the trucks and the water used to cure the concrete.

Concrete plants make heavy use of water, not only in the production of the concrete itself, but also to wash off the waste from concrete mixer trucks, floors and to sprinkle on the aggregates to reduce dust (Sealey; Phillips; Hill, 2001).

Usually, the washing of mixer trucks occurs twice a day. Considering the use of 15 trucks, a concrete plant is estimated to use approximately 15 thousand liters of water per day. In addition, a plant producing 500 m³ of concrete per day consumes approximately 10 thousand liters of water for this production (Ekolu; Dawneerangen, 2010). The use of residual water can reduce the consumption of drinking water and contribute to a cleaner production of concrete in terms of water (Paula; Ilha, 2014).

Since it contains cementitious material and other impurities, the wash water of concrete mixers cannot be disposed of on construction sites or landfills. The practice of recycling waste water has become essential, and its conservation is pursued as a process necessary for a safe environment. When reused in concrete, waste water from the washed trucks can contribute in an effective and environmentally friendly way, since its reuse does not require chemical treatment (Ekolu; Dawneerangen, 2010). The NBR 15900-1 (ABNT, 2009) defines that waters considered as drinkable are those suitable for concrete, and that they should possess a pH between 5.80 and 8.0 and respect the maximum limits for organic matter (3 mg/L) and solid material (50 000 mg/L).

The chemical properties must meet the following requirements, sulfates (expressed in SO_4^- ions) must not exceed 2 000 mg/L, chlorides (expressed in CL^- ions) must not exceed 500 mg/L for prestressed or grout concrete, 1000 mg/L for reinforced concrete and 4500 mg/L for simple concrete (without reinforcement). Any contamination by harmful substances can affect the setting time and strength of the concrete, and the maximum tolerances must be respected: 100 mg/L for sugar, 100 mg/L for phosphates (expressed as P_2O_5), 500 mg/L for nitrates (expressed as NO_3^-), 100 mg/L for lead (expressed as Pb_2^+) and 100 mg/L for zinc (expressed as Zn_2^+).

It is estimated that to produce 1 m³ of concrete, 200 liters of drinking water are needed on average, which may vary in accordance with the composition and the water/cement factor (Ekolu; Dawneerangen, 2010).

The reuse of waste water from the washing of concrete mixer trucks generates large environmental benefits. However, chemicals are used during the washing to assist in the removal of the concrete of the surfaces of the truck mixer, leaving doubts about the reactions that these products may cause on the concrete. Other compounds present in the water are the cement and aggregate residues from the concrete, which can contribute in a positive way to a new concrete mix.

A cleaner production consists in the continuous application of an economic, environmental and technological strategy integrated into the processes and products, which prevents, minimizes or recycles the generation of waste in the productive processes in order to increase the efficiency in the use of raw material, water and energy and to reduce the risks to people and the environment (Terra et al., 2013).

The construction industry demands a large quantity of raw materials at the same time that it generates a considerable volume of waste. The deployment of cleaner production can establish a connection between these two extremes, enabling the transformation of waste into raw materials once again.

Through a focus on the reuse the water, this paper seeks to reuse the waste water generated by the washing of concrete mixer trucks in the production of concrete, avoiding the consumption of drinking water. Test specimens were produced and tested, and the behavior of the concrete made with this water was analyzed, with all assays being performed based on the standards of the Brazilian Association of Technical Standards (ABNT).

II. THE IMPLEMENTATION OF CLEANER PRODUCTION

2.1 Diagnosis of the Production Activity

For the development and application of this study, the steps of the concrete production process in the concrete plant were established, with these steps being made up of following activities, as shown in Figure 1.

The proposed implementation of cleaner production has been applied in a concrete and mortar plant located in the municipality of Chapecó-Santa Catarina - Brazil. A survey of the plant's industrial layout was developed, as shown in Figure 2.

The company has an average daily output of approximately 100 m³ of concrete, with around 50 thousand liters of water being consumed for this production. The largest volume of waste water is generated through the washing of the mixers of the trucks and yards, in addition to the portion of the concrete that returns to the plant after the concreting.

The mixer is an accessory equipment coupled to the chassis of the truck, responsible for receiving and mixing the materials dosed by the dosing equipment.

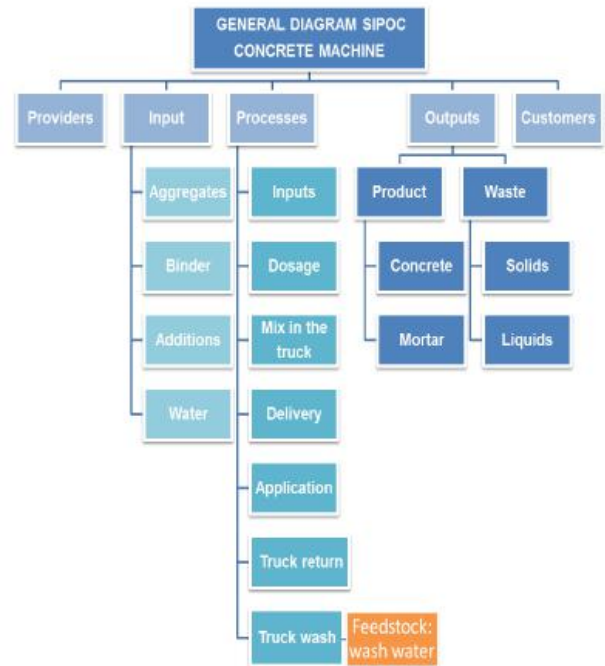


Fig. 1: Flow diagram of the steps of the concrete production process

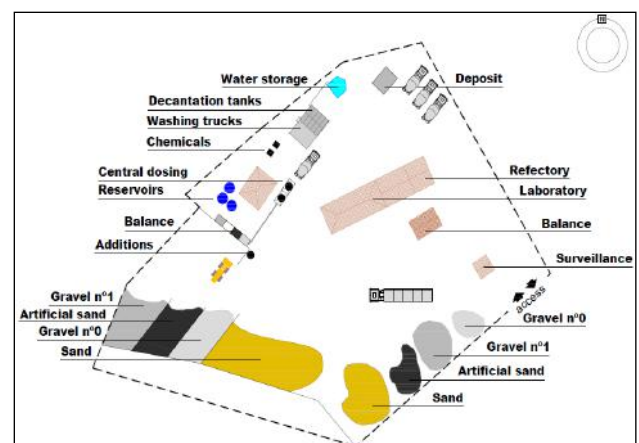


Fig. 2: Industrial Layout of the plant

Based on this information, the main focus for the implementation of cleaner production within this company was to intervene in the water used in the washing of the mixer trucks, as a source of new applications in concrete.

Concrete production demands a huge amount of raw materials, such as aggregates of different particle sizes, binders, additives and water. The company under study acquires its inputs from different production sources.

The fine aggregate (sand) is derived from deposits in the city of Porto União - Santa Catarina - Brazil, the coarse aggregate (gravel) and the artificial sand (stone dust) are obtained from an own mine located in the municipality of Guatambu - Santa Catarina - Brazil. Both are stored in the company's yard. The cement is supplied by the cement company Itambé, is classified as CP II-F-32 and is stored in silos for its conservation.

For the Technological control of the concrete, the company uses specific software for the dosage of materials in order to ensure quality and meet the demands required for each application. As such, it is possible for the products to satisfy the requirements laid down by the consumer, including: strength, workability, curing time, among others.

After the homogenization of the materials in the concrete mixer truck, the concrete or mortar are sent to their application. The truck then returns to the company where it is washed, which is necessary before each new load. This washing generates solid and liquid waste, which is stored in tanks for decanting. After decanting the solid materials, the water is currently reused for the washing of the trucks, yard and equipment.

It is estimated that each production day 30 thousand liters of waste water are generated from the washing of the trucks, and more than 5 m³ of solid waste from the decanting. Part of this water remains in the decanting tanks and is used for subsequent washings, the surplus is sent to third parties who may need water without specific technical specifications, such as for the moisture correction of soils in compression processes.

Because of the large volume of water needed for the company's production process, a new opportunity was identified to incorporate this water from the washing of concrete mixer trucks into the production of concrete or mortar.

It is known that the company uses water from an artesian well, located in the yard of the company, which is graded as drinking water for human consumption. With this in mind, the project in question sought to implement cleaner production within the company, evaluating the volume of water discarded and seeking to replace the use of water from the artesian well by this residual water in the production of concrete, given that the volume generated daily by the washings is relevant in relation to the daily consumption of the company.

In addition to working on the reduction of water consumption, this cleaner production initiative also decreases the quantity of liquid waste disposed of inappropriately in nature or in landfills, since the reuse of wastewater in concrete production may not require chemical treatment.

Another opportunity for cleaner production would be the reuse of the solid waste, because today these materials are disposed of in landfills. As a suggestion for future projects, an analysis of the characteristics of these materials through specific procedures is recommended, classifying their granulometry and applying them again to the concrete, potentially being used in works without structural purposes.

III. INTERVENTION PROPOSALS / OPPORTUNITIES

By evaluating the layout of the concrete plant and studying its entire production process, some opportunities for improvement of this process were identified. Some proposals for intervention are therefore presented with actions in the short (Table 1, 2, 3).

3.1 Prioritization of Identified Opportunities

The priority of the cleaner production initiative was to study the use of water to wash the concrete mixer trucks in the production of concrete in order to achieve results that allow for its applicability, providing a more noble destination for this residual water, reducing the consumption of drinking water and minimizing the inappropriate disposal of this water.

IV. ADOPTED METHODOLOGY

About 20 L of water from washing of the trucks, which was stored in the decanting tanks, was collected and stored for the development of laboratory tests, as shown in Figure 3 (a). The collected water presented a certain degree of turbidity because of the solid particles in suspension. It was therefore necessary to assess the amount of solid material present in the water.

For this analysis, 101.1023 g of water was placed in a beaker, and this was subsequently put in an oven at a temperature of 105°C for complete evaporation of the liquid so as to quantify the volume of solid material present in the sample. After the necessary time for evaporation had passed, the solid material remaining in the beaker was weighed and this returned a mass of 0.1494 g, which represents less than 0.15% of solid matter present in the water, as shown in Figure 3 (b).

4.1 Concrete Production

Once in possession of all materials, three concrete compositions were developed in order to apply the residual water of the concrete plant. The compositions were established in accordance with the proportion of drinking water replaced by the water from the concrete manufacturer.

A ratio of 1:2:3 was chosen for these compositions, respectively cement, fine aggregate and coarse aggregate, with the water/cement ratio at 0.53. The physical characteristics of the aggregates were ignored, since the focus of analysis in this project was the replacement of the water. Initially, the first experiment contained only drinking water, collected directly from the lab, being named the reference composition. At this stage, 11.31 kg of gravel, 7.54 kg of sand, 3.77 kg of cement and 2 L of water were added to the concrete mixer.

These materials were kept in the concrete mixer's mixing process for about 5 minutes until the mixture was homogeneous. Soon after, a slump test was carried out in accordance with the NBR NM 67 standard (ABNT, 1998). Test specimens were molded in triplicate and then sent for the compression strength trials after 14 days and 28 days of curing.

Table 1: Actions to be undertaken in the short term.

Opportunity	Name of the Action	Description of the Action	Indicators	U/M
1	Concrete with reused water	Use of the concrete mixer truck washing water in concrete production.	Strength	MPa

U/M = Unit of Measurement.

Table 2: Actions to be undertaken in the medium term.

Opportunity	Name of the Action	Description of the Action	Indicators	U/M
1	Concrete with solid waste	Use of the solid waste arising from the concrete mixer truck washing in concrete production.	Strength	MPa

U/M = Unit of Measurement.

Table 3: Actions to be undertaken in the long term.

Opportunity	Name of the Action	Description of the Action	Indicators	U/M
1	Improving the water collection system	Improve the collection system of the water arising from the washing of the concrete mixer trucks, deploying a simple system for the treatment and quality control of this water	Volume of water	m ³
2	Take advantage of the remaining concrete in the trucks to manufacture artifacts	Purchase equipment for the manufacture of concrete artifacts with the concreting leftovers	Quantity of parts	UN

U/M = Unit of Measurement.

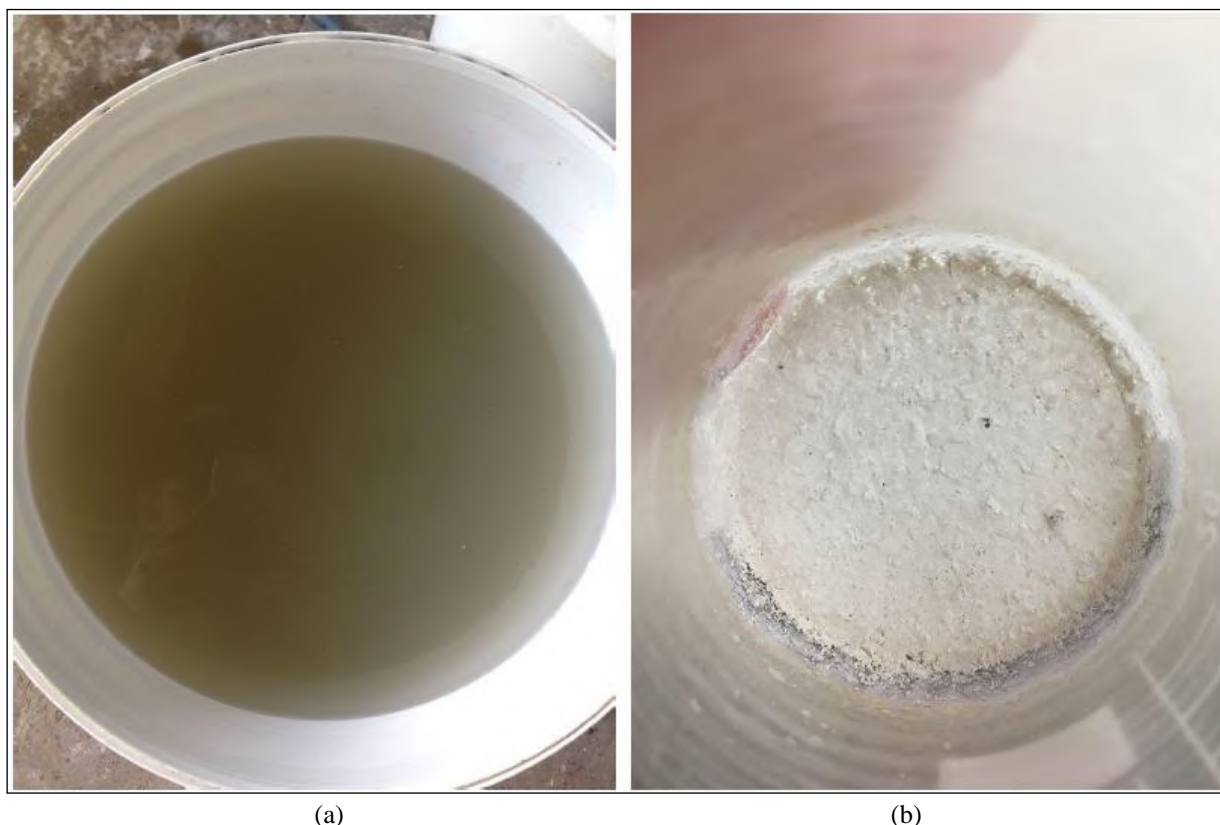


Fig. 3: Water used to wash the concrete mixer trucks (a); solid waste present in the water (b)

On a second moment, the same quantities of materials were added in the concrete mixer, obeying the proportions adopted, but now with 50% of the drinking water replaced by residual water collected at the concrete plant, following the same procedure as described

previously. Test specimens were also produced in triplicate for the compression strength tests at two ages, 14 and 28 days.

Finally, in the third experiment, only the wash water from the concrete mixer trucks was used. The procedure for the

development of this composition followed the same conditions and proportions as the reference experiment. Test specimens were once again produced in triplicate to be subjected to the compression strength test at different curing ages.

The test specimens were demolded 24 h after the production of the concrete, and then put into specific tanks for wet curing until the day of the mechanical tests. In total, 18 test specimens were molded, 6 for each composition divided into two different ages.

At 14 days, three specimens per composition were subjected to the compression test in order to analyze the strength of the material according to the curing period. With this objective, the surface of the specimens were rectified to improve the distribution of the load applied in the test. The specimens were then submitted to the compression test standardized by NBR 5739 (ABNT, 2007). This test consists basically in submitting the cylindrical concrete specimen to an axial force until there is a rupture of the material in order to verify the maximum compression strength of the concrete.

At 28 days, the same procedures were followed to obtain the strength results. Subsequently, the surface of the rupture was examined visually as well as the interaction between the aggregate and the matrix.

The values obtained in the tests were statistically treated with the Tukey method and analyzed in order to validate the proposed objective of cleaner production.

V. RESULTS AND DISCUSSIONS

The compression trials produced strength values for the different concrete curing ages. The values found at 14 and 28 days are shown in, which presents the data for the different compositions used in the methodology (Table 4).

Table 4: Mean compressive strength and standard deviation values

% of waste water used	Ages of mechanical tests (days)	
	14*	28*
0	21.53 ± 0.77a	25.59 ± 1.07a
50	23.34 ± 0.59b	26.59 ± 1.55a
100	20.16 ± 0.34a	24.22 ± 0.59a

* Means followed by the same letter in the column don't differ by Tukey test at 5% probability. The data represent the means ± standard deviation of three replicates of each volume of water.

For a better understanding of the results, the Tukey test was applied to the experiment, which consists of a means comparison test, serving as a complement to the analysis of variance of the results. This test proves statistically if any of the samples has a significant difference in relation to the other.

Since this study's objective was to apply the residual water, the data found needed to be treated statistically to prove if the results were statistically significant. This way one could observe that, at the younger age, the concrete with the addition of 50% of water from the concrete plant had strength values with a significant increase. At the older ages, however, the different proportions of water used for replacement yielded differences that were no

longer statistically significant. Figure 4 shows the mean values found for each trait at different ages for each sample.

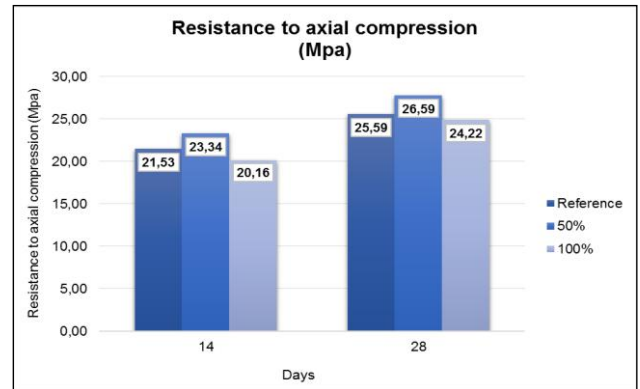


Fig. 4: Compression strength between the different proportions of residual water from the concrete plant.

At 14 days, it is observed that the composition with 50% of residual water had an increase of 8.45% in its compression strength in relation to the reference composition. The composition with 100% of residual water, on the other hand, had a decrease of 6.36% in its compression strength in relation to the reference composition.

At 28 days, it is observed that the composition with 50% of residual water had an increase of 8.63% in its compression strength in relation to the reference composition. The composition with 100% of residual water, on the other hand, had a decrease of 2.77% in its compression strength in relation to the reference composition.

When analyzing the data, an increase in the strength can be seen only in the sample with 50% of residual water, with an improvement at 28 days. It appears that using 100% of residual water tends to decrease the strength.

Although there were no results with statistically significant higher strengths, one can conclude that the residual water from the company can be used in mixtures with a cement basis, since it has the same behavior as those prepared with drinking water.

The conclusion can therefore be drawn that the residual water from the washing can be applied in concrete production, since the results showed that the concrete containing the residual water achieves the same compression strength when compared to the experiment that used only drinking water.

Another relevant factor is the behavior of the concrete with the replacement of the water. The concrete showed typical behavior when subjected to the compression test because conventional Concrete tends to break down in the form of a cone or diagonally. As can be seen in Figure 5, the specimen with 50% water replaced maintained the normal behavior for concrete, breaking diagonally in the transition zone.

When the internal macro-structure of the fractured concrete is analyzed, it is possible to identify that there was a rupture in the transition zone between the aggregate and the matrix. This behavior is explained by the high

water/cement factor used.

Other tests, such as the water's pH and chemical composition, should be performed on the concrete to analyze its behavior and check if there has been any effect of any chemicals that were used in the washing of trucks. This can cause harmful reactions to the concrete that were not identified in this study.



Fig. 5: Fractured test specimens in the compression test with the composition with 50% of residual water.

The application of residual water in the concrete can bring environmental and economic benefits, and it can be used without harming the quality of the concrete. It is therefore estimated that a replacement of up to 50% of drinking water by water from the concrete plant could be used, reducing the volume of water extracted from the groundwater through the artesian well.

The greatest contribution of the deployment of the cleaner production project is linked to the environmental aspect with the reduction in the extraction of natural resources, since from a financial point of view, obtaining water through the artesian well represents negligible costs for the company.

A medium-term action would be linked to the employment of the solid waste in the production of the concrete. Knowing that the daily production of solid waste is approximately 5 cubic meters, this material could be classified according to granulometry and once again used as aggregate, according to its characteristics.

In view of the different applications of concrete, it is necessary for the company to develop an appropriate procedure for the collection and storage of water and also to evaluate the dosages for the achievement of the best performance of the concrete.

In the long term, two opportunities for intervention were identified. In a first analysis, the deployment of a water quality control system is recommended in order to make it similar to the water from the artesian well. This process can be accomplished through the deployment of filter systems that are capable of retaining the particles in suspension.

The chemical characteristics of the water in question

should also be analyzed to avoid the presence of harmful agents or those that can modify the properties of the concrete. This measure will require technological and financial investments, contributing to the validation of the initial proposal.

The second opportunity in the long term is linked to the possibility of exploiting the percentages of concrete that return from works inside the mixers. This occurs because of the excess volume of concrete with respect to the request by the customer.

Often, the volume requested ends up being higher than what is actually used in the concreting. This excess material returns to the concrete plant still with the capacity of being applied. To avoid it being disposed in landfills or other types of inappropriate disposal, this material should therefore be given a more noble purpose.

To take advantage of this opportunity, equipment could be purchased for the manufacture of concrete artifacts, adding commercial value and contributing even more with the reduction of environmental impacts. In addition, this proposal would lead to the reduction of solid and liquid waste already at the beginning of the process, since the remaining concrete returning from works inside the mixer is washed, transformed into a compound volume of waste and deposited in the decanters. Otherwise, these materials wouldn't even be included in the waste decantation and filtration cycle.

However, the possibility of adopting this last measure would impact the previously proposed actions, both in the short and medium term, considerably reducing the opportunities for exploiting the solid waste as aggregates and also the water for use in the production of machined concrete.

VI. MONITORING AND EVALUATION

To put the cleaner production proposal into practice, it is necessary to implement a plan to monitor and evaluate the actions so as to maintain the improvement of the program. Fundamental steps for the proper functioning of the project will include: monitoring the collection of wash water, preventing the entry of contaminants; studying dosages for the optimization of the concrete's strength; continuously evaluating the concrete produced through this method; and assessing the purpose of the application of the concrete.

VII. IDENTIFICATION OF BARRIERS

There are factors that interfere with the possibility of deploying the technique described in this project, because chemical products are used in the washing of the mixer trucks and this can cause abnormalities in the concrete if this water is applied. In addition, other impurities can be harmful, such as oils and greases from the truck.

Since there is no treatment of this water to ensure its quality, this leaves some doubts as to the reactions that these chemicals can cause in the concrete. The company will therefore restrict itself in the deployment of this cleaner production technique, given that any abnormality generated in the concrete can be detrimental to the progress of a work and disqualify the product of the concrete plant.

VIII. CONCLUDING REMARKS

When dealing with civil construction, it is essential to develop new techniques and to improve already existing ones, since this segment causes significant impacts to the environment, more than any other.

The greatest contribution of the deployment of the cleaner production project is linked to replacing the drinking water by the residual water in the production of concrete, bringing major environmental and social benefits, reducing the consumption of drinking water and decreasing the amount of waste disposed of inappropriately in nature or in landfills.

According to the Tukey test performed on the samples at 14 days of curing, there was a statistical significance between the 50% composition and the reference composition, as well as between the 100% and 50% composition, showing that replacing 50% of residual water in the mix yielded the best compression strength results in relation to the reference composition and the composition with 100% of residual water. At 28 days of curing, on the other hand, no statistically significant difference was found for any of the comparisons because of the chemical reactions in the concrete's curing process. It is estimated that a replacement of up to 50% of drinking water by water from the concrete plant should be used, since the composition containing 50% of residual water showed the greatest gains in strength in relation to the other compositions.

Based on the results, the conclusion can be drawn that the residual water from the washing can be applied in concrete production, since they showed that the concrete containing the residual water achieves the same compression strength when compared to the experiment that used only drinking water.

As a continuation of this research, it is suggested that the effects of any chemicals used in the washing of concrete mixer trucks on the concrete's behavior are analyzed, since these may cause pathologies in the concrete.

REFERENCES

- [1] ABNT - Associação Brasileira de Normas Técnicas. NBR 15900-1. Água para amassamento do concreto - Parte 1: Requisitos. Rio de Janeiro, 2009.
- [2] ABNT - Associação Brasileira de Normas Técnicas. NBR NM 67. Concreto - Determinação da consistência pelo abatimento do tronco de cone. Rio de Janeiro, 1998.
- [3] ABNT - Associação Brasileira de Normas Técnicas. NBR 5739. Concreto - Ensaio de compressão de corpos-de-prova cilíndrico. Rio de Janeiro, 2007.
- [4] Ekolu, S.; Dawneerangen, A. (2010). Evaluation of recycled water recovered from a ready-mix concrete plant for reuse in concrete. *Journal of the South African Institution of Civil Engineering*, 52(2): 77-82.
- [5] Meyer, C. (2009). The greening of the concrete industry. *Cement & Concrete Composites*, 31: 601-605.
- [6] Paula, H. M.; Ilha, M. S. O. (2014). Qualidade da água residuária de usina de concreto para fins de aproveitamento. *Revista Ibracon de Estruturas e Materiais*, 7(3): 349-366.
- [7] Sealey, B.J; Phillips, P.S; Hill, G.J. (2001). Waste management issues for the UK ready-mixed concrete industry. *Resources, Conservation and Recycling*, 32: 321-331.
- [8] Terra, G. P.; Wasserman, J. C. De F. A.; Lima, G. B. A.; Quelhas, O. L. G. (2013). Análise crítica de aplicação de práticas de P+L. In: *Congresso Nacional de Excelência em Gestão*, 9, 2013, Rio de Janeiro, RJ. Anais... Rio de Janeiro, RJ: CNEG.

Fan Footing Soil Foundation to Safeguard High and Low Rise Buildings from Seismic Waves

B. Bikas Maiti¹, Dr. Ajayswarup²

¹Research Scholar, Department of Civil Engineering, Sri SathyaSai University of Technology and Medical Sciences, Sehore, Bhopal. Madhya Pradesh, India

²Professor, Department of Civil Engineering, Sri SathyaSai University of Technology and Medical Sciences, Sehore, Bhopal. Madhya Pradesh, India

Abstract—Foundations may experience serious misery during an earthquake. Earthquake consequences for shallow and profound foundations are represented by planning them fundamentally to give important quality and ensure serviceability. Quality contemplations basically includes ensuring that the foundation loads stay well underneath that directed by the suitable bearing limit under seismic conditions and serviceability is ensured by outlining the substructure for the evaluated perpetual ground distortion. This paper talked about different aspects of earthquake ground motion influence on structures and furthermore how certain building qualities alter the manners by which the building reacts to the ground motion. The association of these attributes decide the general seismic response of the building: regardless of whether it is undamaged; endures minor harm; ends up unusable for quite a long time, weeks, or months; or crumples with extraordinary death toll. Clarifications of a few qualities of ground motion are trailed by portrayals of a few material, auxiliary, and building characteristics that, by communicating with ground motion, decide the building's seismic execution the degree and nature of its harm. The fundamental motivation behind the examination is to break down the seismic bearing limit of foundations and seismic weight and talk about the different issues and issue related into it. Fan Footing Soil Foundation (FPSF) technique was presented for reinforcing.

Keywords—Seismic Waves, Shallow Foundation, Fan Footing (FF), Soil Foundation (SF), P and S Wave, Peak ground acceleration (PGA).

I. INTRODUCTION

Surface waves travel more gradually than body waves (P and S); and of the two surface waves, Love waves for the most part travel speedier than Rayleigh waves. Love waves (do not spread through water) can impact surface water just seeing that the sides of lakes and sea narrows pushing water sideways like the sides of a vibrating tank, though Rayleigh waves, because of vertical segment of their motion can influence the waterways, for example,

lakes. P and S waves have trade mark which impacts shaking: when they travel through layers of shake in the hull, they are reflected or refracted at the interfaces between shake composes. At whatever point either wave is refracted or mirrored, a portion of the vitality of one kind is changed over to waves of the other sort. A typical illustration; a P wave ventures upwards and strikes the base of a layer of alluvium, some portion of its vitality will go upward through the alluvium as a P wave and part will pass upward as the changed over S-wave motion. Taking note of additionally that piece of the vitality will likewise be reflected back descending as P and S waves.

The realities talked about in this examination to the display of seismic bearing limit of foundations and seismic pressure along these lines, finding out the validity of the algorithm will distinguish the restriction of the investigation. FPSF technique based algorithm was presented for additional reinforcing. There is no huge distinction amongst present and past common structure framework in India. There is huge distinction between seismic bearing limit of foundations and seismic pressure. **The information on seismic design of shallow foundations is presented below for four different cases:**

1. Shallow Foundations on Soils Not Prone to Liquefaction
2. Settlement of Shallow Foundations on Soils Not Prone to Liquefaction
3. Shallow Foundation on Soil Prone to Liquefaction
4. Settlement of Shallow Foundations on Soil Prone to Liquefaction

The two most important variables affecting earthquake damage are,

1. The intensity of ground shaking caused by the quake coupled and
2. The quality of the engineering of structures in the region

The level of shaking, in turn, is controlled by the proximity of the earthquake source to the affected region and the types of rocks that seismic waves pass through en route (particularly those at or near the ground surface).

II. RELATED STUDY OF SHALLOW FOUNDATIONS

V K Puri et al., (2013) The seismic design of foundations for structures relies upon dynamic bearing limit, dynamic settlements and liquefaction vulnerability of soil. The dynamic bearing limit issue has been drawing attention scientists around fifty years.

Juan Carlos Tiznado A et al., (2014) With regards to engineering practice, the issue of the seismic bearing limit of shallow foundations has been unraveled in a roundabout way, either due an expansion of the static permissible soil weights identified with the likelihood of event of the plan earthquake or by embracing a proportional pseudo-static approach. In any case, amid a decades ago, a progression of diagnostic strategies that specifically address the issue from the seismic perspective has been created. This paper displays a parametric near investigation of various techniques for evaluating seismic bearing limit of shallow strip foundations. Expository techniques, created in the system of both cut off balance and breaking point examination speculations, and furthermore improved plan methods regularly utilized as a part of training were considered.

Strip footing: The strip footing is utilized if there should be an occurrence of a heap bearing divider. The strip footing is likewise utilized for a line of segments that are firmly held and divided with the end goal that their spread footing cover or has a tendency to about touch each other. In such cases it is more practical and successful to utilize a strip footing than to utilize various spread footings held in a solitary line. Along these lines, a strip footing is likewise called as continuous footing (**Alhassan, 2013**).

Spread/isolated footing: The spread/confined/cushion footing is for the most part built to help an individual segment. The spread footing might be roundabout, square or rectangular chunk of uniform thickness. Here and there it might be outlined as ventured or haunched to spread/circulate the heap over a bigger region (**M. T. Adams et al, 1997**).

Combined footing: The joined footing is intended to help two parallel sections. It is essentially utilized when the two sections are close to the point that to each other that their individual footing would cover. The joined footing may likewise be built when the property line is so near section that a spread footing gets erratically stacked if kept inside the property lines. Accordingly, by consolidating it with that of an inside segment, the heap gets equally/consistently disseminated. The consolidated footing might be rectangular or trapezoidal (**M. Tolga Yilmaz, 2009**).

Strap or cantilever footing: The lash (or cantilever) footing includes two isolated/singular footing associated with a basic tie or a lever. The tie is included to associate the two footing all together that they works and winds up like a solitary unit. Be that as it may, the tie essentially fills in as an association pillar and does not avoid any soil response. Consequently, the tie is composed as an unbending member. The individual footings are planned with the end goal that their joined line of activity goes through the resultant of the aggregate load. The tie footing turns out to be more efficient than a consolidate footing when the allowable soil weight is relatively more prominent and furthermore the separation between the columns is more noteworthy (**Vikram Singh Rathore, 2017**).

Mat or raft foundations: The mat/raft foundation is a major chunk supporting various columns and walls of whole structure or in an expansive piece of the structure. The tangle is proficient when the passable soil weight littler or where the sections and dividers are close to the end goal that individual footing gets cover or almost touched each other. The tangle foundations are effective in wiping out the differential settlement on the non-homogeneous soils or where there is an extensive variety in loads on the individual sections (**Saad Eldin, 2014**).

III. DIFFERENT IMPACTS ON B/W HIGH AND LOW RISE BUILDINGS

During an earthquake buildings oscillate, however not all buildings react to an earthquake similarly. In the event that the recurrence of swaying of the ground is near the characteristic resonance of the building, reverberation (high sufficiency proceeded with wavering) may cause extreme harm. Low ascent buildings are more influenced or shaken by high recurrence waves (short and incessant). For instance, a little vessel cruising in the sea will not be incredibly influenced by a low-recurrence swell where the waves are far separated. Then again a few little waves with hardly a pause in between can upset, or invert, the watercraft. Similarly, a little building encounters all the more shaking by high recurrence earthquake waves. Tall structures are more influenced by low-recurrence, or moderate shaking. For example, a sea liner will encounter little aggravation by short waves with hardly a pause in between. Be that as it may, a low-recurrence swell will fundamentally influence the ship. Also, a high rise will maintain more prominent shaking by long stretch earthquake waves than by the shorter waves.

Table.1: Properties of Wave

Braces or Bracing	Structural components incorporated with a wall to include strength. These might be made of different materials and associated with the building and each other in different ways. Their capacity to withstand pressure relies upon the attributes of the materials and how they are connected.
Lead	The sum of vertical forces (gravity) and horizontal forces (shear forces) following up on the mass of a structure. The general load is additionally separated into the loads of the different parts of the building. Various parts of a building are outlined and built to convey distinctive loads.
Lead path	The path a load or force takes through the structural elements of a building.
Rigid connections	Connections that do not permit any motion of the structural elements relative to each other.
Shear force	Force that demonstration horizontally (along the side) on a wall. These forces can be caused by seismic tremors and by wind, in addition to other things. Various parts of a wall encounter diverse shear forces.
Shear walls	Walls added to a structure to carry horizontal (shear) forces. These are usually solid elements and are not necessarily designed to carry the structure's vertical load.
Structural elements or structural features	A general term for all the basic, non-enriching parts of a building that contribute basic quality. These incorporate the walls, vertical section underpins, horizontal beams, connectors, and braces.

IV. SEISMIC WAVE

Seismic waves will be waves of vitality that movement through the Earth's layers, and are a consequence of earthquakes, volcanic emissions, magma movement, huge avalanches and extensive man-made blasts that give out low-recurrence acoustic vitality. Numerous other normal and anthropogenic sources make low-amplitude waves ordinarily alluded to as encompassing vibrations. Seismic waves are considered by geophysicists called seismologists. Seismic wave fields are recorded by a

seismometer, hydrophone (in water), or accelerometer. Earthquakes make particular sorts of waves with various speeds; when achieving seismic observatories, their diverse travel times help researchers to find the wellspring of the hypocenter. In geophysics the refraction or impression of seismic waves is utilized for examine into the structure of the Earth's inside, and man-made vibrations are regularly created to explore shallow, subsurface structures.

Table.3: List of Different types of Waves

c	the wave reflects off the outer core
d	a wave that has been reflected off a discontinuity at depth d
g	a wave that only travels through the crust
i	a wave that reflects off the inner core
I	a P-wave in the inner core
h	a reflection off a discontinuity in the inner core
J	an S wave in the inner core
K	a P-wave in the outer core
L	a Love wave sometimes called LT-Wave (Both caps, while an Lt is different)
n	a wave that travels along the boundary between the crust and mantle
P	a P wave in the mantle
p	a P wave ascending to the surface from the focus
R	a Rayleigh wave
S	an S wave in the mantle
s	an S wave ascending to the surface from the focus
w	the wave reflects off the bottom of the ocean
	No letter is used when the wave reflects off of the surfaces

Table.2: Types of Wave

Body waves	Body waves go through the inside of the Earth along ways controlled by the material properties regarding density and modulus (firmness). The density and modulus, thus, differ as per temperature, structure, and material stage. This impact takes after the refraction of light waves. Two kinds of molecule movement result in two sorts of body waves: Primary and Secondary waves.
Primary waves	Primary waves (P-waves) are compressional waves that are longitudinal in nature. P waves are pressure waves that is moving quicker than different waves through the earth to land at seismograph stations first, subsequently the name "Primary". These waves can go through a material, including liquids, and can go at about 1.7 times quicker than the S waves. In air, they appear as sound waves, henceforth they go at the speed of sound. Run of the mill speeds are 330 m/s in air, 1450 m/s in water and around 5000 m/s in granite.
Secondary waves	Secondary waves (S-waves) are shear waves that are transverse in nature. Following a tremor event, S-waves land at seismograph stations after the quicker moving P-waves and dislodge the ground opposite to the course of engendering. Contingent upon the propagational course, the wave can go up against various surface attributes; for instance, on account of horizontally energized S waves, the ground moves on the other hand to the other side and afterward the other. S-waves can travel just through solids, as liquids (fluids and gases) don't bolster shear stresses. S-waves are slower than P-waves, and speeds are normally around 60% of that of P-waves in any given material.
Surface waves	Seismic surface waves go along the Earth's surface. They can be named a type of mechanical surface waves. They are called surface waves, as they reduce as they get further down from the surface. They travel more gradually than seismic body waves (P and S). In vast seismic tremors, surface waves can have an amplitude of a few centimetres.
Rayleigh waves	Rayleigh waves, additionally called ground roll, are surface waves that travel as swells with motions that are like those of waves on the surface of water (note, in any case, that the related molecule motion at shallow profundities is retrograde, and that the re-establishing power in Rayleigh and in other seismic waves is versatile, not gravitational concerning water waves). The presence of these waves was anticipated by John William Strutt, Lord Rayleigh, in 1885. They are slower than body waves, around 90% of the speed of S waves for run of the mill homogeneous flexible media. In the layered medium (like the outside and upper mantle) the speed of the Rayleigh waves relies upon their recurrence and wavelength.
Love waves	Love waves are horizontally polarized shear waves (SH waves), existing just within the sight of a semi-endless medium overlain by an upper layer of limited thickness. They are named after A.E.H. Love, a British mathematician who made a scientific model of the waves in 1911. They generally travel marginally speedier than Rayleigh waves, around 90% of the S wave speed, and have the biggest amplitude.
Stoneley waves	A Stoneley wave is a type of boundary wave (or interface wave) that engenders along a strong liquid limit or, under particular conditions, additionally along a strong limit. Amplitudes of Stoneley waves have their most extreme esteems at the limit between the two reaching media and rot exponentially towards the profundity of every one of them. These waves can be created along the walls of a liquid filled borehole, being a vital wellspring of reasonable commotion in VSPs and making up the low recurrence part of the source in sonic logging. The equation for Stoneley waves was first given by Dr. Robert Stoneley (1894–1976), Emeritus Professor of Seismology, Cambridge.

V. SOUND AND LIGHT WAVES

Since seismic waves are like sound waves in a considerable lot of their properties, it is valuable to think about the attributes of sound waves. At the point when a tuning fork is struck, the vibrations of its prongs create substitute compressions (pushes) and expansions (pulls) of the contiguous air, setting up the sound waves. Such

stable waves are transmitted by longitudinal vibrations of the air; which implies the relocations of the air are dependably toward the path in which the wave is voyaging. In a uniform gas, the wave front will spread out at an equivalent speed every which way, shaping a roundly extending surface. Unpredictable sound waves by and large constitute clamor; normal waves, for example,

those created by the tuning fork, offer ascent to melodic notes of unequivocal pitch. Pitch is controlled by the recurrence of the sound waves, and uproar by their amplitude or wave vitality. A large number of the ideas and phrasing utilized as a part of the investigation of music persist to seismological examinations.

An unadulterated melodic tone comprises of a solitary pitch or recurrence. In any case, most melodic tones are mind boggling summations of different unadulterated frequencies - one trademark recurrence, called the major, and a progression of suggestions or music. Any perplexing tone from a melodic instrument can be recognized by the prepared ear or electronic hardware from a comparative tone from another instrument since music tones are created in various mixes of amplitudes by various instruments. The show of the part tones as far as individual frequencies an amplitudes is known as the wave range. Photos of the spectra of complex wave structures can be extremely helpful in acoustical examinations as well as in seismology. Sound waves have similar variations of other wave frames. As they go out from their source they reduce in uproar because of the procedure of geometrical spreading and frictional lessening. When they go from a medium of one thickness into a medium of another thickness, they are refracted. When they experience impediments, they are reflected as echoes. The retrogressive diffusing that happens when they strike little hindrances is a noteworthy reason for weakening. A wide range of waves endure constriction by diffusing as they proliferate through issue conditions

containing hindrances, limits, cavaties and layers of various materials. The blueness of the day sky is a consequence of the diffusing of daylight via air atoms. Light waves rather than sound waves (which just have longitudinal characteristics) vibrate in a plane opposite to the course in which the light is voyaging. The wave properties of sound and light can be firmly identified with the attributes of ground vibrations caused by earthquakes.

VI. WAVE PROPERTIES AND MOTION

The pure musical tone delivered by striking a tuning fork is said to have a specific unadulterated pitch or recurrence. That recurrence is the circumstances that the sound waves pack and widen in a moment, or, for water waves and different sorts of vibration, the circumstances the wave rises or falls in a moment. Frequencies are given in hertz, truncated Hz, a unit of estimation named to pay tribute to Heinrich Hertz, a German physicist who in 1887 first created electromagnetic waves. One hertz is equivalent to one cycle of rise and fall every second. The time between the peaks is the wave time frame; it is equivalent to the corresponding of the wave recurrence. Individuals can identify sounds having frequencies in the vicinity of 20 and 10,000 Hz. A seismic P wave can refract out of the stone surface into the climate, and if the frequencies are in the capable of being hearing range, the wave can be heard as a thunder as it goes by the ear. Most earthquake waves have frequencies lower than 20 Hz, and are generally felt by individuals as opposed to felt.

Table.4: Damage during an earthquake results from several factors

Strength of shaking	The strong shaking created by an magnitude 7 earthquake turns out to be half as strong at a distance of 8 miles, a quarter as strong at a separation of 17 miles, an eighth as solid at a separation of 30 miles, and a sixteenth as solid at a distance of 50 miles.
Length of shaking	Length relies upon how the blame breaks amid the seismic tremor. The most extreme shaking amid the Loma Prieta tremor kept going just 10 to 15 seconds. During other magnitude 7 seismic tremors in the Bay Area, the shaking may last 30 to 40 seconds. The more drawn out structures shake, the more noteworthy the damage.
Type of soil	Shaking is expanded in soft, thick, wet soils. In certain soils the ground surface may settle or slide.
Type of building	Certain types of buildings, discussed in the reducing seismic tremor damage section, are not sufficiently safe to the side-to-side shaking common during earthquakes.

Waves can be described by a few parameters. Consider the simple harmonic wave drawn as a solid line below with wave height y at a particular position x and time t . Suppose that the maximum amplitude of the wave is A and that the wave length λ is the distance between the crests. The time for a complete wave (crest to crest_ to travel one wavelength is called the period T . Thus the wave velocity v is the wave length divided by the period:

$$v = \frac{\lambda}{T}$$

The frequency of the wave, f , is the number of complete waves that pass every second, so that

$$f = \frac{1}{T}$$

The actual position of a wave depends on its position relative to the origin time and distance.

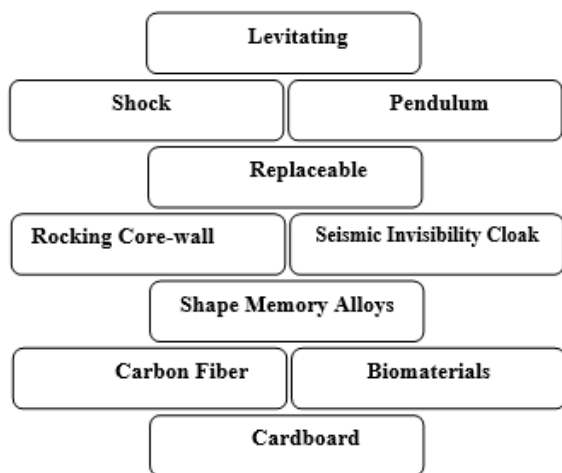


Fig.1: Protection Technologies for Buildings from Earthquake

Table.5: Presumptive bearing capacity values as per IS1904-1978

Type of soil/rock	Safe/allowable bearing capacity (KN/ m ²)
Rock	3240
Soft rock	440
Coarse sand	440
Medium sand	245
Fine sand	440
Soft shell / stiff clay	100
Soft clay	100
Very soft clay	50

Table.6: Bearing Capacity Based on Presumptive Analysis

Type of soil/rock	Safe/allowable bearing capacity (KN/ m ²)
Rock	3240
Soft rock	440
Coarse sand	440
Medium sand	245
Fine sand	100
Soft shell / stiff clay	440
Soft clay	100
Very soft clay	50

VII. FAN FOOTING WITH SFIN SEISMIC ENVIRONMENT

Not like geothermal and water well boring and fan footing operators, a foundation boring contractor is a little cog in a vast wheel, at that point fan footing utilizing with 2 wings, 3 wings and with single layer, twofold layer, multi-layer. Regardless of whether it is respectful development or bridge construction, foundation drillers

work with the prime contractual workers and perform inside the bounds of the outline parameters of the bigger project. The exercises the foundation drillers perform, for example, anchored earth retention, pile construction and bored shaft foundations, are altogether controlled by the elements that administer the building venture they are a piece of soil foundations. This requires a nearer association between foundation drillers and prime contractual workers. A great deal of issues decide the gainfulness of foundation with fan footing tasks and the contractual workers must stay cautious of poor offering rehearses, delays, change-orders, spending overwhelms, doubt, question, and specialized difficulties to ensure that the fan footing work is finished securely, soundly and productively. This white paper examines a portion of the key advances foundation fan footing temporary workers need to take to keep their employments productive. A cautious examination of these reports will furnish the fan footing temporary worker with a great deal of data basic to understanding the extent of the work, for example, the sort, size, amount and the auxiliary subtle elements of the heaps that should be built; site particular data about the basic idea of the overburden and shake layers (dirts, chilly till, shale shake and so on.) will be point by point in the drag sign on these reports.

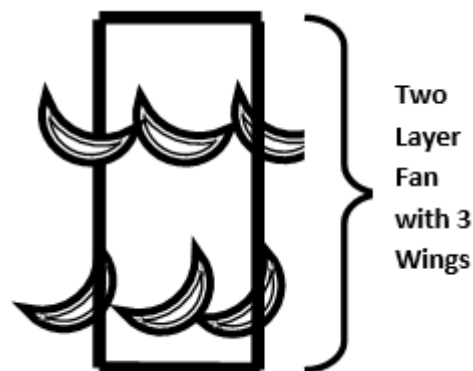


Fig.2: Fan Footing for Soil Foundation

Earthquake motion spreads in soil layers by diffraction and refraction and rise to the top with even and vertical parts that are called P and S waves. P wave compresses and relaxes the earth volumetrically and as it spreads slopes to vertical course while going through the layers of the earth. It ways to deal with the plumb (has a tendency to be vertical) till achieving the surface. S waves are otherwise called float waves. They frame float motions which keep running in opposite to the undulation course. Amplitudes of P waves are little and of S waves are huge that can cause obliteration. The P waves rise to the surface in plumb line that causes vertical motions in the surface while S wave causes even motion. As the ground is extremely unpredictable with numerous stone layers, it may not be conceivable that the p waves rise to the top

totally vertical. By introducing some foundation layers without sticky materials this can be obtained. Because of the limit conditions, amplitudes of the earthquake wave pairs in free surface because of increasing speed of gravity going with vertical P wave. It becomes $\{g+2a.\sin(\omega t)\}$ in the structure on the surface of the ground by oscillations with $2a$ accelerations due to earthquake:

$$W(t) = m.\{g + 2a.\sin(\omega t)\} = m.g + 2a.\sin(\omega t)$$

The weight of the structure on the surface, W goes through the harmonic change dependent on time. The effect of (mg) which is the modulus of the vertical load is accompanied by harmonic $2am.\sin(\omega t)$ load. Vertical load vector remains with the same sign in each period and it changes its direction in the event of rare case of (a) value (Fig.3).

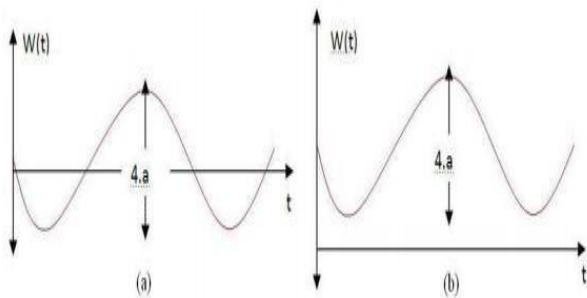


Fig.3: a) Weight of a structure during an earthquake with acceleration a , and b) Changing signs of acceleration in drift motion of the ground

S wave dependably reshapes the full harmonic $2a.\sin(\omega t)$ motion. Load vector which constitutes float pressures swings to one (+) and one (-) vector by changing sign in every period (Fig. 3b). It is effectively observed that the increasing speed of gravity's up and down in the layer from where the P wave rises to the surface. Float stresses which are shaped by the heaviness of the structure up and downs in each time of the earthquake in flat planes. The float focuses on that up and downs in the basic even planes can be utilized to diminish the impact of S wave vitality. One might say that S wave with the level wavering does not pass on especially to the structure when vertical speeding up esteem is at greatest. In the meantime when vertical speeding up is least, the float pressures lessening to a critical extent in the even layer. This demonstrates the coefficient of rubbing in the energetic surface abatements with the vertical vibration time frame and adequacy of the plane. The numerical detailing for discovering change parameters can be determined for structure with expanded foundation in period interim. We can make the capacity of the two motions that will be framed the base for the count by

taking out the time in the $W(t)=m.\{g+2a.\sin(\omega t)\}$ function to a period interval (Fig.4).

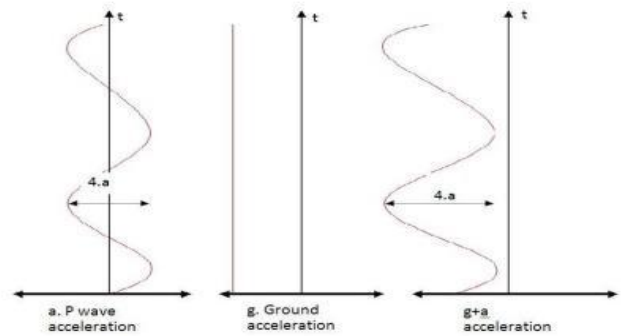


Fig.4: Increasing and decreasing of acceleration on the ground surface due to earthquake.

Some assumption can be made to continue the calculation with the value of the vertical loads $W=m.\{g\pm 2a\}$ in the structure. We accept the vertical acceleration of gravity as positive. The acceleration of the P wave, m is the mass of the structure, A is the S wave acceleration on the ground and μ is the coefficient of friction of the horizontal plane made between the foundation and block. $N = \frac{a}{A} = P$ is the proportion of the P wave acceleration to the S wave acceleration. This value is in the position of $N = 2/3$.

The force that the S wave can form in the horizontal direction on the structure's ground is as much as $F=m.A\sin(\omega t)$. It becomes $F=m.A$, if we degrade it to the half period interval. This force passes to the structure as it is and shakes it in the horizontal direction, if there is no drift on the ground. $W=m.(g+2a)$ vertical load originates in the structure base in the $(g+2a)$ state of P wave acceleration. The weight of the structure is $W=m.(g-2a)$ in the $(g-2a)$ state. If the structure is separated from the upper structure with dilatation on the plane from where it emerges to the surface if static friction force is $f=\mu.m.(g\pm 2a)$. The shifting force magnitude which the earthquake will form in the horizontal direction is as much as $F=m.A$ under the dilatation plane in the structure. The drift is formed if the friction force F in the dilatation is equal to or smaller than the shifting force magnitude.

$$\mu.m(g \pm 2g) \leq m.A \rightarrow \mu = \frac{A}{(g \pm 2a)} N = \frac{a}{A} \rightarrow a = NA$$

If we take as $A = a.g$; $a \rightarrow$ is the earthquake acceleration parameter according to the acceleration of gravity.

$$\mu \leq \frac{A}{g \pm 2.N.A} = \frac{a}{1 \pm 2N.a}$$

$\mu \leq \frac{a}{1 \pm 2N.a}$ Two separate equation are formed in a period interval.

We can make the graphic of the change of the coefficient of friction with the earthquake acceleration parameter and make interpretations (Fig.5). We can determine the limits of the coefficient of friction for the formation of drift in the structure's foundations according to the change of the ground acceleration parameter of the earthquake. In the graphic, there is asymptote of the coefficient of friction in $a = 1/2N$ value for the $\mu \leq \frac{a}{1-2N.a}$ case. In the upper accelerations of the α value, the structure and stratum are separated. The vertical earthquake acceleration is bigger than the acceleration of gravity and between the structure and foundation is widened. There is asymptote of $\mu \leq \frac{a}{1+2N.a}$ equality for the coefficient of friction $\mu = 1/2N$ value. Coefficients of friction above this value do not let the drift in the structure's foundation. For every value within these borders, drift occurs in the structure's foundation.

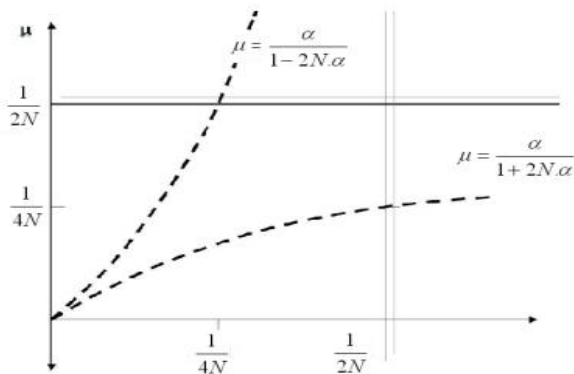


Fig.5: Diagram showing the structure's motion depending on the acceleration ratio to that of the coefficient of friction

When $N=a/A \leq 1$ or $N \geq 1$, we evaluate $1/2N$. In the $N \leq 1$ environment, P wave of the earthquake is bigger than

the S wave acceleration. It makes it easy that friction can occur in the structure's foundation for the high values of the coefficient of friction. When $N \geq 1$, it is necessary to form planes with low coefficient of friction for the formation of drift in the structure's ground as the P wave acceleration is big.

Inertial forces and acceleration with Fan Footing

The seismic body and surface waves make inertial forces inside the building. Inertial forces are made inside a question when an outside power tries to influence it to move on the off chance that it is very still or alters its rate or course of motion on the off chance that it is moving. Inertial power takes us back to secondary school material science and to Newton's Second Law of Motion, for when a building shakes it is liable to inertial powers and should comply with this law similarly as though it were a plane, a ship, or a competitor. Newton's Second Law of Motion expresses that an inertial power, F, rises to mass, M, increased by the acceleration, A.

$$F = MA$$

Figure: Newton's Second Law of Motion

Mass can be expected as proportionate (at ground level) to the heaviness of the building, thus this piece of the law clarifies why light buildings, for example, wood outline houses, have a tendency to perform preferred in earthquakes over substantial overwhelming ones the powers on the building are less. The speeding up or the rate of progress of the speed of the waves getting the building under way, decides the level of the building mass or weight that must be managed as a horizontal force.

Table.7: Site Response without FF (Test-1)

S.No	Depth in meter	Velocity m/sec	Spectral Acceleration	Peak ground acceleration	Vertical force	Lateral force	Zone
1	0	0	0.00	0.01	20	10	Iv
2	5	0	0.012	0.012	30	15	IV
3	10	50	0.016	0.018	40	20	IV
4	15	100	0.02	0.0215	60	40	III
5	20	150	0.025	0.0266	70	50	III
6	25	200	0.03	0.0357	90	60	III
7	30	250	0.032	0.0384	100	70	II
8	35	300	0.034	0.0451	120	80	II
9	40	350	0.05	0.0499	160	120	I
10	45	400	0.07	0.0687	180	130	I

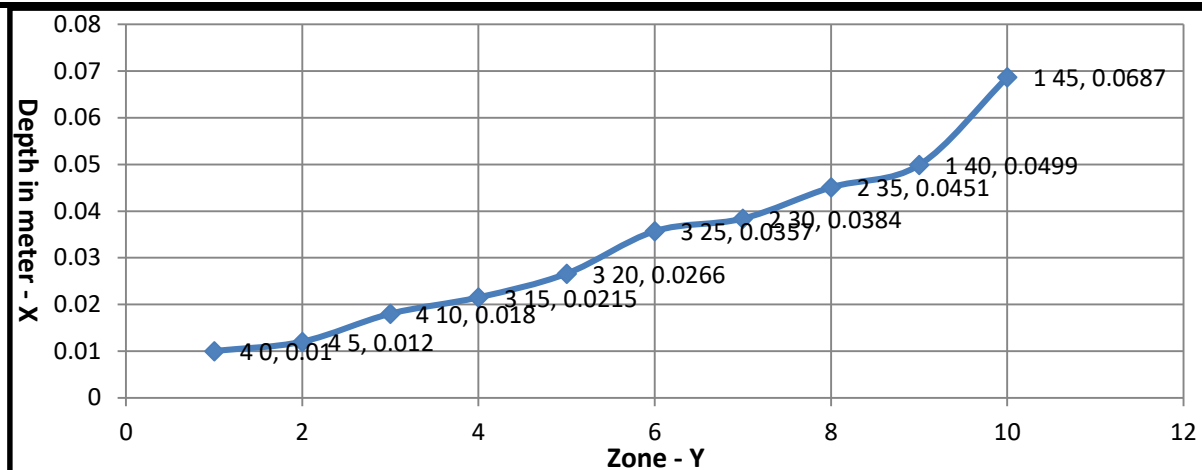


Fig.6: Result of without FF

Table.8: Typical values of elastic constants, density, Poisson's ratio and seismic wave velocities

Material or Geologic Formation	Bulk Modulus in 10^9 Pa	Shear Modulus in 10^9 Pa	Density in $kg\ m^{-3}$	Poisson Ratio	V_D in $km\ s^{-1}$	V_D in $km\ s^{-1}$	V_p/V_s
Air	0.0001	0	1.0	0.5	0.32	0	∞
Water	2.2	0	1000	0.5	1.5	0	∞
Ice	3.0	4.9	920	-0.034	3.2	2.3	1.39
Clastic sedimentary rocks	-	-	-	-	(1.4-5.3)	-	-
Sand stone	24	17	2500	0.21	4.3	2.6	1.65
Salt	24	18	2200	0.17	4.6 (3.8-3.7)	2.9	1.59
Limestone	38	22	2700	0.19	4.7 (2.9-5.6)	3.6 (3.4-3.7)	1.62
Granite	56 (47-69)	34 (30-37)	2610 (2340-2670)	0.25 (0.20-0.31)	6.2 (5.8-6.4)	3.6 (3.4-3.7)	1.73 (1.65-1.91)
Basalt	71 (64-80)	38 (33-41)	2940 (2850-3050)	0.28(0.26-0.29)	6.4 (6.1-6.7)	4.4 (4.0-4.7)	1.80 (1.76-1.82)
Peridotite, Dunit, Pyroxenite	128 (113-141)	63 (52-72)	3300(3190-3365)	0.29 (0.26-0.29)	8.0 (7.5-8.4)	-	1.8 (1.76-1.91)
Metamorphic & igneous rocks	-	-	-	-	(3.8-6.4)	-	-
Ultramafic rocks	-	-	-	-	(7.2-8.7)	-	-
Cenozoic	-	-	1500-2100	0.38- <0.5	(0.2-1.9)	0.34	2.3-8
Cenozoic water saturated	-	-	1950	0.48	1.7	0.34	5
Cretaceous & Jurassic	-	-	2400-2500	0.28-0.43	-	-	1.8-2.8
Triassic	-	-	2500-2700	0.28-0.40	-	-	1.8-2.5
Upper Permian	-	-	2000-2900	0.23-0.31	-	-	1.7-1.9
Carboniferous	-	-	-	0.31-0.35	-	-	1.9-2.1

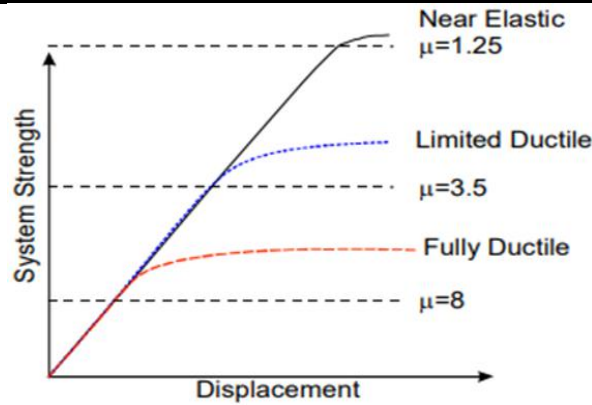


Fig.7: Performance of test result

Table.9: Inertial forces and acceleration with Fan Footing (Test-2)

S.No	Depth in meter	Velocity m/sec	Spectral Acceleration	Peak ground acceleration	Vertical force	Lateral force	Zone
1	0	0	0.00	0.00	10	0	IV
2	5	0	0.00	0.011	20	5	IV
3	10	40	0.011	0.0112	30	15	IV
4	15	80	0.015	0.016	40	20	III
5	20	110	0.019	0.0172	45	25	III
6	25	150	0.021	0.0211	50	30	III
7	30	190	0.024	0.0264	55	35	II
8	35	210	0.037	0.0287	70	50	II
9	40	250	0.039	0.0299	85	55	I
10	45	290	0.041	0.0312	110	70	I

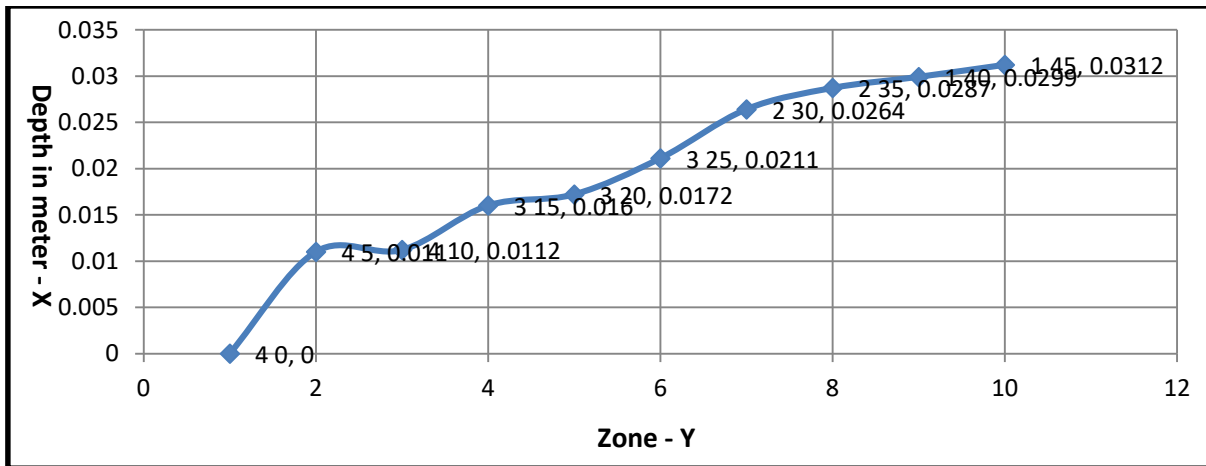


Fig.8: Performance result with FF

VIII. CONCLUSION

The calculations are about the static coefficient of friction. Moreover, there is likewise dynamic coefficient of friction. The dynamic coefficient of friction is greater than the static coefficient of friction. On the off chance that the calculations are made by the static coefficient of friction, it will be a more secure region than the active one. The float of the foundation to the structure's ground causes critical releases in the earthquake vitality which will go to the structure. The vitality got in the earthquake

waves loses quality with moment releases is vital for its consequences for the structure. For this situation the structure's foundation proceeds with its motions without shaking. If the structure is tied down to the foundation whatever is left of the structure turns into the last layer that implies over the foundation up to the rooftop. For this situation the increasing speed in the structure ends up multiplied. We can shield the structure from the S wave by utilizing the way that P waves reach to the structure first and shape vibrations vertical way. In other words that

we can isolate the upper piece from the foundation by influencing dilatation on the ground to surface. Vertical vibrations that the P waves shape in the structure diminish the coefficient of grinding in the even dilatation on the foundation. S waves of the earthquake which reach to the structure's ground later resemble achieving the free layer and release its vitality in this way cause level vibrations not to achieve the upper structure which then it stops S waves horizontal and destructive impacts.

and behavioural aspects pursuant to Chhattisgarh region in India, Research Journal of Engineering Sciences, Vol. 6(6), July (2017), 8-18.

REFERENCES

- [1] Civalek, O. and Yavas, A.2006. Large deflection static analysis of rectangular plates on two parameter elastic foundations. International Journal of Science & Technology, Vol. 1, No 1, 43-50.
- [2] Juan Carlos Tiznado A, Analysis of the seismic bearing capacity of shallow foundations, Journal of Construction, 2014, Vol. 13, Issue 2, pp. 40-48.
- [3] M. Alhassan and I. L. Boiko, Shallow Foundations for Low-rise Residential Buildings in Nigeria, International Journal of Science, Engineering and Technology Research (IJSETR) Volume 2, Issue 3, March 2013.
- [4] M. T. Adams and J. G. Collin, "Large model spread footing load tests on geosynthetic reinforced soil foundations," Journal of Geotechnical and Geoenvironmental Engineering, vol. 123, no. 1, pp. 66–72, 1997.
- [5] M. TolgaYilmaz, B. SadikBakir, Capacity of shallow foundations on saturated cohesionless soils under combined loading, Canadian Geotechnical Journal, 2009, 46(6): 639-649.
- [6] Mehrab, J. and Mehrad, K. 2010. Comparison between numerical and analytical solution of dynamic response of circular shallow footing. EJGE, Vol. 15.
- [7] Mohamed SaadEldin, Arafa El-Helloty, Effect of Opening on Behavior of Raft Foundations Resting on Different Types of Sand Soil, International Journal of Computer Applications, Volume 94 – No.7, May 2014.
- [8] Srilakshmi, G. and Rekha, B. 2011. Analysis of mat foundation using finite element method. International Journal of Earth Sciences and Engineering, Vol. 04, No. 06, pp. 113-115, October 2011.
- [9] V K Puri, Shallow Foundations For Seismic Loads: Design Considerations, International Conference on Case Histories in Geotechnical Engineering, 2013, pp. 1-16.
- [10] Vikram Singh Rathore, M.K. Gupta, Designing and contrastive inquisition of spread- isolated and strap-combined footing underlying economical criterion

Sensory quality and physicochemical evaluation of two brine pickled cucumber (*Cucumis sativus* L.) varieties

T. G. G. Uthpala¹, R. A. U. J. Marapana¹, S. A. S. Jayawardana²

¹Department of Food Science & Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Colombo, Sri Lanka

²Industrial Technology Institute, Colombo 7, Sri Lanka

Abstract— *Ajax* and *Vlasset* gherkin (*Cucumis sativus* L.) varieties used in brine pickling were analyzed for its sensory attributes and physicochemical changes within 6 month of brine fermentation. Sensory characteristics (colour, texture, odour and overall acceptability) of brine fermented fruits were determined using five point hedonic scale. Uronic acid content (UA) and moisture variation were determined within 6 months. Ca and Na ion absorption was done for the fruits within fermentation and after de-brining.

The results revealed that sensory perception of texture attribute among cultivars have apparent impact after brining. In view of all sensory parameters of varieties, 1st and 6th month *Vlasset* were obtained the highest sensory quality while the least preferred were obtained within 1st, 3rd and 6th month of *Ajax*.

A positive correlation (0.829) between Calcium and Sodium ion absorption were noted irrespective to the variety. The data obtained from the de-bring process showed lower retention of both Calcium and Sodium ion in *Ajax* than *Vlasset* which may lead to lower sensory quality. Calcium ion level of *Ajax* and *Vlasset* varieties have declined from 54% and 16.47% respectively while Sodium level of *Ajax* and *Vlasset* have declined from 84.13% and 55.547% respectively compared to before de-brining process. Irrespective to the variety UA was continuously decreased up to 3 months while it increased in both varieties up to 6month. *Vlasset* was noted to have higher UA content than *Ajax* before and after the fermentation period. Moreover a positive correlation was observed (0.858) between moisture and UA content.

Keywords— *Ajax*, brine fermented, sensory evaluation, Uronic acid, *Vlasset*.

I. INTRODUCTION

Cucumis sativus L. which is generally called as commercial cucumber thought to have originated in the southern Himalayan foothills region of Asia. Moreover cucumber production occurs in North Central America

and Europe but half of world cucumber production occurs in Asia [1]. The pickling type gherkins are produced in Sri Lanka nearly 30 years for export market and it expanded over several agrological regions [2]. The immature fruits are used for the preparation of pickles [3] and cucumber for pickling must be grown from varieties known to have regular form, firm texture and overall good pickling characteristics. *Ajax* variety is having wide adaptability, high yield in early age and suitability for all grades. *Vlasset* is a popular hand pick hybrid that features a blocky fruit shape and length to diameter ratio in the 2.8 range which nicely matches the needs of many hand pick green and brine stock programs. Brining can defined as steeping of vegetable in a salt solution of predetermined concentration for a certain length of time. It involves transfer of various solutes between brine and porous solid phase, coupled with reaction within the liquid. Solute transfer through micro pores (stomata) in the skin. It may control the rate of diffusion of the solutes in to and out of the cucumbers with reaction within the liquid [4]. Texture is an important attribute in pickling cucumbers which demands product acceptance and quality. Pickling cucumbers of any type must be firm and crisp in order to get most consumer acceptance. In the pickle industry, cucumbers are typically fermented in a brine containing ranging from 6% to 12 % NaCl and after fermentation excess salt is removed (de-brining) to make it edible.

Existing study was carried out in one of leading cucumber pickling company, with two gherkin varieties (*Ajax* and *Vlasset*) treated in brine fermentation with salt, Calcium Chloride, Acetic acid and B80 clay as main ingredients. Even though previous studies have been done with the nutritional composition [2] on fresh fruits there is a scarcity in scientific information on sensory quality of gherkin varieties, mineral changes, moisture and UA content variation during the fermentation period of commercially grown cultivars in Sri Lanka. This research was a comparative study on evaluating sensory attributes with the aspects of unrevealed chemical changes of

locally grown Ajax and Vlasset gherkin varieties while providing them same processing conditions.

II. MATERIALS AND METHODOLOGY

2.1 Sample collection

Disease free, same maturity status (No 3, 32-42 mm diameter) fresh gherkin of Ajax (Nunhems seeds) & Vlasset (Seminis seeds) varieties, were obtained from local processor.

2.2 Sample Preparation

Brine fermentation was triplicated in 9000L plastic vats of cucumber with 2:1 pack out ratio (6000Kg gherkin: 3000L of fresh brine) of 10 % NaCl, 0.02% CaCl₂, 0.1 % acetic acid and 0.0028 % B-80 pure clay concentration were fermented using the controlled fermentation process of Etchells and others [5]. During this fermentation period salinity of the brine is maintained 10% range by incorporating salt to the liquid & the gherkins were continuously purged with 20ml/ min air for 3 weeks. Brined fruits were analyzed at 1, 2, 3, 4, 5 & 6 months after brining for its UA%, Ca and Na ion absorption, moisture variations and sensory evaluations analysis.

2.3 Preparation of homogeneous sample for analysis

The gherkin flesh with peel was first diced into cubes of about 5mm x 5mm x 5mm size & dried up to 10% moisture content in dehydration oven at 60 °C. Dried samples were milled using a Fritsch Mill (sieve size 0.5 mm), packed in polythene and stored at 12 °C until use for the analysis of UA and moisture.

2.4 Sensory Evaluation

The brine fermented gherkins were assessed on 5 point hedonic scale for its sensory attributes of colour, odour, texture and overall quality. Fruits from 1 to 6 month after brine fermentation were taken from the both varieties and those 12 samples were evaluated for above four attributes by using 32 semi-trained panelists. The letter 'A' is denoted for Ajax and 'V' is denoted for Vlasset while corresponding number denote the month. Panelists scored scale ranging from 1 (not acceptable) to 5 (Standard).

2.5 Ion absorption amount of fermented cucumber

Ca⁺⁺ & Na⁺ absorption amount of fruits (peel + flesh) two varieties was measured using Inductively Coupled Plasma Mass Spectrometry (Thermo Scientific iCAP RQ ICP-MS) for the fresh fruit and fruits after brining (1,7,14,21,30,60,90 and 180 days). Ca⁺⁺ & Na⁺ amounts were tested according to the protocols of AOAC.985.35 and AOAC.984.27 respectively.

Above two tests were conducted for 6 month fermented and de-brining (up to 2% salinity) fruits for the

determination of available Ca⁺⁺ & Na⁺ amounts in two varieties.

2.6 Uronic Acid (UA) content

Amount of UA (dry basis) for fresh fruit & 1 to 6 months after fermentation was detected by the method described in Bitter and Muir [6]. UA content was determined after acid hydrolysis of sample and reacting with Carbozol and corresponding concentrations were directly measured using spectrophotometer (Sigma Co., Germany-model No-UV-1601) at 530nm.

2.7 Moisture variation

Moisture of the fruits in both varieties was measured by AOAC 925.10 method for the fresh fruit and brine fermented fruits up to 6 month.

2.8 Data analysis

The collected data was finally analyzed by using, Minitab 17 package. Sensory data were analyzed using Kruskal-Wallis non parametric analysis to determine whether any significant difference (confidence interval of 95%) exists between selected samples. Then mean separation was carried out to identify significantly different having samples. The Mann Whitney test was carried out to identification of significantly different among varieties. Two sample T test, Onaway ANOVA and Regression analysis were carried out for the parametric data analysis.

III. RESULTS AND DISCUSSION

3.1 Sensory evaluation

3.1.1 Best time period of the varieties

The average rank values graphically represented in Fig. 1 and the most preferred sample on colour attribute was noted from Vlasset variety (6 month fermentation).in line with analysis, sample V2 and V6 were observed highest average ranks for odour. In view of overall attribute Vlasset variety was showed better sensory quality compared to Ajax variety during 6 month of fermenting period (except 5th month).

Pursuant to the statistical evaluation results there was a significant difference of textural attribute among samples with time. Confirming to paired wise comparison texture attribute of V6-A3 & V1-A3 samples were having higher ($p < 0.05$) average rank differences.

In consonance with all the sensory parameters for all samples, sample V1 & V6 have gained the highest sensory quality. Previous studies have shown that the sensory perception of texture (crispiness) among cultivars have apparent impact after brining [7]. In line with that the least preferred samples were A1, A3 & A6 among all the sensory parameters.

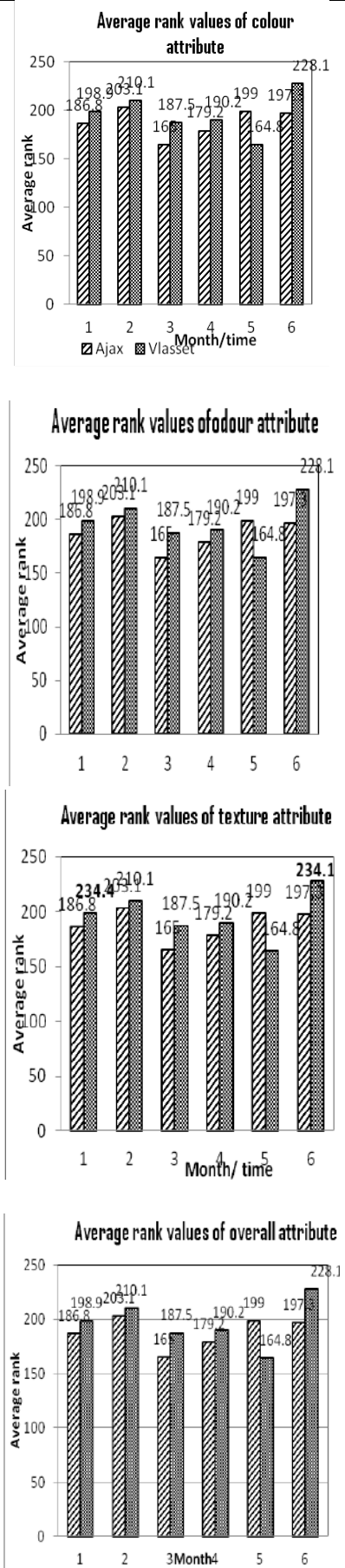


Fig. 1: Average rank values of colour, odour, texture & overall attribute in Ajax & Vlasset varieties

3.2 Ion absorption of fermented cucumber in two varieties 3.2.1 Ion absorption with time

Under this analyzing concentration of Ca^{++} and Na^{+} ions in both gherkins fruit samples were detected within 6 month of fermenting period. Measured ion concentrations using ICP-MS are given in fig. 2 and 3. Measured Calcium and Sodium ions were changed irregularly during fermentation period irrespective to the variety. Even though sodium ion concentration is lower in raw fruits than calcium throughout the fermentation period sodium ion concentration in fruits were significantly greater than the calcium ion amount in the fruits. Due to osmosis water will move from cucumber to the salt solution. In view of Walter and others [8] fruits immersed in supra-osmotic solution had lost about 14% of its weight after 23hrs. Results can be expected due to semi permeable nature of plant cell membrane. Irrespective to the varieties there was a positive correlation of between Calcium and Sodium ion amount in gherkin food. The Pearson correlation of between Na^{+} ppm and Ca^{++} ppm were obtained as 0.829 value while having a liner regression model of $y = 0.0048x^{1.9515}$ with $R^2 = 0.9003$ ($x = Ca^{++}$ ppm & $Y = Na^{+}$ ppm).

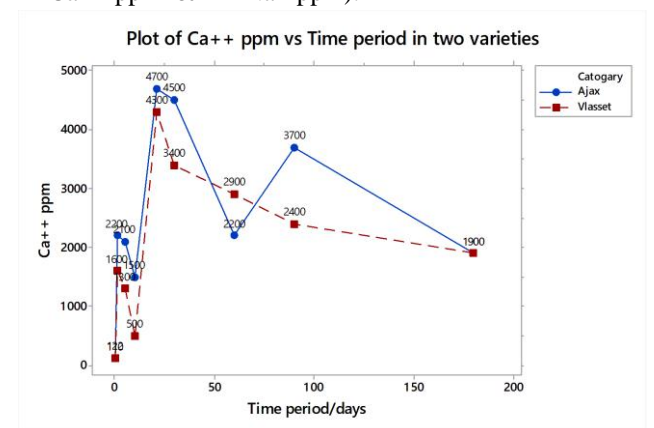


Fig.2: Variation of absorbed Ca^{++} ions in both gherkins fruit samples with time.

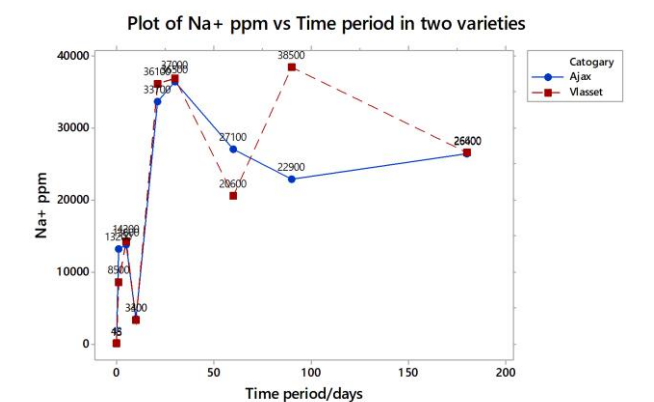


Fig.3: Variation of absorbed Na^{+} ions in both gherkins fruit samples with time.

3.2.2 Ion absorption of brined cucumber before and after de-brining

Using ICP-MS the determination of available Ca^{++} & Na^{+} amounts in fruits were conducted for 6 month brined gherkins of two varieties, before and after de-brining up to 2% salinity. Measured ion concentrations before & after de-brining up to 2% salinity are shown in the Fig. 4. As reported by de-brining process, after de-bring have great impact on both Calcium and Sodium ion concentration of Ajax variety. Even though both are supplied the same conditions there is a rapid decrease of both ion content in Ajax variety. Calcium ion level of Ajax and Vlasset varieties have declined from 54% and 16.47% respectively compared to before de-brining process. While Sodium ion level of Ajax and Vlasset varieties have declined from 84.13% and 55.547% respectively compared to before de-brining process. This may be due to the breakdown of cell permeability, variation of surface (peel) characters of varieties. It may be due to higher concentrated ion levels of Ajax which are bounded to the peel area or etc.

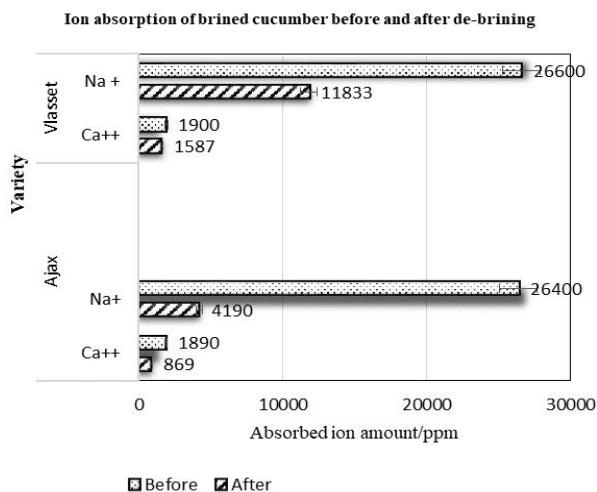


Fig. 4: Ion concentration of brined cucumber before and after de-brining (6 month period) up to 2% salinity.

3.3 Uronic acid content

Under this study UA content in both gherkin varieties were conducted because the amount of UA is related to the cell wall component pectin. UA content can be determined after acid hydrolysis of sample and reacting with Carbozol. Corresponding concentrations can be directly measured by using spectrophotometer. Irrespective to the variety uronic acid content continuously decreased up to 3 months (Fig.5). These results are coincided with firmness variation of 3 month and 6 month in mesocarp tissues of both varieties. It was suggested that the resistance of plant tissues high in Calcium to breakdown by fungal pathogens is due to calcium pectate complex formed [8]. From 3 month to 4 month UA content was increased in both varieties and in

Ajax this increment was continued up to 5 months and gradually decreased.

Irrespective to the time Vlasset was noted to have higher UA content than Ajax. D-galacturonic acid determines the pectin content present in the sample. Even though proportion of total dietary fibre contributed by vegetable is less than legumes it has higher soluble fraction. Pectin is basically water soluble, the extent of solubility depends on the degree of esterification of galacto uronic acid and makeup of the side chain [9]. Therefore pectin can find not only soluble fraction but also insoluble fraction of dietary fibre.

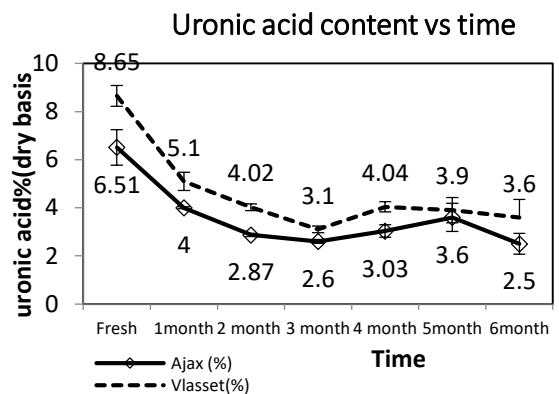


Fig.5: UA percentage of two varieties within fermenting time as dry matter basis

3.4 Moisture variation

Fig. 6 shows the change of moisture content of two varieties during fermentation period. Irrespective to the varieties initial moisture content has continuously declined up to 2 months and after it changes within 84 to 87 % moisture range with an unpredictable nature. Table 1 shows the moisture loss as a percentage of moisture in initial fresh fruit sample.

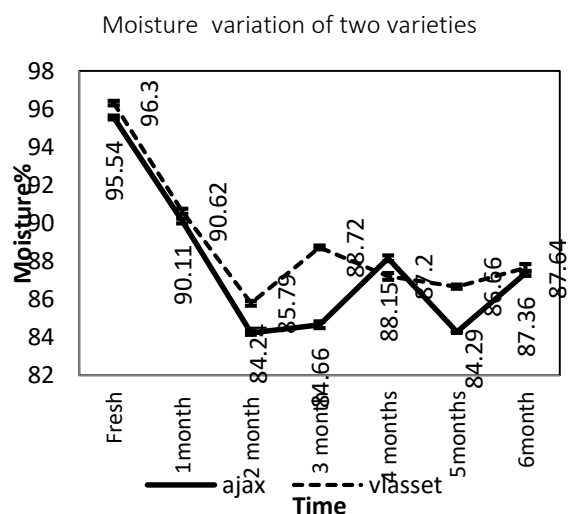


Fig.6: Moisture variation of two varieties within fermentation period.

Table.1: Percentage of moisture loss respect to initial fresh fruit sample

Month	% Moisture loss compared to initial fresh fruit	
	Ajax	Vlasset
1	5.68±0.01	6.43±0.01
2	11.83±0.07	12.52±0.01
3	11.39±0.02	12.09±0.03
4	7.73±0.05	8.46±0.06
5	11.78±0.02	12.47±0.01
6	8.56±0.08	9.28±0.01

In lined with this results Vlasset variety is having higher moisture loss throughout the fermenting period. Hence it may be the reason for increasing its sensory properties than the variety Ajax. Higher moisture loss was noted at the end of the 2nd month for Ajax and Vlasset giving 11.83% and 12.52% respectively.

According to Walter et al [8] fruits immersed in supra-osmotic solution had lost about 14% of its weight after 23hrs. Moreover there is a strong positive correlation of 0.858 between moisture content and UA content of samples (P-Value = 0.000). Moisture levels of food products have a bearing on their dry matter content. The higher the moisture content the lower the dry matter yield [2]. In this study moisture content of Vlasset variety was greater than the Ajax variety during 6 months of fermenting period instead records in 4 months.

IV. CONCLUSION

Although both gherkin varieties are supplied with same brine fermentation conditions, the results obtained from sensory evaluation proves to have a better quality product from the Vlasset gherkin variety. UA and moisture content of Vlasset variety showed higher percentage during the fermentation period than the Ajax variety. Besides there is a positive correlation was between moisture and UA content of gherkin fruits. During the de brining process Vlasset variety remains higher amount of Calcium and Sodium ions with respect to Ajax which may be the reason for its higher texture quality.

REFERENCES

- [1] Khan, Z., Shah, A. H., Gul, R., Majid, A., Khan, U., & Ahmad, H. (2015). Morpho-agronomic characterization of cucumber germplasm for yield and yield associated traits. *International Journal of Agronomy and Agricultural Research*, 1-6, 6(1).
- [2] Uthpala, T., & Marapana, R. (2017). Study on Nutritional Composition on Firmness of Two Gherkin (*Cucumis sativus* L.) Varieties (Ajax & Vlasset) on Brine Fermentation. *American Journal of*

Food Science and Technology (2333-4835), 61-63, 5(2).

- [3] Sareedha, P., Amburani, A., & Samruban, J. (2006). Influence of integrated nutrient management on growth of gherkin (*Cucumis sativus* L.) Cv. Ajax hybrid. *Vegetable Science* 196-197, 33(2).
- [4] Passos, F. V., Felder, R. M., Fleming, H. P., McFeeters, R. F., & Ollis, D. F. (2005). Dynamic model for mass transfer of solutes in cucumber fermentation. *Journal of food engineering*, 297-302, 68(3).
- [5] Etchells, J. L., Bell, T. A., Costilow, R. N., Hood, C. E., & Anderson, T. E. (1973). Influence of temperature and humidity on microbial, enzymatic, and physical changes of stored, pickling cucumbers. *Applied microbiology*, 943-950, 26(6).
- [6] Bitter, T., & Muir, H. M. (1962). A modified uronic acid carbazole reaction. *Analytical biochemistry*, 330-334, 4(4).
- [7] Ennis, D. M., & O'sullivan, J. (1979). Sensory quality of cucumbers before and after brining. *Journal of Food Science*, 847-849, 44(3)
- [8] Walter, W. M., Fleming, H. P., Thompson, R. L., & Fine, T. I. (1996). Effect of sodium chloride concentration on calcium uptake into brined cucumbers. *Journal of food quality*, 161-172, 19(2).
- [9] Potty, V. H. (1996). Physio-chemical [physico-chemical] aspects, physiological functions, nutritional importance and technological significance of dietary fibres: A critical appraisal. *Journal of Food science and Technology*, 1-18, 33(1).

Evaluation of Land Cover changes of Mangroves along Mandovi, West Coast of India using RS and GIS

S. M. Parvez Al-Usmani

D. M.'s College and Research Centre, Assagao, Goa, India

Abstract—Mangroves habitats are highly adoptable halophytes found in intertidal regions of tropical estuaries, are threatened by variety of anthropogenic activities including mining. Many mining sites and loading points are located along the course of Mandovi estuary, West Coast Of India, Goa which sustains mangrove habitats. Mangroves are of a great significance in arresting mining rejects and recycling its constituents and have proved to be a good indicator for detecting and quantifying short-term changes in the coastal zones. Time lapse satellite data suggested changes in land use patterns. The present study showed that mangrove cover along the stretch of Mandovi increased by 116.68% during 1997-2011, a decline of 12.52% from 2001-2006. The increased in mangrove cover could be attributed to government's rehabilitation initiatives and invasion by mangroves on agricultural farms; besides a new mangrove formations in the areas on deposited mudflats between the existing mangrove and open mudflats. Isle within the mid-stream of river was noticed with more proliferation with mangroves due to sediment deposition due to mining rejects and also from spilling of ores during transported. Mangroves have inherent characteristics to withstand pollutions to certain extent due to its robust nature. All these lead to tremendous improvement of mangroves. Mining may not affect mangrove distribution (area, content and canopy cover) to greater extent but its associated biological, hydrological and sediment logical features could get adversely affected. Current findings will serve in understanding the land cover changes of mangrove habitats and in devising effective strategies for their conservation and rehabilitation.

Keywords— Mangroves; RS; mining; land use pattern; sediments; conservation; rehabilitation.

I. INTRODUCTION

Many global coastal zones are currently subjected to stress owing to spur of anthropogenic activities associated with economic consideration, land use, and resource development. India, in particular, is facing increasing stress

as a result of cumulative environmental changes driven by urbanization, industrialization, unsustainable growth, and ever increasing population leading to degradation of coastal zones and ecosystems (Jagtap *et al.*, 2003).

Though, land cover change is a complex environmental indicator from regional to global level, but is an important aspect of resource management and environmental mitigation. Therefore, any unplanned interference can prove detrimental to its inherent value. Trends in vegetation cover dynamics, is an important aspect as it provides information about landscape processes and ecological status (Nagi, 2008). Remote Sensing data having good spectral and spatial resolution are found to be very effective in evaluating and monitoring land use and land cover changes (Lillesand *et al.*, 2004).

Mangroves form an ecological sensitive habitat in the tidal influenced intertidal regions of tropical estuaries and are of a great significance in arresting mining rejects and recycling its constituents, particularly metals (Kathiresan, 2000). Marine vegetation, particularly mangrove, plays a significant role in stabilizing the shores by preventing soil erosion. Besides, mangrove ecosystems inhabit various kinds of fauna of ecological and socio-economical significance (Ajana, 1980; Jagtap, 1985). These habitats have proved to be a good indicator for detecting and quantifying the short-term changes in the coastal zones (Filho *et al.*, 2006).

Many estuaries of Goa namely, Terekhol, Chapora, Mandovi, Zuari, Sal, Talpona, Galgibag and along its coastline (~120 km) sustain mangroves. The Chorao island of Mandovi estuary sustains the best mangrove formation in the State. The major mangrove plantations (~ 80%) in Goa are located along the Mandovi-Zuari-Cumbarjua estuarine complex (Jagtap, 1986). This particular complex is extensively used to transport mining ores from loading points located along the bank of the Mandovi to Mormugoa harbour for shipment to other countries. Mining, a centrepiece of Goa's economy, forms the major source of sediment and oil to the close-by estuary areas. During

recent years, Goa has been undergoing tremendous changes in its land use patterns (Murali *et al.*, 2006). Mangrove ecosystems are important for fish production and serve as nursery, feeding and breeding grounds for many fish and shellfish. The healthy ecosystem of mangroves is vital in context of Goa since many mining sites are located around the catchment areas of many estuaries and also significant number of its population from the coastal areas are in the fisheries occupation.

The objective of this work is to assess the changes in mangrove vegetation along Mandovi estuary during last fourteen years (1997-2011) and to assess its prevailing situation using remote sensing (RS) and Geographical Information Systems (GIS) techniques. This will greatly help in monitoring and management of major mangrove habitats of Goa and also help to evaluate the extent of possible impact of mining on mangrove ecosystem along the course of Mandovi estuary.

II. STUDY AREA

Mandovi River originates in the Barwa Ghat of the Sahyadri hills in Karnataka, flows downstream as Mandovi estuary (Fig. 1) and after traversing a stretch of about 70 km joins the Arabian Sea through the Aguada bay near Panaji. Its width at confluence region is 3.2 km, while at upstream it narrows down to 0.25 km and is fed by monsoon precipitation from the discharges of a catchment area of ~ 1150 sq km (Shetye *et al.*, 2007). The Mandovi basin has an area of 1530 sq km and constitutes about 42% of the land area of the State (Shetye *et al.*, 2007). Its pre- and post-monsoonal flows are also regulated by the semidiurnal tide of 1.0-2.5 m range. Along its course, Mandovi has number of tributaries and islands with narrow bends and shallow depth. It is connected with Zuari estuary through a canal called Cumbarjua canal having a length of 17.0 km and an average width of 0.5 km. It is a natural course connecting the two estuaries.

Status of Mangroves:

Mangrove vegetation in the world has been declining at the assumed rate of 2 to 8% per year or 0.6 % of all inland forests (Spalding, 1997). The total area of mangroves in the year 2000 was 1,37,760 sq km in 118 countries and territories in the tropical and subtropical regions of the world; approximately 75% of world's mangroves are found in just 15 countries and only 6.9% are protected under the existing protected areas network (Giri, *et al.*, 2010). Indonesia has the highest mangrove cover of 22.6% of total global mangrove area, while India accounts for only 2.7%.

The Indian sub-continent harbours about 9700 sq km of mangrove area with major formations occur in the regions of the Indus, Sunderband, and Mahanadi deltas, the Gulf of

Kutchchh, the Andaman and Nicobar group of islands, and a part of the West Coast and the Jaffana Peninsula in the north of Sri Lanka (Jagtap, *et al.*, 2007). Mangrove habitats of India have been facing tremendous threats due to indiscriminate exploitation of mangrove resources for various uses. In recent past, the mangrove vegetation in the world and particularly in Indian subcontinent has deteriorated, mainly due to their poor management (Jagtap, *et al.*, 1993; Khalil, 1999; Jayatissa, *et al.*, 2002). Pollution is major common occurrences that dwindled mangrove area (Jagtap, 1983). According to Government of India report (1981), there was a loss of 40% of mangrove forests during the last century (Kumar, 2000 a). The National Remote Sensing Agency (NRSA, 1983) recorded a decline of 59.18 sq km of mangrove between 1972-1975 and 1980-1982. Owing to these threats, more than 33% of the Indian mangrove areas have been lost within the last 15 years; East Coast has lost an area of about 28%, West Coast lost about 44% and Andaman and Nicobar Islands approximately 32% (Jagtap, 1983; Babukutty and Chacko, 1992; Chakrabarti, 1995; Naskar, *et al.*, 1999; Elizabeth, *et al.*, 2006; De Souza, 2006; Naskar, *et al.*, 2008).

In the context of Goa, as well, there are concerns of the mangrove habitats being put under threat due to anthropogenic activities of various kinds. Mining, being a major industry in Goa is believed to be one of such activities, which have a potential to cause a considerable damage to their existence and in their conservation efforts.

III. METHODOLOGY

Mapping of mangroves along Mandovi estuary was done using cloud free satellite data (February, 2011) of LISS III sensor of IRS-P6 series during the low tide period in order to obtain maximum coastal zone and exposure of vegetation. IRS LISS III provides data in four spectral bands; green, red, Near Infra Red (NIR) and Short Wave Infra Red (SWIR). Density-wise classification details are obtained from LISS III data with the resolution of 23.5 m at 1:25,000 Scale. Geometric correction was performed to improve the geolocation to a root mean square error of half a pixel, an accuracy needed for subsequent change analysis. Each image was normalized for variation in solar angle and earth-sun distance by converting the digital number values to the top of atmosphere reflectance. The images were not enhanced prior to unsupervised classification, and the thermal band (band 6) was excluded. Prior to classification, satellite images were subsetted to include only areas where mangrove forest is likely to occur. Subsetting an area of interest helped to increase overall classification accuracy by reducing the number of land-cover types and spectral

variation. In addition, subsetting was done which helped to substantially reduce data size.

Satellite data of LISS III sensor of IRS-P6 series for the February 2011 with spatial resolution 23.5 m was used for the purpose of this study. Whereas, data of IRS-1C LISS III of year 1997, IRS-1D LISS III of the year 2001 and IRS-P6 LISS III of the year 2006 were used. Scales of various images are depicted in the respective maps. Images of above mentioned years (Fig. 2) available with the National Institute of Oceanography, (CSIR-NIO), Dona Paula, Goa were acquired. They were geo-corrected to match the real world coordinate using an already geo corrected image of LISS III image of 2006 image to image registration procedure using ERDAS 9.1 software. Images were projected to UTM (Universal Transverse Mercator) projection and WGS84 datum. Area of interest was separated using subset method and then subjected to unsupervised classification. From the results obtained, mangrove classes were visually separated and grouped into one common class. Google map was used as reference for confirmation of the classified area. These images were later opened in Arc Map 9.3 environment to spatially assess change detection in mangrove habitat (Figure 6.2). Ground truth information was used to match the classified images to check the accuracy of the result and for the production of final maps.

IV. RESULTS

Satellite imaginaries (Fig. 2) of the four years, namely 1997, 2001, 2006 and 2011 showed various spectral reflectances in the different bands. Mangroves as well as terrestrial vegetation and the agricultural fields showed maximum spectral reflectance to the NIR (Near Infra Red) band. The lowest spectral reflectance was to the red band. The water bodies, barren lands, built-up lands, mud flats and mudflats showed the highest spectral reflectance to the green band and the lowest to the NIR band. The sandy beaches showed similar reflectance in all three bands.

It is found that the mangrove vegetation during the period from 1997 to 2011 has shown tremendous improvement with an increase of 116.68%, particularly from 2006 to 2011 (Table 1). From 1997 to 2001, a growth was noted from 5.563 sq km to 7.783 sq km thereby, registering an increase of 39.90%. However, a decline in the mangrove vegetation was noted between the period from 2001 to 2006 and the mangrove vegetation declined from 7.783 sq km to 6.806 sq km respectively during this period. This period showed negative growth of 12.52% in mangrove plantation. Between the period 2006 and 2011, mangrove vegetation increased to 12.054 sq. km from 6.808 sq. km in 2006, resultantly, showing much more healthy growth of 77.05%.

Thereby, over the period of time from 1997 to 2011, a cumulative growth of 116.68 % was recorded in mangrove vegetation along the Mandovi estuary.

V. DISCUSSION

RS data in combination with GIS offers possibilities for effective and efficient analysis of detailed mangrove communities allowing qualitative and quantitative assessments of inaccessible area and is also able to retrieve, transform and display spatial data (Jensen, 1986; Davis and Quinn, 2002). GIS has been used with RS and field data to map and monitor regional and global environments, including the extent and dynamics of mangrove communities (Chaudhury, 1991; Hussain *et al.*, 1999). Numerous researchers have carried out study on various aspects of mangroves in India (Jagtap, 1985; Banerjee and Gosh, 1998; Singh, 1998; Naskar and Mandal, 1999; Nayak and Bhuguna, 2001; Singh, 2002). To arrive at the clear picture of status of mangroves, Kumar (2000 b) worked extensively on the status of natural regeneration in mangroves of Goa through sample surveys in all the estuaries and compared observations with Untawale *et al.* (1982).

Upper reaches of the bank of Mandovi estuary is amidst of intense mining activities for considerable time. It has > 27 mines in its catchment area and 12 loading points on its bank or on the bank of its tributaries. About two third of mining operations are confined in its catchment area (Pathak *et al.*, 1988) generating a reject of ~ 1500 to 6000 tonnes/day by each mine in this area (Nair, *et al.*, 2003). Ore loading platforms are constructed along the bank of the rivers from where it is loaded on the barges and transported to Mormugoa harbour. Thus, the estuarine bed and associated mangrove of the Mandovi are exposed to an influx of metal affluent from ferromanganese mining (Attri and Kerkar, 2011).

Mangrove cover in Goa was estimated to be around 20 sq km according to one mapping (Untawale, *et al.*, 1982; Jagtap, 1985 and Jagtap, *et al.*, 2003). As per the report of Forest Survey of India (1999), the State had five sq km areas under mangroves, which appears to be an underestimate (Singh, *et al.*, 2004). In the context of the presently study, it is revealed that there is an increase of 116.68% in mangrove vegetation from an area of 5.563 sq km to 12.054 sq km during the span from 1997 to 2011 along the Mandovi estuary. Whereas, from 1997 to 2001, a growth was noted from 5.563 to 7.783 sq km thereby, registering an increase of 39.90%. According to one study (Singh, *et al.*, 2004), an increase in the mangrove vegetation in the important estuaries has been found during 1994 to 2001. During this period, the mangrove habitat increased by

44.90% as a result of increased protection and consequent regeneration. The plantation of mangrove species has been raised to 8.76 sq km during the period 1985 to 1997 by the State Forest department, further mangrove cover increased from 5.93 to 9.08 sq km between 1994 and 2001 along the entire stretch of Mandovi estuary, showing 53.11% increase. As per the study of Nagi (2008), there is an increase of about 36.50% of mangrove cover along the entire stretch of Mandovi estuary. The predominant increase was witnessed in Mandovi, Chapora and Sal estuaries, adding about 5.38 sq km with respect to data of 1973 (Jagtap, 1985) over the span of three decades. In accordance with the National Wetland Atlas (2009), there are 84 numbers of wetlands of mangrove in North Goa District covering about 15.87 sq km. The composition of mangroves species along the bank of the three regions of the study area of Mandovi estuary (GOG, 1983) are: 1) Pilgao (St. # 1): *Sonneratia caseolaris* (70%), *Acanthus illicifolius* and *Aegiceras corniculatum* (20%) and others (10%); 2) Old Goa (St. # 2): *Avicennia officinalis* (30%), *Sonneratia alba* (30%), *Porterasia coarctata* (20%) and others (20%); 3) Verem (St. # 3): *Sonneratia alba* (80%), *Rhizophora mucronata* (10%) and others (10%).

Such habitats are being subjected to a tremendous stress owing to wide range of anthropogenic activities and natural calamities all over the world including Indian sub-continent. In 1976, the Government of India set up the National Mangrove Committee in the Ministry of Environment and Forests to advise the Government on mangrove conservation and development. The need to conduct survey on the extent of existing mangrove areas, identification of selected mangrove areas for conservation, preparation of management plan, promotion of research, adaptation of multidisciplinary approaches involving State Government, Universities, researchers, institutions and local organizations have been recommended (MoEF, 1987). Towards this endeavour, the Goa government declared about 1.78 sq km of the best mangrove area at Chora Island as reserved forest under the Indian Forest Act, 1927 to protect and conserve the mangrove forest. Subsequently, in 1988, this area was declared a bird sanctuary under the Wildlife (Protection) Act, 1972). The Goa State Forest Department initiated afforestation works to restore degraded mangrove areas in 1985 in all the estuaries and by 1997, an area of 8.76 sq km was planted (FSI, 1999 b). In 1988, The Government of Goa formed a State Level Steering Committee to oversee the improvement and conservation of the mangrove forest. In 1990, the State Government set up Multidisciplinary Project Formulation Team to facilitate the preparation of a Comprehensive Action Plan for the development of the mangrove ecosystem. In the same year,

the government decided that no construction or development work would be allowed in the area earmarked by the Forest Department for mangrove conservation and declared that mangrove species should not be felled for a period of ten years. A five-year Mangrove Management Plan for Goa was prepared in 1991-1992 and implemented with financial assistance from the Government of India and one sq km of mangroves were planted each year as planned. The increase in the mangrove habitat in the study region can also be attributed to conservation and restoration mechanism initiated by the forest department of the State government and their well organized awareness programmes. As per the latest released India State of Forest report (2011) by government of Goa, the State has 22 sq km areas under mangrove cover and there has been increase in mangrove habitat in North Goa by 5 sq km over last two years.

Ground truth observations revealed that mudflats due to the mining operations in the catchment region of Mandovi estuary provide a suitable substratum for the mangrove vegetation for its growth (Plate 1 a). Besides the increase in mangrove habitat could also be attributed to the reduction in agriculture activity in the area adjacent to mangrove plantation which is infested by mangrove (Plate 1 b). Further, Ground truth observations revealed that new mangrove formations have taken place, particularly in the area on the recently deposited mudflats between the existing mangrove and open mudflats along the waterways. More recently, an expansion of recently developed isle (Plate 1 c) was noticed in the mid stream of Mandovi estuary at Ribandar, close to station # 2, perhaps due to deposition of heavy sediments. The primary reason can be attributed to the flow of mining rejects from mining operations located along the bank of Mandovi estuary on its upper region. Spilling of ores from the barges while being transported from loading points situated either along its bank or its tributaries to Mormugoa harbour is also a contributing factor. Such types of new isles provide a good substratum for the growth of mangroves. This has proved to be blessing in disguise for the profusion of mangroves. Plantation efforts of the State forest department also assisted in a major way for the increase of mangrove cover. All these could be possible reasons of tremendous improvement of mangrove vegetation along the Mandovi estuary. Here, one side there is a heavy deposition of sediments in the Mandovi river and gets affected to such an extent that a small island of sort being formed whereas, on the other side, the sediments deposition acts as a good substratum for the growth of mangroves. Therefore, to conclude that there is no effect of mining operations on marine environment of Mandovi river on the basis of tremendous growth of

mangroves in Mandovi river and along its bank would be erroneous and far from facts. The effects of mining pollutants on aquatic ecosystem of Mandovi estuary needs to be judged from the study of various marine hydrological parameters.

One estimate suggests that on an average about 25 to 30 million tonnes of mining rejects per year is generated in the regions around Mandovi and Zuari estuaries. Along the basin of Mandovi estuary itself, an average reject amounting to 1500-6000 tonnes/day/mine is generated and about 27 major mines are located in the area (Nair, *et al.*, 2003). Luxuriant growth of mangroves particularly in the Mandovi is attributed to favourable ecological conditions and substratum deposition (Jagtap, 1985). However, a study by Jagtap *et al.*, (2007) revealed that an excess of sediments to a tune of > 9-12 cm thick per year due to natural and human activities has potential to threaten mangroves by way of clogging and ultimately may result in their deaths besides retarding new formations. Therefore, this parameter needs to be investigated regularly as a part of monitoring of mining to understand the impact on the mangrove habitats.

Nevertheless, this work throws a light on healthy situation with regard to mangrove ecosystem and its potential for further growth and its conservation along the bank of the Mandovi estuary provided the various measures initiated by the government are continued further and if possible, strengthen the same. This study gives an updated geospatial database of these natural resources, which is the pre-requisite for the management and conservation planning.

Hence, to draw a conclusion that the mining pollutants do not exhibit visible impact on mangrove vegetation along the bank of Mandovi estuary is difficult to conclude, as there are multiple reasons for its growth as discussed above. However, various initiatives and mitigation steps taken by the government towards the conservation and protection of mangrove vegetation did help in yielding the desired result including steps taken to prevent the pollutants from mining operations reaching mangrove ecosystem.

Summary and Conclusion:

The anthropogenic activities worldwide along with natural disturbances in the past have yielded varied results. Mining was the backbone of Goa's economy till recent past; however, illegal mining in the past decade has caused severe damage to the ecology, hydrology and agriculture. This study was aimed to understand possible effects of mining on mangrove ecosystem along the course of Mandovi estuary of Goa. The present study reveals that there was an overall increase of 116.68% in mangrove cover from an area of 5.563 sq km. to 12.054 sq km during the span from 1997 to 2011 along the Mandovi estuary. However, a decline in the mangrove vegetation was

observed from 2001 to 2006 registering negative growth of 12.52% and the mangrove vegetation declined from 7.783 sq km to 6.806 sq km, further from 1997 to 2001, registered an increase of 39.90%. To conclude that mining activities do not have any tangible effect on mangrove ecosystem along the bank of Mandovi estuary is difficult to arrive at due to increase of its cover. It is observed that the proliferation of mangroves is greatly helped by the aforestration efforts of the State forest department's initiatives. Further, mudflats due to mining operations in the Mandovi estuary provides a substratum for the mangrove vegetation for its growth, besides the increase in mangrove habitat could be attributed to the reduction in agriculture activity in the area adjacent to mangrove plantation, which is infested by mangrove. Ground Truth Observations revealed that new mangrove formations have taken place, particularly in the area on the recently deposited mudflats between the existing mangrove and open mudflats along the waterways. Besides, of late formed isle within the mid stream of Mandovi river, close to St. # 2, was noticed with more proliferation with mangroves due to the deposition of sediments of mining rejects from mining operations and also spilling of ores from the barges while being transported from loading points to Mormugoa harbour. Besides, mangroves have inherent characteristics to withstand pollutions to certain extent due to its robust nature. All these could be the possible reasons of tremendous improvement of mangrove vegetation along the Mandovi estuary. As such, mining activities may not affect mangrove distribution (area, content and canopy cover) to greater extent but, its associated biological, hydrological and sedimentological features could get adversely affected. The present work will form a baseline data on mangrove habitats to monitor the changes in near future.

ACKNOWLEDGEMENT

The author is thankful to the Principal, D. M.'s College and Research Centre, Assagao, Dr. D. B. Arolkar for his encouragement. I am also thankful to my research supervisor, Dr. T. G. Jagtap and Prof. D. N. Patil for their suggestions in improving the manuscript.

REFERENCES

- [1] Ajana, A. M.1980. Fishery of the Mangrove Oyster, *Crassostrea gasar* Adanson (1757), in the Lagos Area, Nigeria; *Aquaculture*; **21**: 120-137.
- [2] Attri, K. and Kerkar, S. 2011. Seasonal Assessment of heavy metal pollution in the tropical mangrove sediment (Goa, India). *Jour. Biotechnology*, **3**: 9-15.

- [3] Babukutty Y. and Chacko J. 1992. Trace Metals in an Estuarine Bivalve from the Southwest Coast of India, *Ambio*, **21(4)**: 292-296.
- [4] Banerjee, L. K. and Gosh, D. 1998. Species diversity and distribution of mangroves in India, An Anthology of Indian Mangroves. *ENVIS*, **2(1)**: 22-24.
- [5] Chakrabarti, P. 1995. Coastal Zone Management in Hooghly Estuary – An Operational Approach, *Indian Journal of Earth Sciences*, **22(3)**: 125-134.
- [6] Chaudhury, M. U. 1991. Monitoring the ecological status of mangrove forests of Sunderbans in Bangladesh- classification and change detection with Landsat and Spot. In: Murai, S. (ed.): 286 – 291.
- [7] Davis, B. E. and Quinn, Norman; online <http://www.gisdevelopment.net/acs/2002/czm/088.pdf>.
- [8] De Souza, R. J. S. 2006. Remote Sensing and GIS Tools for Integrated Coastal Zone Management – Goa State; A Ph.D. Thesis Submitted to Goa University. Resources, Govt. of Goa and Central Ground Water Board, Bangalore: 6-
- [9] FSI. 1999. State of Forest Report 1999, Summary, Forest Survey of India, Ministry of Environment and Forest, Government of India, Dehradun: 4.
- [10] Elizabeth McLeod and Rodney V. Salm. 2006. Managing Mangroves for Resilience to Climate Change. The World Conservation Union (IUCN), Gland Switzerland, E. V. M. 2003. Safe upper levels for vitamins and minerals, London: food standard agency.
- [11] Filho, P. M. W.; Martins, E. S. F. and da costa, F. R. 2006. Using Mangroves as a Geological Indicator of Coastal Changes in the Braganca Macrotidal Flat, Brazilian Amazon: A Remote Sensing Data Approach; *Ocean & Coastal Management*: **49**: 462-475.
- [12] Giri, C.; Ochieng, E.; Tieszen, L. L.; Zhu, Z.; Singh, A.; Loveland, T.; Masek, J. and Duke, N. 2010. Status and distribution of mangrove forests of the world using earth observation satellite data, *Global Ecology and Biogeography*: 1-6.
- [13] GOG. 1983. Mangroves of Goa. Dept. of Forest, Government of Goa: 13-17.
- [14] GOI. 1981. Eco-development Plan for Goa (Report of Task Force on coastal area planning), Government of India: 42.
- [15] Hussain, Y.; Zuhair, H. and Weir, M. 1999. Monitoring mangrove forests using remote sensing and GIS. Asian Conference on Remote Sensing, Hong Kong. Poster Session 5, Online at: <http://www.gisdevelopment.net/aars/acs/1999/ps5/ps512pf.htm>.
- [16] Jagtap T. G., 1983, Metal Distribution in Halophila beccarii (Aschers) and Surrounding Environment along the Central West Coast of India; *Mahasagar Bulletin of the National Institute of Oceanography*, **16(4)**: 429-434.
- [17] Jagtap, T. G., 1985. Ecological studies in relation to the mangrove environment along the Goa coast, India. A Ph.D. Thesis submitted to Shivaji University, Kolhapur.
- [18] Jagtap, T. G., 1986. The mangroves; *Proceedings of national symp. on Biol. utilization and conservation of mangroves*, November 1985: 183-195.
- [19] Jagtap, T. G.; Chavan, V. and Untawale, A. G. 1993. Mangrove ecosystems of India: a need for protection. Royal Academy of Sciences, *Ambio*. **22**: 252-254.
- [20] Jagtap, T. G.; Desai, K. and Rodrique R. 2003. Coastal Vegetation: Pattern in a Tourism region; [In Coastal tourism, Environment and Sustainable Local Development (Eds.) Noronha, L. et al.,]; New Delhi; 221-150.
- [21] Jagtap, T. G., and Nagle, Vinod L. 2007. Response and Adaptability of Mangroves Habitants from the Indian Subcontinent to Changing Climate, Royal Academy of Sciences, *Ambio* Vol. **36**, No. **4**: 328-334.
- [22] Jensen, J. R., 1986. Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall, Englewoods Cliff, NJ.
- [23] Jayatissa, L. P.; Dandough-Guegas, F. and Koedam, N. 2002. A review of the floral composition and distribution of mangroves in Sri Lanka. *Bot. J. Linn. Soc.* **138**: 29-43.
- [24] Kathiresan, K., 2000. A review of studies on Pichavaram mangrove, south east India. *Hydrobiologia*, **430**: 185-205.
- [25] Khalil, S. 1999. Economic valuation of the mangrove ecosystem along the Karachi coastal areas. In: The Economic value of the Environment: Case of South Asia. Hecht, E. (ed) IUCN publ. online <http://www.incnus.org/publications.html>.
- [26] Kumar, R. 2000 (a). Distribution of mangroves in Goa, *Indian Journal of Forestry*, **23(4)**: 360-365.
- [27] Kumar, R. 2000 (b). Status of natural regeneration in mangroves of Goa, *Indian Journal of Forestry*, **23(3)**: 342-348.
- [28] Lillesand, T. M., Keifer, R. W. and Chipman, J. W. 2004. Remote Sensing and Image Interpretation; 5th edition; John Wiley and Sons (Asia), Private Ltd., Singapore: 763.
- [29] MoEF. 1987. Government of India. Mangroves in India – Status Report, Ministry of Environment Forest, New Delhi: 52-55.

- [30] Murali, R. M.; Vethamony, P.; Saran, A. K. and Jayakumar, S. 2006. Change Detection Studies in Coastal Zone Features of Goa, India by Remote Sensing; *Current Science*; **91**(6): 816-820.
- [31] Nagi Hisham, M. H. 2008. Environmental Studies on Mangrove Cover in Goa and its Resident *Crassostrea* population; A Ph. D. Thesis submitted to Goa University, Goa.
- [32] Nair, M.; Joseph, T.; Balachandran K. K. and Nair, K. C. 2003. Arsenic Enrichment in Estuarine Sediments- Impact of Iron and Manganese Mining 2003 (Int. symp. On Fate of arsenic in the environment, Dhaka Eds. by Ahmed, M. F.; Ali, M. A.; Adeel, Z. L.): 57-67.
- [33] Naskar, K. R. and R. N., Mandal. 1999. Ecology and Biodiversity of Indian Mangroves, Daya Publishing House, New Delhi, India.
- [34] Naskar, K. R. and Mandal, R. N. 2008. Diversity and classification of Indian mangroves: a review. *Tropical Ecology*, ISSN 0564-329549(2): 131-146.
- [35] Naskar, K. R. and Mandal, R. N. 1999. Ecology and Biodiversity of Indian Mangroves. Milton Book Company, Dehradun: 3-34.
- [36] Nayak, S. and Bhuguna, A. 2001. Application of remote sensing data to monitor mangroves and other coastal vegetation of India, *Indian J. of Marine Sciences*, Vol. **30** (4): 195-213.
- [37] NRSA. 1983. Mapping of forest cover in India from satellite imagery (1972-75 and 1980-82), Summary Report, National Remote Sensing Agency, Hyderabad: 5-6.
- [38] Pathak, M. C.; Kotnala, K. L. and Prabakaran, N. 1988. Effect of bridge piers on tropical estuary in Goa, *India J. Coast Res.* **58**: 229-244.
- [39] Shetye, S. R.; Suresh, I. and Sundar, D. 2007. Tide and sea level variability. In *The Mandovi and Zuari estuaries*, edited by S. R. Shetye, M. Dileep Kumar and D. Shankar, National Institute of Oceanography: 29-38.
- [40] Shetye, S. R.; Shankar, D.; Neetu, S.; Suprit, K.; Michael, G. S. and Chandramohan, P. 2007. The environment that conditions the Mandovi and Zuari estuaries. In: *The Mandovi and Zuari estuaries*. Editors, S. R. Shetye, M. Dileep Kumar and D. Shankar, Special publication of NIO: 3-28.
- [41] Singh, I. G.; Kushwaha, S. P. S.; Ashutosh S. and Singh R. K. 2004. *Journal of the Indian Society of Remote Sensing*, Vol. **32**, No. **2**: 167-174.
- [42] Singh, R. K. 2002. Mangroves of Goa. Goa Forest Department, Research and Utilization Division publication, Aquem, Margao, Goa: 1-10.
- [43] Singh, S. K. 1998. Mangroves of Tamil Nadu, *Annals of Forestry*, Dehradun, **6** (1): 44-46.
- [44] Spalding, M. D. 1997. The global distribution of status of mangrove ecosystems in : Intercoast Network International Newsletter of Coastal Management), Mangrove Edition [Published Quaterly by the Coastal Resources Management Project of the University of Rhode Island's Resources Centre and the U. S. Agency for International Development (USAID), Narragansett, Rhode Island, USA]: 20-21.
- [45] Untawale, A. G.; Wafar, S. and Jagtap, T. G. 1982. Application of Remote Sensing Techniques to Study the Distribution of Mangroves along the Estuaries of Goa; [In *Wetlands: Ecology and Management* (Proceedings of the First International Wetlands Conference), New Delhi, 10-17 Sep. 1980; (Eds.); Gopal, B.; Turner, R. E.; Wetzel, R. G. and Whigham, D. F.]; National Institute of Ecology and International Scientific Publications.

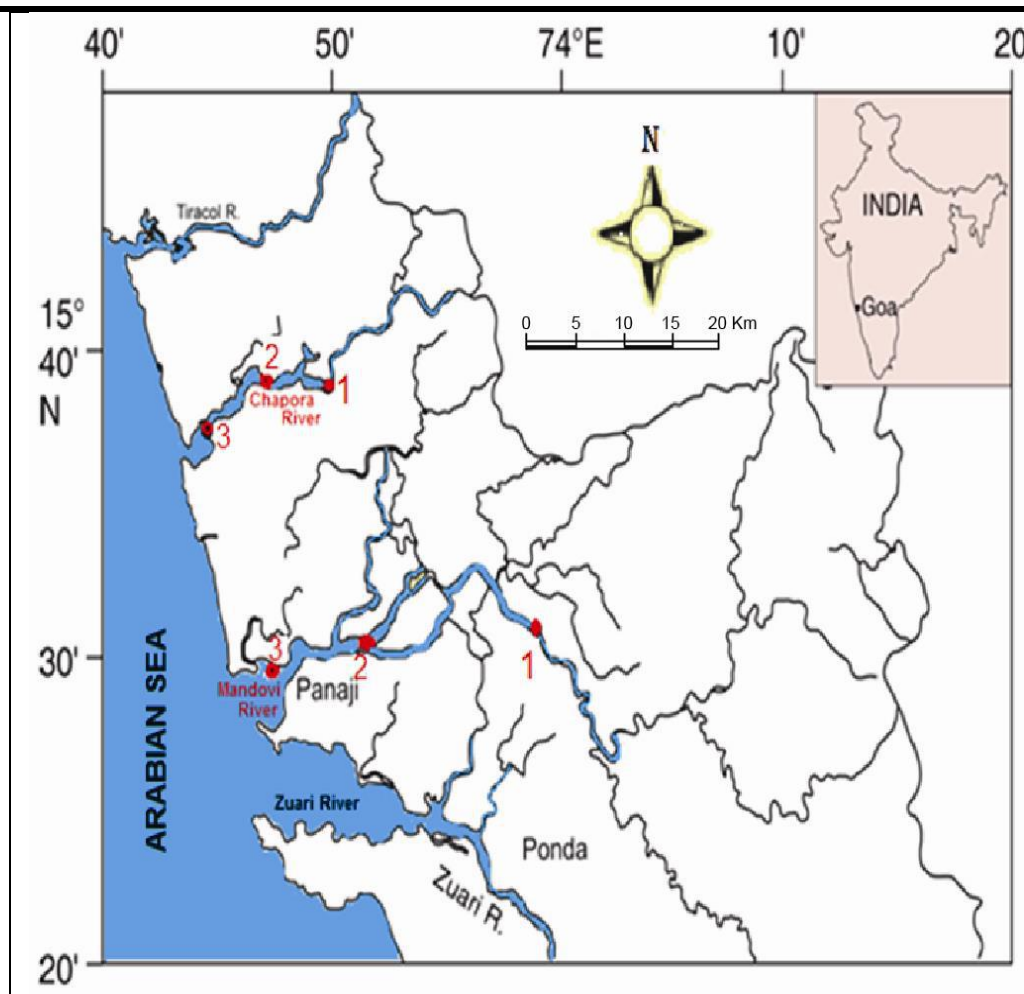


Fig.1: Study area-Mandovi estuary

Table.1: Change detection of mangroves (sq km) along Mandovi estuary

Estuary	Total Area	Mangrove extent in				% change (1997-2011)
		1997	2001	2006	2011	
Mandovi	348.480	5.563	7.783	6.808	12.054	116.680

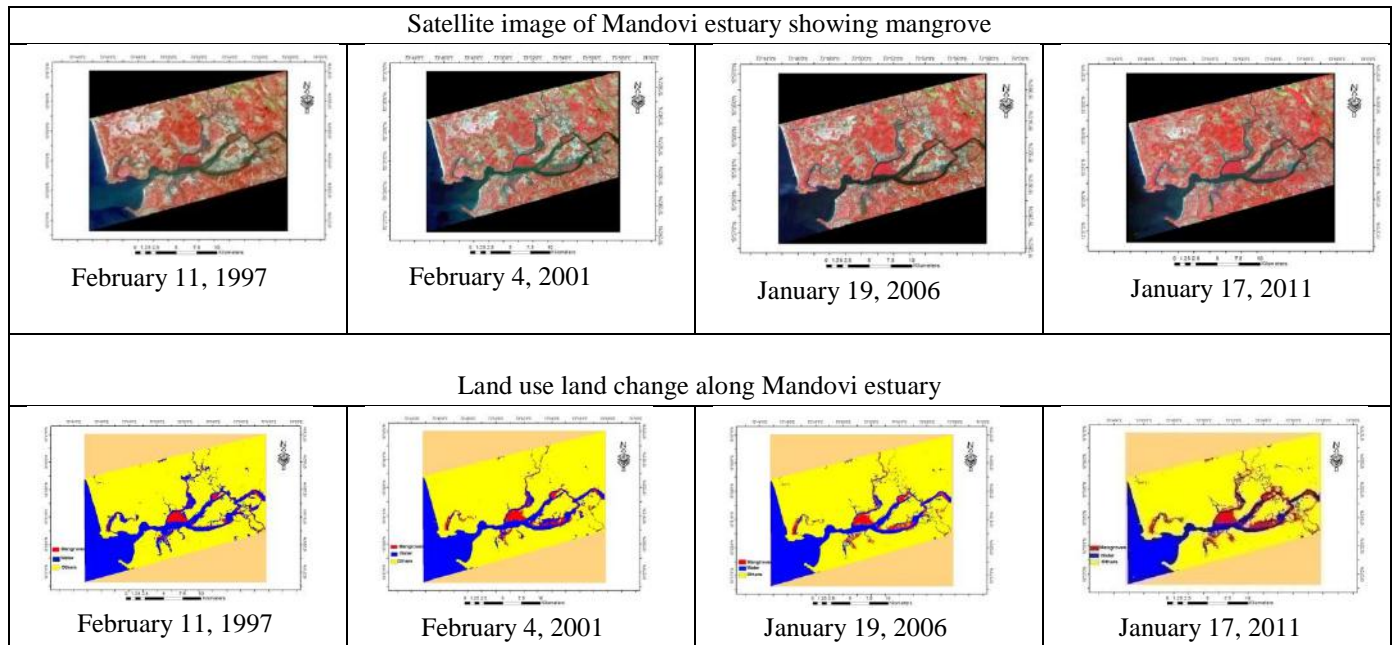


Fig.2: Satellite images and land use land change of study area-Mandovi estuary during different years

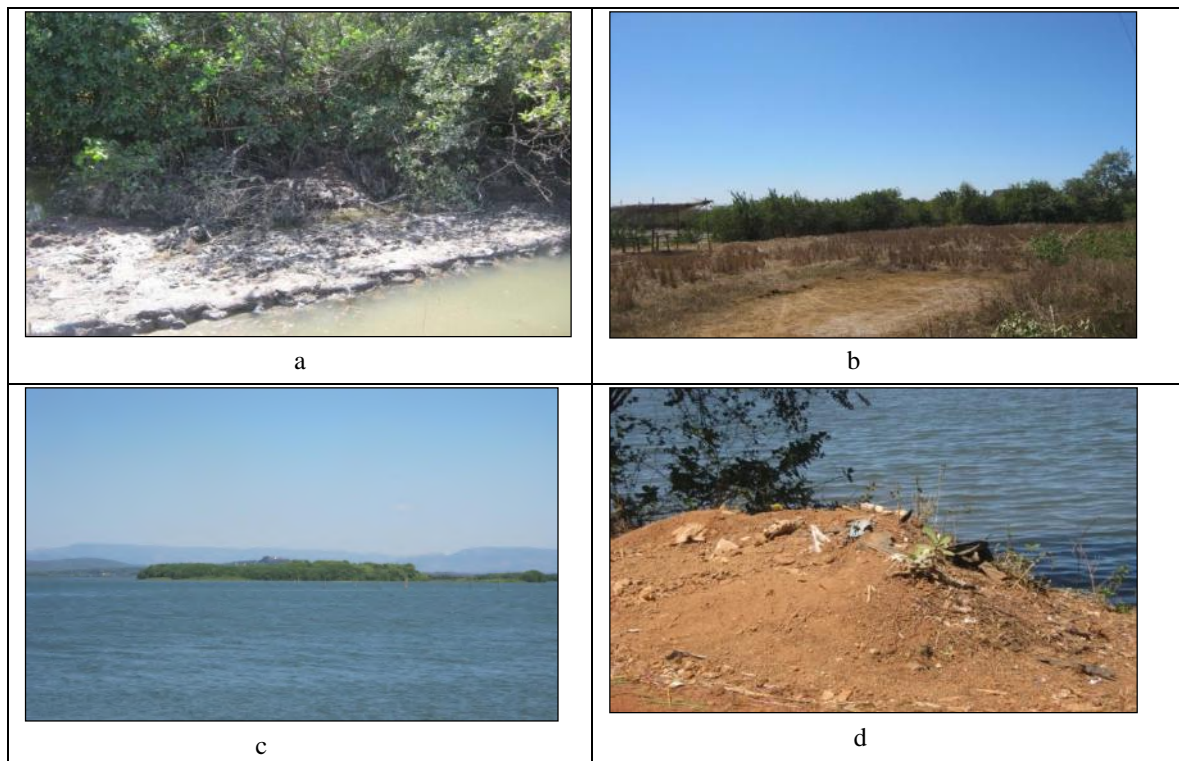


Plate 1: a. Mudflats providing substratum for the growth of mangroves, b. An abandoned agriculture field adjoining Mandovi estuary, c. A small island formed in the middle of Mandovi estuary, d. A freshly deposited reject along the bank of estuary

The Effects of Nitrogen Fertilization and Deficit Irrigation Practices on Tomato Growth and Chlorophyll Concentration

Meryem Kuzucu

Kilis 7 Aralık University Technical Science Vocational School, Department of Plant and Animal Production, Horticulture Programme.79000 Kilis, Turkey.

Abstract—Irrigation and fertilization are absolutely necessary in order to increase productivity in agricultural production. Water is the most important source of life on the earth. All living things need absolute water so that they can continue plants life. The fact that the nutrients present in the soil can complete the natural cycle is completely dependent on the water cycle. Irrigation is the amount and time required for the root zone of the plant in soil, which is needed by the plant and cannot enough by precipitation in agriculture.

This study was carried out in the farmer's greenhouse conditions between 2004-2005 years. Three different doses of nitrogen (N₁:75 ppm N, N₂:150 ppm N, N₃:225 ppm N) were applied to the tomato plant grown in the greenhouse. S₁:100% full irrigation, S₂:50% irrigation according to pot capacity. The study was based on a trial randomized block design with 3 replications. At the end of 2 years, the results gave us; the best plant growth was measured with N₃S₁ an average height by 128 cm. The worst plant height was obtained from N₁S₂ an average height by 88 cm. Plant body diameter has been found between 0,82cm and 0,54cm. Irrigation practices were more effective to total chlorophyll content than the fertilization practices. As a result, the deficit irrigation has also developed as well as full irrigation. Deficit irrigation and nitrogen fertilizer increased crop yield in arid regions. It is suggested that irrigation water can be reduced and adequate fertilization can be increased crop production in arid regions.

Keywords— Nitrogen Fertilization, Deficit Irrigation, Tomato, Chlorophyll Concentration.

I. INTRODUCTION

Plants need water to grown in agriculture production. The process of photosynthesis uses water to make the building blocks of life for plants. Agriculture is the growing of plants for humans and animals. In crop agriculture, water is an important climatic factor. It affects or determines plant growth and development. It is availability, or scarcity, can mean a successful harvest, or diminution in

yield, or total failure. Irrigation typically doubles farm yields and the number of crops grown in one year is increased from 1 to 2. Precipitation mainly rainfall, liquid water is made available to plants as surface water, soil moisture, or groundwater. One of the primary ways in which humans use water is by planting important crops in places where they can capture natural rainfall as rain-fed agriculture. Some forms of agriculture, such as intensive rice and corn production, can be practiced only in rainy climates. Such agricultural forms are much more productive than others, such as cattle and sheep herding, which are usually relegated to semiarid climates. One of the primary reasons rain-dependent forms of agriculture are more productive than dry-land forms is that they have sufficient water to allow plants to grow to their maximum potential. Therefore, the most agriculturally productive regions of the world are all regions where natural rainfall is sufficient to allow rain-fed agriculture. Because agricultural crops are so dependent on water, purposely adding water, beyond what naturally falls as rain is widely practiced to increase agricultural production. This critical practice is known as irrigation. In the twentieth century, the practice of irrigation was greatly increased to provide food for the world's growing population. The main purpose of the irrigation is to reduce the minimum need of the plant. Water shortage may not always result in low productivity (Turner 1990). If irrigation water increases in given to the plant increases the vegetative growth but cannot increase the generative yield (Alvarez-Reyna 1991).

In every irrigated region, water supplies are a limitation on further expansion of irrigated agriculture. In many regions, renewable supplies have already been exceeded, resulting in falling groundwater levels and greatly reduced river flow. In some regions, the depletion of water resources due to irrigation has reached crisis proportions. These are all examples of the depletion of regional water resources by irrigated agriculture. Irrigation is generally defined as the provision of water, which is necessary for plant development but cannot be met by

natural means, to the soil without causing environmental problems. The amount of water to be given; irrigation time and number, soil structure, climatic conditions, slope of land, plant variety and age. (Kanber,1997). Water scarcity affects plants by reducing chlorophyll formation. This effect is due to the reduced ability of the stomata to diffuse and to chloroplasts and other cell organelles it arises. Decrease in the amount of leaf water accelerates the decomposition of chlorophyll, such as slowing down the synthesis rate.

Most arid countries also Turkey has need deficit irrigation in agricultural production. In this study were applied 3 doses of nitrogen fertilizer and 2 doses irrigation tomato plants grown in the greenhouse. At the end of 2 years, deficit irrigation treatments also showed good growth and development. There is an indirect effect on photosynthesis of partial water shortage due to imbalance caused by soil and ecological conditions at any time during the development of plant-water relationships.

II. MATERIALS AND METHODS

This study has taken place in the province of Şanlıurfa Harran Region, latitude 37 ° 07 '30" North, longitude 39 ° 15' 00" East and 530 meters above sea level and is located in the Harran Plain in Turkey. The average rainfall is being carried out the study received a total of 322 mm in the study area (Anonim, 2006). This shows that, for the deficit irrigation research is needed in this area. This study has been carried out in the farmer's greenhouse. This research was set up to randomized block design with 3 replication. Domestic tomato seeds are used. Each of 5-liter pots 1:1 ratios were filled with soil material and sand. 1 plant per pot was grown well developed. Irrigation was determined as 100% and 50% according to field capacity. The fertilization was determined 75 ppm N, 150 ppm N, and 225 ppm N. Ammonium sulfate (21%N) was used as the nitrogen source. Irrigation water is determined according to the pot capacity. The pots were weighed every three days and the reduced water was completed according to the pot capacity. After 10 weeks from sowing, all measurements were made and the plants were harvested. These measurements continued for two years.

Plant height was measured. Chlorophyll determination has been made. It was calculated by these formulas. Chlorophyll a: $11.64x (A663) - 2.16x (A645)$,

Chlorophyll b: $20.97x (A645) - 3.94x (A663)$ (Strain and Svec).

Tarist statistical program was used. It is grouped according to LSD test (Açıközve ark. 1994).

III. RESULTS AND DISCUSSION

In this study carried out as a pot experiment, the tomato plant was applied deficit irrigation and different doses nitrogen fertilizer. As a result of this study, it was concluded nitrogen fertilization can be done together with the deficit irrigation. Such agricultural production can be applied in arid and semi-arid regions. We were applied % 100 irrigation and 225 ppm N fertilizer was the best plant height was average 118 cm from N₃S₁. The minimum height was determined average 88cm with deficit irrigation and 75 ppm N application (Table 1).

Table.1: Average Plant Height (cm) under Different Treatments

Fertilizer	Irrigation I (%100)	Irrigation II (%50)
N ₁ (75 ppm N)	104	88
N ₂ (150 ppm N)	110	103
N ₃ (225 ppm N)	118	108

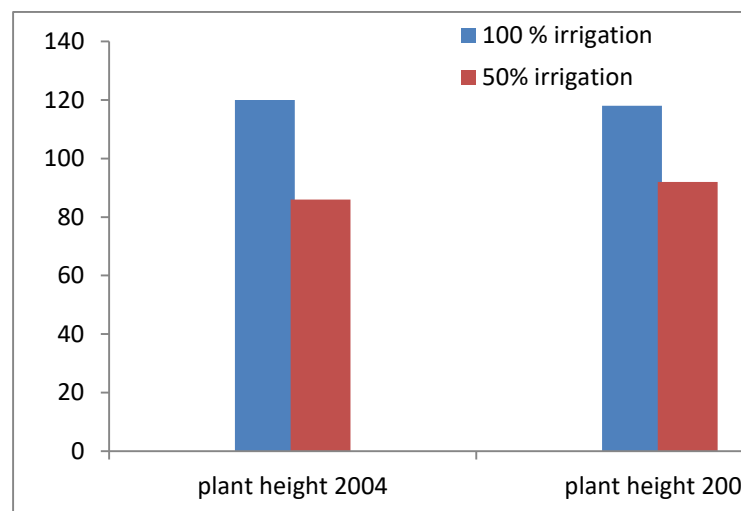


Fig.1: Irrigation - Plant Height Relation

Plant height was determined mean 120cm by 100% irrigation, while 86cm by 50% irrigation in 2004. Irrigation supported plant development. Plant height increased with irrigation water.

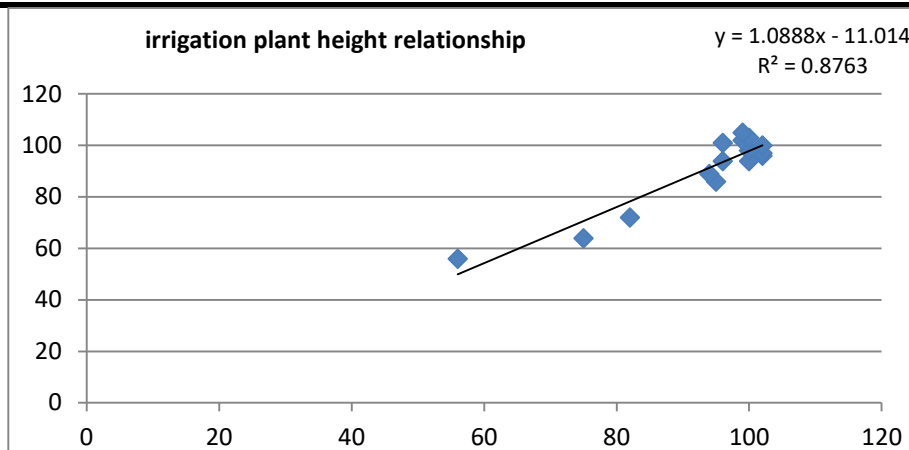


Fig.2: Irrigation and Plant Height Relation

The effects of doses of N2 and N3 on plant height were similar (Fig 3). Intermediate dose N in the study supported the growth and development of the plant. This result reveals that the plant will reach a sufficient level, even if the fertilizer is not used in excess.

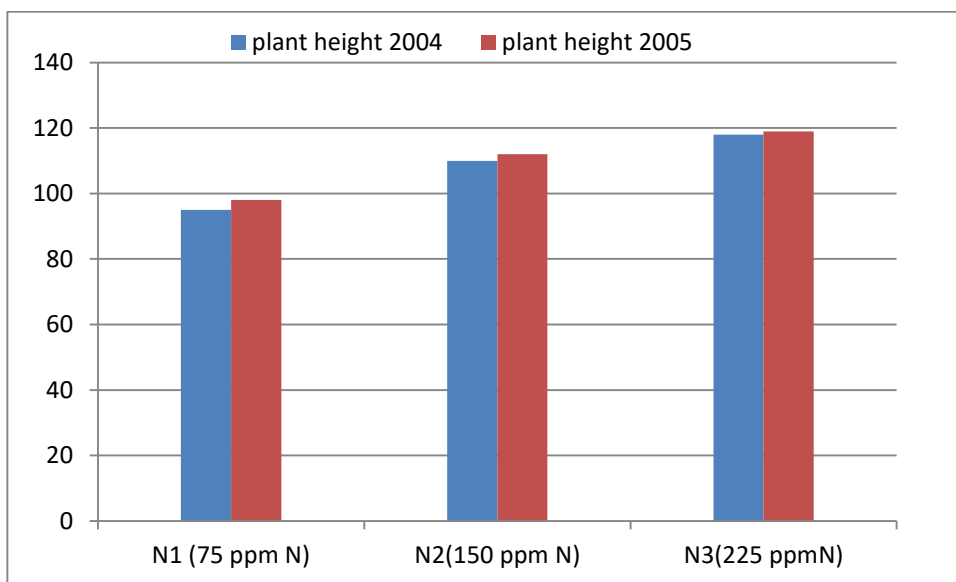


Fig.3: Fertilization Plant Height Relation

Plant body diameters were determined along two research year. Fertilization was found to be more effective on plant stem diameter growth (Table2).

Table.2: Average Plant Body Diameter (cm)

Fertilizer	Irrigation I (% 100)	Irrigation II (% 50)
N ₁ (75 ppm N)	0,56c	0,54c
N ₂ (150 ppm N)	0,65b	0,67b
N ₃ (225 ppm N)	0,82a	0,78a
LSD(% 5):0.912		

*There was no difference between the averages in the same letter group

The highest amount of chlorophyll was found in 25 mMNaCl and it was found that this value decreased with increasing amount of salt (Acaret al.2011). Iron deficiency reduces the amount of chlorophyll a and b. Most researchers have reported plant-feeding chlorophyll association (KacarveKatkat, 2009).Leaf chlorophyll-a,

chlorophyll-b and total chlorophyll levels were reduced by restriction of the water given to the plants (Kaynaş and Eriş 1998).the values of leaf chlorophyll content were found higher in plants irrigated at frequent intervals, and the decrease in leaf chlorophyll content decreased as the irrigation intervals increased.

Table.3: Mean Total Chlorophyll Content of Leaf (mg/ml)

Fertilizer	Irrigation I (%100)	Irrigation II (%50)
N ₁ (75 ppm N)	2.12c	1.14d
N ₂ (150 ppm N)	3.64b	1.63d
N ₃ (225 ppmN)	4.12a	2.37c
LSD(%5):1.05		

*There was no difference between the averages in the same letter group

Some researchers have reported that fertilization practices increase chlorophyll concentration in plants (Abdalla and Abdelwahab 1995), (Sangakkara et al. 1996), (Güneş and Aktaş 2004). Iron is not involved in the chlorophyll structure, but there is a close relationship between the iron nutrition of the plant and chlorophyll content. There is a close relationship between adequate and inadequate iron feeding and chlorophyll coverage (Aktaş, 1994).

IV. CONCLUSIONS

N fertilization applied to tomato plants at different doses, results in full irrigation and partial irrigation applications higher plant height, best plant body diameter and highest chlorophyll formation has determined from 225ppmN and full irrigation treatments. As the amount of irrigation decreased, the plant height decreased. As plant development slowed, the trunk diameter decreased. As the amount of water given decreases, the formation of chlorophyll decreases. In areas with water scarcity and semi-arid, irrigation can be carried out to support the development of the plant and the chlorophyll formation with N fertilization as needed.

REFERENCES

- [1] Abdalla, M.H. and Abdelwahab, M.H. 1995. Response of Nitrogen fixation, nodule activities and growth of potassium supply in water stressed broadbean. J. Plant Nutrition. 18:1391-1402.
- [2] Açıkgöz, N., Akaş M.E., Moghaddam A.F. and Özcan K., 1994. TARİST.PC'leri için bir agro-istatistik programı. Tarla Bitkileri Kongresi, 25-29 Nisan, İzmir.
- [3] Acar, R., Yorgancılar, M., Atalay E., Yaman, C. 2011. Farklı Tuz Uygulamalarının Bezelyede (*Pisum sativum* L.) Bağlı Su İçeriği, Klorofil ve Bitki Gelişimine Etkisi Selçuk Tarım ve Gıda Bilimleri Dergisi 25 (3): (2011) 42-46 ISSN:1309-0550
- [4] Alvarez-Reyna, V., De P. 1991. Growth and Development of three Cotton Cultivars of Contrasting Plant Types Differentially Irrigated Through a Drip Irrigation System. Dissertation Abstracts International B., Science and Engineering, 51(9).
- [5] Aktaş M, 1994. Bitki besleme ve toprak verimliliği (2. baskı). Ankara Üniversitesi Ziraat Fakültesi Yayın No: 1361, Ankara.
- [6] Anonym 2006. Harran Plain Soil And Climatic Properties. Soil and water resources research institute climate data. 2006.
- [7] Güneş, M. and Aktaş, M. 2005. Effects of Potassium application on the Growth and Yield of Young Corn Plants. . 2008. Harran Üniversitesi Ziraat Fakültesi Dergisi 2008, 12(2): 33-36. Şanlıurfa.
- [8] Kacar B, Katkat V, 2009. Bitki Besleme. Nobel yayınları, Ankara, 659 s.
- [9] Kanber, R. 1997. *Sulama*. Ç.Ü. Ziraat Fakültesi Genel Yayın No: 174. Adana.
- [10] Kaynaş, N. Eriş A. 1998. Bazı Nektarin Çeşitlerinde Toprak Su Noksanlığının Biyokimyasal Değişimler Üzerine Etkileri Tr. J. of Agriculture and Forestry. 22 35-41.
- [11] Sangakkara, U. R. Hartwig, U. A. and Nösberger, J. 1996. Response of Root Branching and shoot Water Potentials of French Beans to Soil Moisture and Fertilizer Potassium. J. Agronomy and Crop Science. 177:165-173.
- [12] Strain, H. H. and W. A. Svec, 1966. Extraction, separation, estimation and isolation of chlorophylls. In: Vernon, L.P., Seely, G. R. (Eds.), The chlorophylls. Academic press, p.21-66, New York.

Geotechnical and Petrographic Characterisation of the Birimian Granitoids in Southern Ghana as an Aggregates for Sustainable Road Construction

Isaac Ahenkorah¹, Evans Mensah Awuah², Anthony Ewusi³, Michael Affam⁴

¹School of Natural and Built Environments, University of South Australia, Adelaide, SA 5095, Australia

^{2,3,4}Department of Geological Engineering, University of Mines and Technology, Tarkwa, Ghana

Abstract— Granitic aggregates are mostly used for civil construction and other engineering works in Ghana. In this project, the characteristics of the Cape Coast (G1) and Dixcove (G2) granitoids for sustainable road construction were assessed. Physical and mechanical properties of the rocks were evaluated. Hand specimen description revealed that, amphibole is the major mafic mineral in the G2 and biotite as the dominant mafic mineral in the G1 granitoids. Petrographic study of the grains showed that, the large grains interlocked with fine grains (well-graded) with irregular grain boundaries in the matrix of the G2 gives the rocks a higher strength to withstand compressive loads than the G1 granitoids which have micro fractures in them that acts as weak planes in the rock. Geotechnical tests performed on the rocks gave an average Aggregate Crushing Value (ACV) of 11.6 % for Dixcove and 20.1 % for the Cape Coast, Aggregates Impact Value (AIV) of 6.1 % for Dixcove and 11.02 % for Cape Coast, Aggregate Abrasion Value (AAV) of 16.60 % for Dixcove and 26.0 % for Cape Coast, Specific Gravity of 2.74 for Dixcove and 2.66 for Cape Coast and Water Absorption of 0.18% for Dixcove and 0.51 % for Cape Coast granites. These values indicate that, both rock aggregates have relatively high strengths. However, G2 granitoids have relatively high resistance to compressive stresses under crushing, impacts and abrasion of traffic loads hence more suitable for sustainable road construction according to the global standards.

Keywords— Cape Coast (G1), Dixcove (G2), Granitoids, Granite, Road Construction.

I. INTRODUCTION

Natural constructional aggregate is one of the most abundant natural resource used in road construction [1]. Granites, which are the most predominant rock material are light coloured igneous rock composed mainly of

quartz and feldspars. The selection of these granitoids for road pavement depends on the physical, mechanical and mineralogical properties of the rock. It should therefore be resistance to crushing and abrasion. The aggregate need also to be durable in the prevailing environmental conditions [1].

In Ghana, such granitoids include the Cape Coast (G1), the Dixcove (G2) and the Bongo granitoids (G3). These can be found in almost all sections of the country especially in the northern and south-western part of Ghana. These granitoids contains minerals such as quartz, alkali feldspar, biotite, amphibole, hornblende and titanite which are at times well foliated. The granites are characterized by the presence of many enclaves of schists and gneisses [2]. In most cases, aggregates from these granitoids are mostly used in roads construction which degrades after some period of time due to the mechanical and mineralogical behaviour of these rocks. The most abundant of all the granitoids used for road construction in Ghana are the Cape Cost (G1) and the Dixcove (G2) granitoids. There is therefore the need to determine the geotechnical and petrographic characteristics of the Dixcove and Cape Coast granitoids within the Birimian rocks in Southern Ghana to determine their suitability for sustainable road construction.

II. INFORMATION ABOUT THE STUDY AREA

2.1 Location and Accessibility

Dixcove is a coastal village in the Ahanta West district in the Western Region of Southern Ghana with Agona Nkwanta as the district capital. It is located approximately 35 km west of the regional capital, Sekondi-Takoradi [3]. It has a geographical coordinate of 4° 48' 00" North and 01° 57' 00" West (Fig. 1). The community is divided into Upper Dixcove and Lower Dixcove, separated by the main road that leads into town. Dixcove is 35 km from Takoradi, and 250 km from Accra [4].

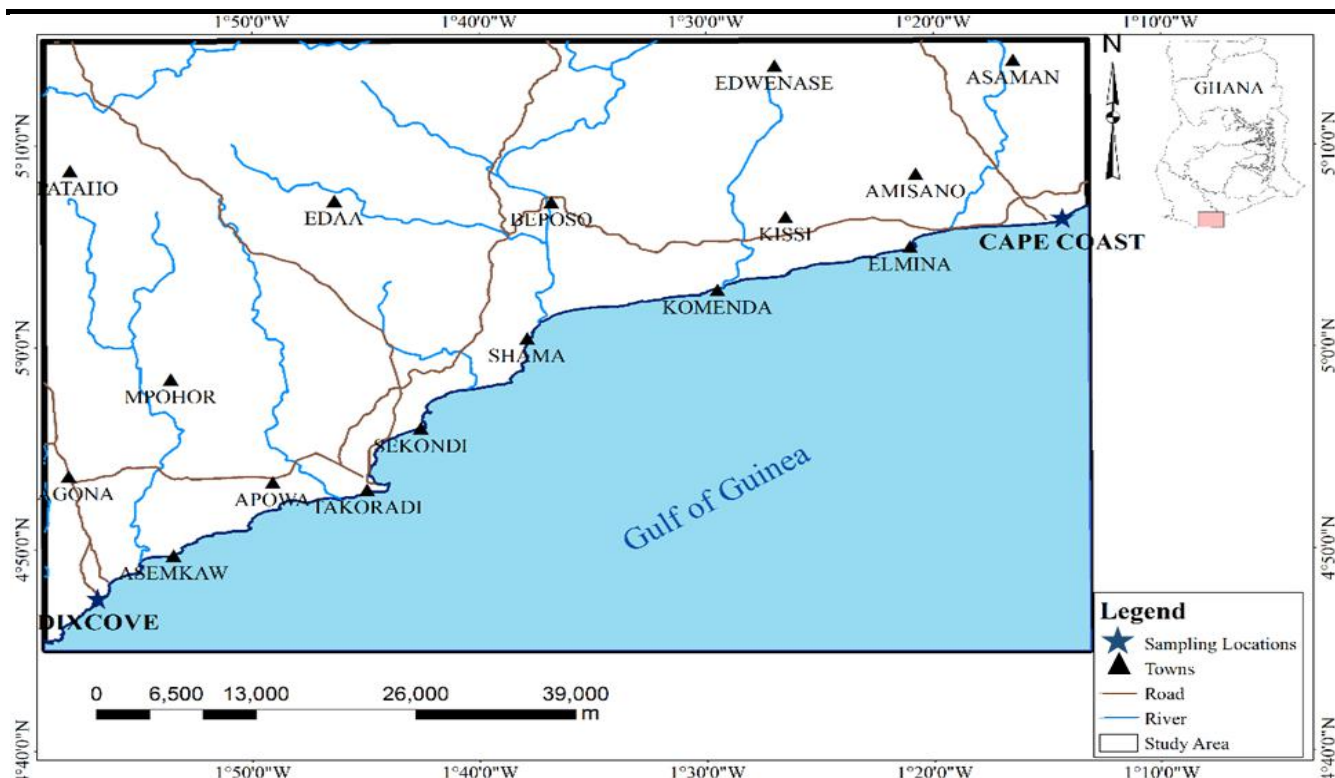


Fig. 1: Map of Southern Part of Ghana showing Sampling Locations

Cape Coast is a city and a fishing port, and the capital of the Central Region of Ghana. The Cape Coast Metropolitan is bounded on the south by the Gulf of Guinea, west by the Komenda / Edina / Eguafu / Abrem Municipal, east by the Abura / Asedu / Kwamankese District and north by the Twifu / Hemang / Lower Denkyira District. It is located with a geographical coordinate of $05^{\circ} 06' 00''$ North and $01^{\circ} 15' 00''$ West (Fig. 1). The Metropolis has a total land area of 9826 square kilometers [5].

2.2 Topography, Climate and Vegetation

Dixcove generally has a flat land with a few isolated hills at Butre and Bansa with height ranging between 20 to 40 meters above sea level between Cape Three Point and Princess Town [3].

The area falls largely within the High Rain Forest Vegetation Zone, capturing several hectares of rubber plantation. To a large extent, this contributes significantly to reducing the problem of global warming, since the vegetation serve as a sink for CO₂ emissions.

The District is found within the South-Western Equatorial Climatic Zone of Ghana. The highest mean temperature is 34°C which is recorded between March and April, while the lowest mean temperature of 20°C is experienced in August. Relative humidity is very high averaging between 75 % to 85 % in the rainy season and 70 % to 80 % in the dry season. The District is located within the wettest

region in Ghana. It experiences a double maxima rainfall of over 1,700 mm [3].

Cape Coast is dominated by batholith rock and is generally undulating with steep slopes. There are valleys of various streams between the hills, with kakum being the largest stream. The minor streams end in wetlands, the largest of which drains into the Fosu Lagoon at Bakano. In the northern part of the district, however, the landscape is suitable for the cultivation of various crops. The metropolis has double maxima rainfall. The major rainy seasons occurs between May to July and the Minor rainy season fall within November to January [5]. Cape Coast is a humid area with mean relative humidity varying between 85 % and 99 %. The sea breeze has a moderately effect on the local climate. The hottest months of the year are February and March, just before the main rainy season, while the coolest months are between June and August [6]. The present vegetation of the municipality consists of shrubs of about 1.5 m high, grass and a few scattered trees. The original vegetation of dense shrubs supported by rainfall, has been replaced by secondary vegetation because of clearing for farming, charcoal burning, bushfires and other human activities [5].

2.3 Geology Setting

The Dixcove granitoid complex is intruded along deep-seated faults in three distinct phases which follow one another from basic to acidic: gabbro-diorite-granodiorite. Although the Dixcove granite has been inferred to be

younger than the Cape Coast granite, there is the presence of minor intrusions. However, granites like members of the Dixcove suits have been observed within biotite gneiss of the Cape Coast type in many scattered areas throughout Ghana [7]. This suite consists of quartz diorite, tonalite and trondhjemite, granodiorite, adamellite, and to a lesser degree, granite [8] & [7]. They are typically hornblende-bearing and are commonly associated with gold mineralisation where they occur as small plutons within the volcanic belts (Fig. 2). The Cape Coast granitoids are large, syntectonic, foliated granitoid batholiths that typically intrude the Birimian

sedimentary strata. Typical lithologies include quartz diorites, tonalities and trondhjemites, granodiorites, adamellites and granites (Fig. 2). The Cape Coast granitoids have extensive contact metamorphic aureoles with mineral assemblages that indicate pressures of at least 4 kb and temperatures around 500 C [8]. The Cape Coast granite complex is believed to represent a multiphase intrusion consisting of four separate magmatic pulses. General mineralogical composition includes quartz, muscovite, biotite, microcline, tourmaline, albite, almandine, beryl, spessartite and kaolin [7].

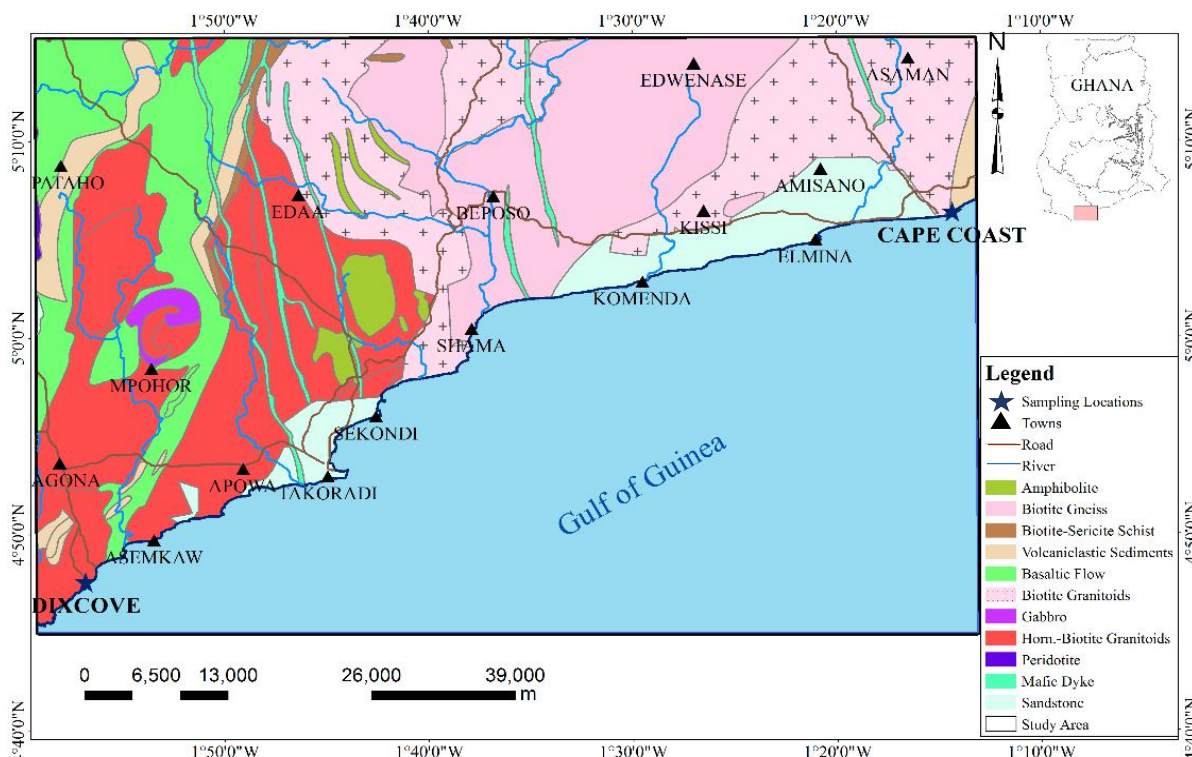


Fig. 2: Geological map of the Southern Part of Ghana showing the Sampling Locations

As such, the top soil consists mainly of dark grey decomposition products of predominantly lateritic quartzite imbedded in clayish silt and sand followed by a zone of briable, highly weathered gneissic and mica-schist rocks at depths ranging between 0.5 and 2.0 m. Beyond this depth, granitic gneiss can be found which by prospecting drilling proves to be homogeny consistent with minor biotite gneiss and quartzite intercalations [7].

III. METHODS USED

Two major methods were used to acquire data and results for the project. These methods include collection of samples from the study area and Laboratory testing and analysis.

3.1 Collection of Samples from the Study Areas

8 rock samples were taken from two different towns or location; Cape Coast (4 samples) and Dixcove (4 samples). The samples were taken from outcrops located at 05° 09' 27" North and 01° 17' 40" West of Cape Coast and 4° 47' 37" North and 01° 56' 44" West of Dixcove. These samples were then crushed into smaller sizes with the jaw crusher. The crushed rocks (aggregates) obtained were sent to the laboratory to assess it geotechnical properties. Thin section preparation was also done to determine the petrographic and mineralogical characteristics of the samples.

3.2 Laboratory Test

The following laboratory test were conducted on the aggregates from all the 8 rock samples collected;

- 1) Preparation of thin section for two samples from each sampling location.
- 2) Aggregate Abrasion Value Test.
- 3) Aggregate Crushing Value Test.
- 4) Aggregate Impact Value Test.
- 5) Specific Gravity Test.
- 6) Water Absorption Test.

3.2.1 Preparation of Thin Section

4 different rock samples from Dixcove (D1 and D2) and Cape Coast (C1 and C2) were identified and registered. The sample were first trimmed or cut by using a diamond edged saw blade with water as lubricant in the recirculation pump. The best face (the face with adequate minerals and less machine deformation) was chosen and grinded to obtain a very flat surface using abrasives papers (Silicon carbide papers with grit sizes of 120, 240, 600 and 1200). Glass slide of uniform thickness was prepared using abrasive powder or papers (400-100 size abrasives).

The slab is first heated to evaporate all water molecules before bonding to the glass slide using Epoxy Resin in a mixing ratio of 1:1 between the catalyst and the resin. A zero-degree bonding was achieved by gently applying hand pressure and simultaneously pushing and pulling sideways of the slide, allowing bubbles to be squeezed out of the resin film. A reasonable weight was then placed on the sample and then allowed to cure overnight. The bulk of the specimen was then removed to about 50 μm . The specimen was then grinded to about 35 μm by using abrasive paper slurry of 800-1200 grits and finally lapped to about 30 μm . The thickness was monitored under the microscope to observe the pale-yellow color. A protective glass cover was then bonded to the slide to prevent breakages and to keep the sample clean always [9].

3.2.2 Aggregate Abrasion Value Test (Los Angeles Abrasion Test)

2500 g weight of each sample group with sieve sizes; 14-12.5 mm and 12.5-9.5 were mixed thoroughly to obtain 5000 g. The samples were poured into a large rotating drum (the Los Angeles Machine) and eleven (11) steel balls was added to it. The drum was then subjected to rotation for 500 revolutions at a speed of 30-33 revolution per minute. The materials were then extracted and separated into materials passing the 1.70mm sieve and those retained on the 1.70 mm. The retained materials were then weighed and compared to the initial sample weight. The Aggregate Abrasion Value was calculated using the formula,

$$AAV = \frac{M1 - M2}{M1} \times 100\% \quad (1)$$

Where;

M1 = initial mass of the sample (5000 g) and
M2 = the final mass that was retained on the sieve

Rock materials with Aggregate Abrasion Values below 30 percent are regarded as strong, while those above 30 percent would normally be regarded as too weak for use in road surface [3].

3.2.3 Aggregate Crushing Value Test [10]

The test was carried out on 10-14 sized surface dry aggregate and required a sample size of about 2 kg. The 150 mm diameter hardened steel cylindrical measure was filled in three layers of approximately equal depth, with each layer being subjected to 25 strokes by the tamping rod dropping freely from a height of approximately 50 mm above the surface of the aggregates. The surface of the aggregate of the weighed sample (mass A) was carefully levelled and the plunger inserted into it. The sample was then placed in a compression test machine and loaded with a force that was increased at a uniform rate from 0 to 400 KN in 10 minutes. After this, the load was released, and the crushed material was removed from the cylinder.

The sample was sieved through a 2.36 mm sieve and the fraction passing through the sieve was weighed (mass B). The test was repeated for a second sample using the same procedure. The mean of the two results is the test result. The aggregate crushing value was calculated from the equation below.

$$\text{Aggregate Crushing Value} = \frac{B}{A} \times 100\% \quad (2)$$

Where;

A = The weight of the measured aggregate

B = Mass of aggregate passing through the 2.36 mm IS sieve [11]

3.2.4 Aggregate Impact Value Test [10]

The test was carried out on 10-14 mm sized surface dry aggregate and required a sample size of about 750 g. The aggregates were poured to fill one-third depth of the steel cup and was compacted by giving the material 25 gentle blows with the rounded end of the tamping rod. Two more layers was added in a similar manner to fully fill the cylinder and the surplus aggregates was strike off to level the surface. The weighed sample portion (mass A) placed in 105-50 mm deep hardened steel cup and tamped to a single horizontal layer. The cup was firmly fixed to the base of the impact machine. The sample was then subjected to 15 blows from the aggregate impact test machine, each being delivered at an interval not less than 1 second. The crushed aggregate was taken from the cup and sieved on 2.36 mm sieve. The mass of material (mass B) passing through the 2.36 mm sieve was

weighed and expressed as a percentage of the total (mass A).

$$\text{Aggregate Impact Value} = \frac{B}{A} \times 100\% \quad (3)$$

Where;

A = weight of the measured aggregate

B = Mass of aggregate passing through the 2.36 mm IS sieve.

Aggregate impact Values below 10 % are regarded as exceptionally tough or strong for roads surfaces while values above 35 % are generally weak [3].

3.2.5 Specific Gravity Test

The specific gravity of an aggregate is a measure of strength or quality of the material. The test was carried out on pieces of the rocks weighing between 70-120 g. The samples were labelled and weighed on an electronic balance to the nearest 0.01 g. The samples were then coated with paraffin wax and weighed again. A beaker was filled to two-thirds (2/3) with distilled water and placed on the electronic balance. The electronic balance was set to zero (0.00 g). Pieces of threads were tied to each specimen and was gently lowered into the beaker until they were fully submerged without touching any part of the beaker. Readings were taken on the electronic balance [12].

Calculations

Mass of rock specimen = M_1 (g)

Mass of waxed specimen = M_2 (g)

Mass of wax = $M_2 - M_1$ (g)

Volume of displaced water = V (cm^3)

The density of the paraffin wax is $911 \text{ kg/m}^3 = 0.911 \text{ g/cm}^3$

$$\text{Volume of wax} = \frac{\text{mass of wax}}{0.91 \text{ g/cm}^3} \quad (4)$$

Since the density of water is 1 g/cm^3 , the mass of displaced water = volume of waxed sample. Volume of specimen = volume of waxed specimen – volume of wax [3].

$$\text{Bulk density} = \frac{\text{mass of rock specimen}}{\text{volume of rock specimen}} \quad (5)$$

3.2.6 Water Absorption Test

A known mass of aggregate was immersed in a test tube filled with two-third full of water for approximately 24 hours to essentially fill the pores. The aggregate was placed on a dry cloth to allow the surface to dry until

visible water films were removed. The mass of this saturated aggregate was recorded. The saturated sample was oven-dried for 24 hours. The hot sample was cool, and its mass was recorded.

The Water Content Absorbed was calculated using the formula;

$$\text{WC} = \frac{A - D}{D} \times 100\% \quad (6)$$

Where;

A = saturated weight of the sample and

D = weight of oven dried sample [3].

IV. RESULTS AND DISCUSSION

4.1 Hand Specimen Description and Analysis on Rock Samples

Table 1: Model percentage of the Dixcove and Cape Coast granitoids

Minerals (%)	Sample ID			
	D1	D2	C1	C2
Quartz	45	43	35	36
Amphibole	30	29	16	15
Plagioclase	12	13	15	12
K-feldspar	8	7	11	13
Biotite	4	6	20	22
Other minerals	1	2	3	2
Total	100	100	100	100

Sample D1 from the Dixcove granitoids has quartz (45 %), plagioclase feldspars (12 %), amphiboles (30 %), K-feldspars (8 %), biotite (4 %) and other minerals (1 %). D2 also has quartz (43 %), plagioclase feldspars (13 %), amphiboles (29 %), K-feldspars (7 %), biotite (6 %) and other minerals (2 %) as shown in Table 1. Amphibole is the dominant mafic minerals found in the samples obtained from the Dixcove granitoids. Hence, the rocks can be classified as syeno-granite based on the QAP classification system (Fig. 3). Sample C1 from the Cape Coast granite on the other hand, has quartz (35 %), plagioclase feldspars (15 %), Amphiboles (16 %), biotites (20 %), K-feldspars (11 %) and other minerals (3 %). Also, sample D2 has quartz (36 %), plagioclase feldspars (12 %), Amphiboles (15 %), biotites (22 %), K-feldspars (13 %) and other minerals (2 %) as shown in Table 1. Biotite is the dominant mafic minerals found in the samples obtained from the Cape Coast granitoids and therefore, these rocks can be classified as monzo-granites based on the QAP classification system (Fig. 3).

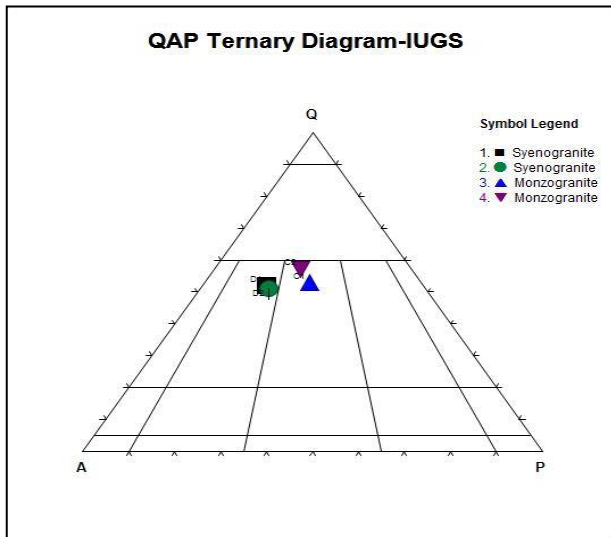


Fig. 3: A QAP ternary classification diagram showing all the sample plots

The hand specimen analysis indicates that, the Dixcove granitoids are rich in hornblende which are generally harder than micas but less resistant to weathering than biotites (micas).

Quartz which is the dominant mineral present in the Dixcove granitoids, lacks a specific cleavage plane and its ability to recrystallise and form complex grain boundary shapes increases the rock's strength to resist fragmentation.

The Cape Coast granites has relatively high quartz content which are harder and good resistant to fragmentation and weathering. It is biotite-rich (micas) and thus mica grains may provide a path for crack propagation due to its weak cleavage planes and may therefore weakening the rock and thus, reducing the bearing capacity of the aggregates when used in road construction.

4.2 Petrographic Observations and Analysis made under the Microscope

Figure 4 and 5 provides photomicrograph observations made under the crossed polars in the Dixcove and the Cape Coast granitoids under a magnification of x5 (250 μ m) using two different samples in each granitoids group. Under the microscope, the Dixcove granites has larger grains sizes (anhedral to subhedral in shape) interlocked with smaller grains between (well-graded) and adjacent the larger ones as shown in Fig. 4 (a). This gives the rock a better resistance to fragmentation and wear. Rocks consisting of both coarse and fine grain in a matrix have a beneficial effect on the strength of the rock. Also, medium to fine grained minerals were found fully interlocking each other which gives the rock a higher strength to withstand stresses as shown in Fig. 4 (b).

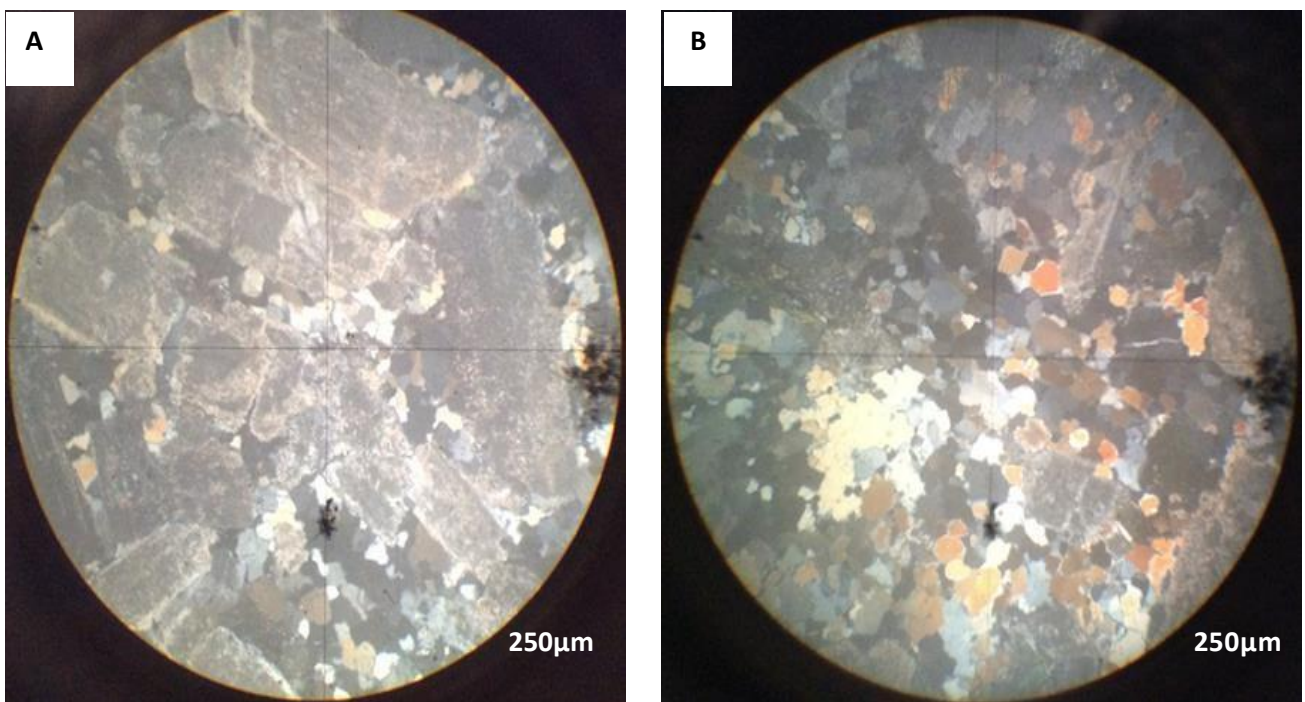


Fig. 4: Photomicrograph of Dixcove Granodiorite under Crossed Polarised Light showing (a) Larger Grains Sizes Interlocked with Smaller Grains (b) Medium to Fine grained minerals interlocking each other

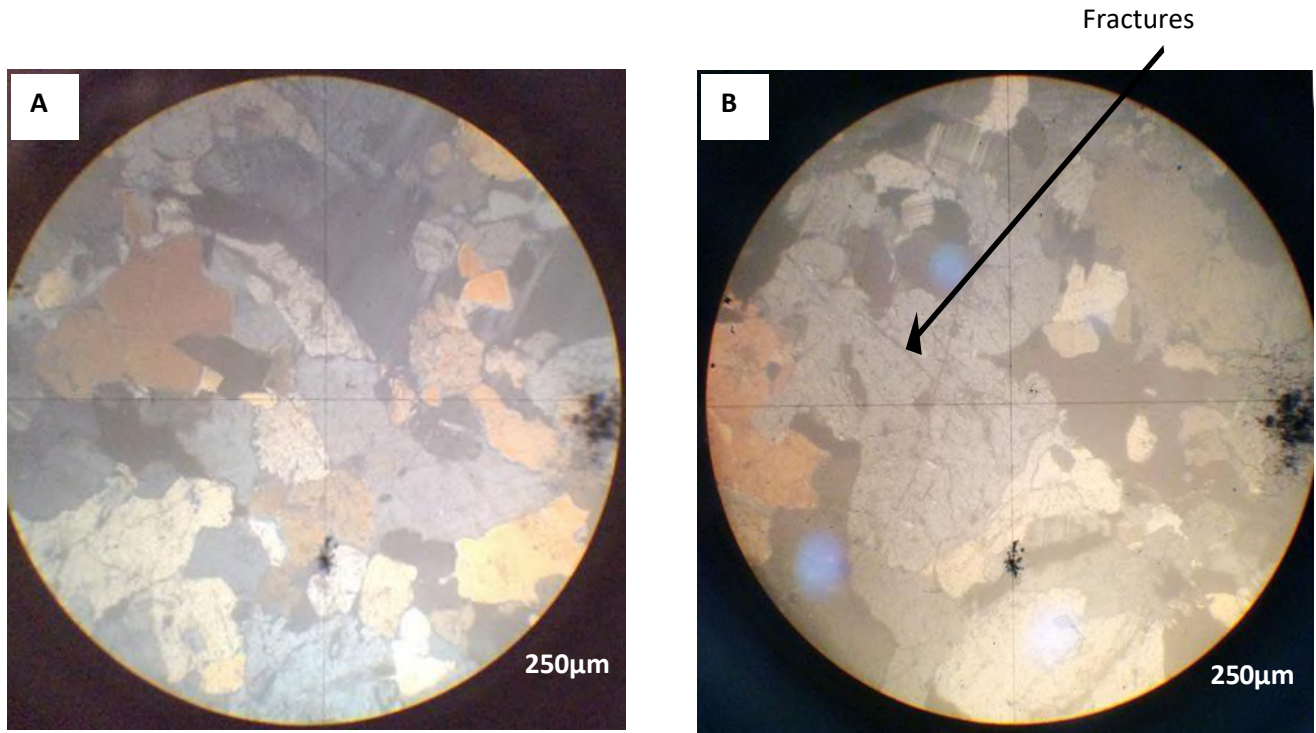


Fig. 5: Photomicrograph of Cape Coast Granite under Crossed Polarised Light Showing (a) Large, Anhedral grains with microfractures and complexity (b) Large grains with microfractures

The Cape Coast granites mainly has larger grain sizes interlocking each other of anhedral shape with few ones being euhedral. The strength and resistance to mechanical fragmentation increases when the shapes of the grains are going from straight surfaces and boundaries to more irregular and complex grain shapes and grain boundaries which was a typical characteristic of the Cape Coast granites. The presence of microfractures in the Cape Coast granites act as weak planes in the rock where

failure is initiated as shown in Fig. 5 (a) and Fig. 5 (b). Micro-fractures reduce the resistance of the rock to fragmentation.

A. Geotechnical Tests and Analysis on the rock samples

The following are the summary of results and analysis made on the mechanical and physical test and observations made on the rock samples collected from Dixcove and Cape Coast as shown in Table 2 to 11.

Table 2: Summary of aggregate abrasion value for Dixcove granitoids

Number of Test	Initial mass of sample (g)	Final mass of Sample	Mass passing (g)	Percentage loss in sample (%)
1	5000.0	4168.0	832.0	16.64
2	5000.0	4175.0	825.0	16.50

*The average AAV of the Dixcove granites is 16.60 %

Table 3: Summary of aggregate abrasion value for Cape Coast granitoids

Number of Test	Initial mass of sample (g)	Final mass of Sample (g)	Mass passing (g)	Percentage loss in sample (%)
1	5000.0	3705.0	1295.0	25.90
2	5000.0	3696.0	1304.0	26.08

*The average AAV of the Cape Coast granites is 26.0 %

Table 4: Summary of aggregate crushing value test of Dixcove granitoids

Number of Test	Initial mass of sample (g)	Final mass of sample (g)	Mass passing (g)	Percentage loss in sample (%)
1	2763.0	2445.0	318.0	11.51
2	2663.0	2352.0	311.0	11.68

*The average ACV of the Dixcove granites is 11.6 %

Table 5: Summary of aggregate crushing value test of Cape Coast granites

Number of Test	Initial mass of sample (g)	Final mass of sample (g)	Mass passing (g)	Percentage loss in sample (%)
1	2719.0	2174.0	545.0	20.15
2	2686.0	2148.0	538.0	20.03

*The average ACV of the Cape Coast granites is 20.1 %

Table 6: Summary of aggregate impact value test of Dixcove granitoids

Number of Test	Initial mass of sample (g)	Final mass of sample (g)	Mass passing (g)	Percentage loss in sample (%)
1	706.0	665.0	41.0	5.81
2	697.0	653.0	44.0	6.31

*The average AIV of the Dixcove granites is 6.1 %

Table 7: Summary of aggregate impact value test of Cape Coast granitoids

Number of Test	Initial mass of sample (g)	Final mass of sample (g)	Mass passing (g)	Percentage loss in sample (%)
1	724.0	645.0	79.0	10.91
2	736.0	654.0	82.0	11.14

*The average AIV of the Cape Coast granites is 11.03 %

Table 8: Summary of specific gravity of Dixcove granitoids

Sample Number	1	2	3	4
Mass of specimen (M_1) (g)	72.50	78.00	77.20	88.40
Mass of specimen + wax (M_2) (g)	77.10	84.40	80.60	93.60
Mass of wax ($M_2 - M_1$) (g)	4.60	6.40	3.40	5.20
Volume of water displaced (V)(cm ³)	31.0	36.0	32.0	38.0
Volume of wax (cm ³)	5.05	7.03	3.73	5.71
Volume of specimen (V)(cm ³)	25.95	28.97	28.27	32.29
Bulk density (g/ cm ³)	2.79	2.69	2.73	2.74

*The average Specific Gravity for Dixcove granitoids is 2.74

Table 9: Summary of specific gravity of Cape Coast granitoids

Specimen No.	1	2	3	4
Mass of specimen (M_1) (g)	97.80	83.40	94.50	82.50
Mass of specimen + wax (M_2) (g)	102.60	89.20	98.60	86.40
Mass of wax ($M_2 - M_1$) (g)	4.80	5.80	4.10	3.90
Volume of water displaced (V)(cm ³)	42.0	38.0	40.0	35.0
Volume of wax (cm ³)	5.27	6.37	4.50	4.28
Volume of specimen (V)(cm ³)	36.73	31.63	35.50	30.72
Bulk density (g/cm ³)	2.66	2.64	2.66	2.68

*The average Specific Gravity for Cape Coast granitoids is 2.66

Table 10: Summary of water absorption test of Dixcove granitoids

Sample Number	1	2	3	4
In-situ bulk weight	32.17	30.23	37.47	28.53
Wet weight	32.18	30.24	37.51	28.54
Dry weight	32.09	30.20	37.43	28.50
Water content	0.09	0.04	0.08	0.04
Water Absorption (%)	0.28	0.13	0.21	0.14

*The average water absorption of Dixcove granitoids is 0.18 %

Table 11: Summary of water absorption test of Cape Coast granitoids

Sample Number	1	2	3	4
In-situ bulk weight	27.021	41.76	37.46	38.70
Wet weight	27.21	41.92	37.59	38.91
Dry weight	27.08	41.69	37.39	38.72
Water content	0.13	0.23	0.20	0.19
Water Absorption (%)	0.48	0.55	0.53	0.49

*The average water absorption for Cape Coast granitoids is 0.51 %

The average abrasion tests performed on the Dixcove gave an Aggregate Abrasion Value (AAV) of 16.60 % (Table 2) and the Cape Coast of 26.0 % (Table 3) which suggest that, the Dixcove is harder to resist the abrasive effect (wear) of traffic over long period of time than the Cape Coast granites. The higher the aggregate abrasion value, the higher the aggregates will be quickly ground to dust, while hard aggregates are resistant to crushing and wearing effect with lower aggregate abrasion values. Aggregates abrasion value for road construction should be less than 30 %.

The average crushing tests performed on the Dixcove gave out an Aggregate Crushing Value (ACV) of 11.6 % (Table 4) and 20.1 % for the Cape Coast granites (Table 5). These values indicate a high resistance to crushing under compressive load of traffics and rollers which is seen to be more in the Dixcove than the Cape Coast granitoids. The aggregates crushing value decreases with increasing strength of aggregates.

The average impact value for the Dixcove sample was 6.1 % (Table 6) and the Cape Coast turned out 11.03 % value (Table 7). The low percentage values obtained from the test indicate that these samples have high strength (tough) to bear the impact of loads exerted by traffics. The Dixcove granitoids have higher resistance to impacts than the Cape Coast granitoids. The general specification for aggregate impact value is less than 35 %.

The average specific gravity test conducted on the Dixcove turned out a value of 2.74 (Table 8) and the Cape Coast, 2.66 (Table 9). High specific gravity generally indicates high quality aggregate while porous, weak or absorptive aggregates has low specific gravities. Thus, the Dixcove has higher strength than the Cape Coast.

The average water absorption value for the Dixcove granites was 0.18 % (Table 10) and the Cape Coast with a value of 0.51 % (Table 11). These values indicate that, the two granitic rocks have low water absorptions, thus, highly durable. Dixcove granitoids has lower water absorption values with higher durability than the Cape Coast type. Cape Coast granitoids generally contains mica that can retain water. Also, the presence of microfractures in them acts as secondary pores for water passage or

absorption. The standard specification for water absorption of aggregates is less than 2.0 %.

V. CONCLUSION

5.1 Conclusions

From the laboratory results, it can be concluded that, Rocks consisting of both coarse and fine grains in a matrix have a beneficial effect on the strength of the rock that gives the rock a better resistance to fragmentation. Hence, the two granitoids are good but the Cape Coast has microfractures in them that reduces its strength and thus, makes the Dixcove more sustainable when used.

The Dixcove granitoids have lower Aggregate Impact value of 6.1 % and thus makes it more resistance to impact loads.

The Dixcove rocks have lower Aggregate Abrasion Value of 16.60 % that helps to resist surface wear caused by trafficking than the Cape Coast granitoids.

The Dixcove granitoids has lower Aggregate Crushing value; 11.6 % which enhances its crushing resistance under wheel loads more than the Cape Coast granitoids.

The Dixcove rocks have low water absorptions of 0.18 % which makes it a stronger aggregate than the Cape Coast granites.

The higher Specific Gravity value of 2.74 for Dixcove makes it stronger and durable when used in roads construction.

Thus, the Dixcove (G2) granitoids, has better engineering properties than the Cape Coast (G1) granitoids and hence more suitable for sustainable road construction.

4.2 Recommendations

The following tests are recommended to be performed on the rocks; Flakiness and Elongation Index Test as well as Magnesium Sulphate Soundness Test. The effect of climate change on asphalt pavements should also be considered.

REFERENCES

- [1] Egesi, N., & Tse, A. C. (2012). Engineering-Geological Evaluation of Rock Materials from Bansara, Bamenda Massif Southeastern Nigeria, as

- Aggregates for Pavement Construction, vol. 2, no. 5, pp. 107–111.
- [2] Tay, C.K., Hayford, E., Hodgson, I.O. and Kortatsi, B. K. (2015). Hydrochemical appraisal of groundwater evolution within the Lower Pra Basin, Ghana: a hierarchical cluster analysis (HCA) approach. *Environ Earth Sci.* Vol. 73 pp. 3579. Anon.
- [3] Ewur, N. E. T., Adupong, R., Eshun, J. D., Mensah, P. A., Nketia, J., & Gormey, B. (2010). Report on Characterization of Coastal Communities and Shoreline Environments in the Western Region of Ghana, Integrated Coastal and Fisheries Governance Initiative for the Western Region of Ghana, USAID Publishers, Ghana, pp. 147-148.
- [4] Dixcove – Wikipedia. (2016). Retrieved February 9, 2018, from <https://en.wikipedia.org/wiki/Dixcove>.
- [5] Faanu, A., Adukpo, O. K., Okoto, R. J. S., Diabor, E., Darko, E. O., Emi-Reynolds, G., Kpordzro, R. (2011). Determination of Radionuclides in Underground Water Sources Within the Environments of University of Cape Coast. *Research Journal of Environmental and Earth Sciences*, University of Cape Coast, Ghana, pp. 270-23.
- [6] Anon. Draft ESIA Report- Onshore Gas Pipeline_GIP _100912 | Environmental Impact Assessment | Pipeline Transport. (2012). Retrieved February 9, 2018, from <https://www.scribd.com/document/341552988/Draft-ESIA-Report-Onshore-Gas-Pipeline-GIP-100912>.
- [7] Kesse, G. O. (1985). *The Mineral and Rock Resources of Ghana*. A. A. Balkema, Publishers, Rotterdam, pp. 610-35.
- [8] Leube, A., Hirdes, W., Mauer, R., & Kesse, G. O. (1990). The early Proterozoic Birimian Supergroup of Ghana and some aspects of its associated gold mineralization. *Precambrian Research*; vol. 46, no. 1, pp. 139–165.
- [9] Dzigbodi-Adjimah, K. (2014). “Optical Mineralogy”. University of Mines and Technology, Tarkwa, pp. 52-53, Unpublished.
- [10] BS 812, P. 2. *Civil Engineering | Civil Engg Lectures, Books, Notes, Softwares site | AboutCivil.Org*, (2016). Retrieved February 9, 2018, from <https://www.aboutcivil.org/>.
- [11] Adebola, M., & Abdulazeez, S. (2014). The Suitability of Some Selected Granite Deposits for Aggregate Stone Production in Road Construction. *The International Journal of Engineering and Science*, Federal University of Technology, Nigeria, vol. 3, pp. 75–81.
- [12] Affam, M. (2014). “Rock Mechanics”. University of Mines and Technology, Tarkwa, pp. 150-13, Unpublished.

Forecasting Oxygen Demand in Treatment Plant Using Artificial Neural Networks

Moein Gheytaspour^{1*}, Omid Habibzadeh Bigdarvish²

¹Department of Civil Engineering, College of Engineering, Islamic Azad University, Shahr-e-Qods Branch, Tehran, Iran

²Department of Civil Engineering, College of Engineering, University of Texas at Arlington, Texas, USA

Abstract— Modeling the wastewater treatment plant is difficult due to nonlinear properties of most of its different processes. Due to the increasing concerns over environmental effects of treatment plants considering the poor operation, fluctuations in process variables and problems of linear analyses, algorithms developed using artificial intelligence methods such as artificial neural networks have attracted a great deal of attention. In this research, first using regression analysis, the parameters of biological oxygen demand, chemical oxygen demand, and pH of the input wastewater were chosen as input parameter among other different parameters. Next, using error analysis, the best topology of neural networks was chosen for prediction. The results revealed that multilayer perception network with the sigmoid tangent training function, with one hidden layer in the input and output as well as 10 training nodes with regression coefficient of 0.92 is the best choice. The regression coefficients obtained from the predictions indicate that neural networked are well able to predict the performance of the wastewater treatment plant in Yazd.

Keywords—Yazd treatment plant, chemical oxygen demand, neural networks, sigmoid tangent.

I. INTRODUCTION

To better and more efficiently control the performance of wastewater treatment plants, one can use a powerful mathematical tool, which is the basis for the recorded information associated with some essential parameters of wastewater during operational periods of the treatment plant. Traditional modeling which was used for biological processes and linear programming was based on writing equations for the rate of growth of microorganisms and formation of products (Zhao et al., 2008; Nahvi et al., 2018; Segre et al., 2002; Akram et al., 2013; Karlebach et al., 2008). However, as microbiological reactions are nonlinear and time-dependent, and have a complex nature. Such modelings had several limitations (Ginn et al., 1995; Xing & Pignatello, 1996; Jacques et al., 2018; Nguyen et al.,

2017; Daghighi, 2017). Use of methods capable of predicting the performance and efficiency of wastewater treatment plants especially based on quantitative and qualitative changes of the input wastewater is of great importance. Based on these predictions, the operator can adopt the necessary measures before incidence of problem, thereby applying suitable control and operation, preventing discharge of contaminated wastewater into the environment, returning the wastewater to the beginning of the treatment line (Eggen et al., 2014; Moles et al., 2003; Daghighi et al., 2017; Mahadevan et al., 2003). Artificial neural networks (ANNs) are among the methods for advanced statistical prediction, which have found extensive uses across all scientific fields. Neural network belongs to advanced statistical methods capable of predicting nonlinear and complex relations between inputs and outputs. Thus, to control the performance of wastewater treatment plants better and more efficiently, one can use a powerful mathematical tool, where the basis of the recorded information is related to some major parameters of wastewater during the treatment plant operational periods. Various research has been conducted about prediction with neural networks in different subjects. Haghiri et al (2018) modeled Wastewater Treatment Plant in Ardabil using ANN. In this study an optimal multi-objective design of neural networks was performed for modeling and optimizing the coagulator materials used in water treatment in Water Treatment Plant in Ardabil province, this research has been welcomed significantly by the Water Treatment Plant in Ardabil province. Han and Qiao (2012) employed ANN for predicting the efficiency of treatment plant. In this research work, ANN modeling was evaluated for predicting the efficiency of this treatment plant, which is equipped with active sludge system with diffusion aeration. Cao et al (2008) utilized ANN for predicting the changes in parameters of an anaerobic system. To optimize the weights of the ANN, they used multi-population genetic algorithm. Mjalli et al (2007) employed ANN models to predict the values of BOD, COD, and TSS parameters of the

wastewater of Doha treatment plant with active sludge system. They found that ANN enjoys a very high accuracy in predicting and estimating the operational parameters of wastewater treatment plants.

Case Study

The wastewater treatment plant in Yazd is located in the northwest of the town, 15 km ways from it, close to Yazd Wastewater Pond. It has an area of about 250 hectares. Based on these studies, the treatment plant has been designed in two stages. Its construction operations began in July 2012 and were exploited in the first half of 2017. The covered population in the year of origin (2012) was 24900 people, while in the goal year (2026), it will be 60000 citizens.

II. METHODS AND MATERIALS

An ANN is an idea which has been inspired by biological nervous system for information processing. ANN processes information like the brain. The key element in this idea is the new structure of information processing system. This

system consists of numerous highly interlinked neurons, which operate together for solving a problem. ANNs, like humans, learn through examples. An ANN is adjusted for performing a certain task such as pattern recognition and information grouping along a learning process. In biological systems, learning occurs with adjustments in synaptic links among the nerves. This method also applies to ANNs (Dawson & Wilby, 2001). Fig. 1 represents a general schema of ANNs. Based on the figure, every network consists of an input layer, one or several middle layer, and one output layer. Each layers is composed of some neurons. Every neuron receives the information from an input series, which act as dendrites in real neurons. After processing, that neuron delivers it to its output which indeed plays the role of synapses of a nervous cell. The output of this neuron is then used as the input for the next neuron. The number of neurons in the input and output layers is determined in proportion with the problem for which the network is used. Regarding the middle layer, the number of neurons is specified by the user through trial and error.

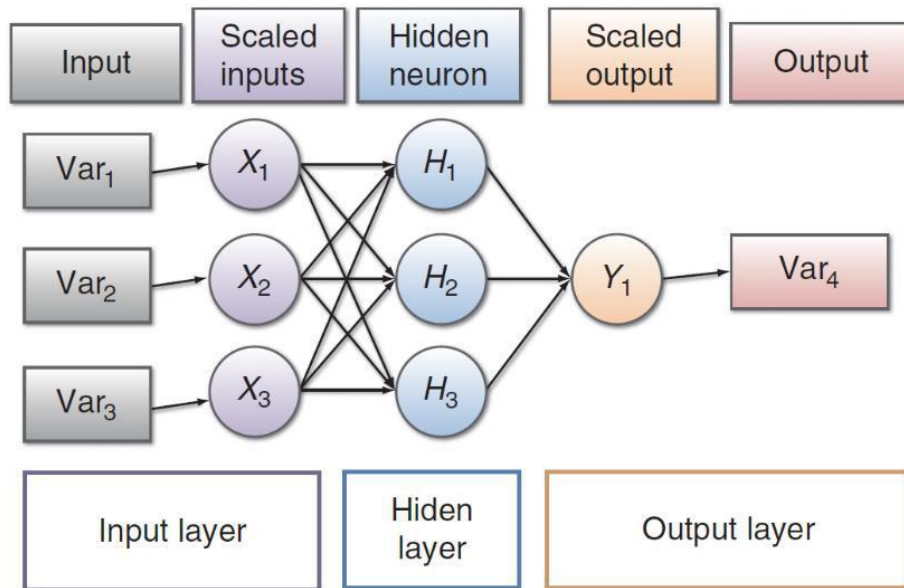


Fig.1: Example of a Simple ANN Network with Three Inputs, One Hidden Layer, Three Neurons, One Output Layer, and One Output Variable (Reinoso, 2017)

III. RESULTS AND DISCUSSION

Input data

The output data in this research is chemical oxygen demand (COD), while the input data include the treatment plant’s input flow rate (Q_{in}), its output flow rate (Q_{out}), the biological oxygen demand of the treatment plant’s input wastewater (BOD_{5in}), the chemical oxygen demand of the treatment plant’s input wastewater (COD_{in}), pH of the treatment plant’s input wastewater (pH_{in}), the plant’s output

wastewater (pH_{out}), and total suspended solids of the plant’s input wastewater (TSS_{in}). In the stepwise multiple linear model, the most effective parameters are incorporated in the model. According to the regression coefficient, three equations were estimated for the COD of the output wastewater as follows:

Model 1, with regression coefficient 0.619,

$$COD_{out} = 11.091 + 0.071BOD_{in}$$

Model 2, with regression coefficient 0.668,

$$COD_{out} = 3.294 + 0.08BOD_{in} + 0.038COD_{in}$$

Model3, with regression coefficient 0.638, $COD_{out} = 93.163 + 0.069BOD_{in} + 0.031COD_{in} - 12.017PH_{in}$

The significance and impact factor of each effective parameter in the above equations have been provided in the following table:

Table.1: the results obtained from multiple linear model for COD of the output wastewater

Model	Parameter	Impact factor	Significance level
1	BOD _{5in}	0.071	0.001
2	BOD _{5in}	0.08	0.003
	COD _{in}	0.038	0.001
3	BOD _{5in}	0.069	0.002
	COD _{in}	0.031	0.014
	pH _{in}	-12.017	0.039

According to Table 1 and in Model 3, the BOD of the input wastewater into the treatment plant has the maximum impact on the output. Next, using the three mentioned parameters in Model 3, prediction was performed.

Error analysis

To obtain the best topology, the criterion used is error and regression coefficient between observational and computational data. For this purpose, the Eq. 1 have been used.

$$r = \frac{\sum_i (x_i - \bar{x})(d_i - \bar{d})}{\sqrt{\sum_i (d_i - \bar{d})^2} \sqrt{\sum_i (x_i - \bar{x})^2}}$$

Eq. 1

where r is the regression coefficient between the observational data (x) and computational data (d), N

represents the number of data, \bar{d} and \bar{x} are the mean values of the computational and observational data, respectively. r value is always between -1 and 1. The closer its value to 1, the more complete the correlation is between the two variables in a direct fashion.

$$MSE = \frac{\sum_{j=0}^P \sum_{i=0}^N (d_{ij} - y_{ij})^2}{N.P}$$

Eq. 2

where MSE is the mean squared error, P represents the number of elements being processed in the output, N shows the number of data in the data series, y_{ij} indicates the network output for sample i in the elements being processed j, and d_{ij} is the output related to the prediction parameter for sample i in the element being processed j.

Neural network design

Network design means selecting the number of training nodes, number of hidden layers, and type of training function. This is because the experience of this research proved that these factors affect the prediction accuracy. In this research, for prediction out of 3, 10, 25, 50, 100, 500, and 1000 training nodes, 1, 2, and 3 hidden layers in the input and output as well as sigmoid function, sigmoid tangent, linear sigmoid tangent, and linear sigmoid functions have been used. The utilized network is multilayer perceptron and the training rule is momentum. A total of 84 models were specified for this research.

In order to select the best scenario, error analysis method was used. For this purpose, the network was trained by different scenarios and the prediction error was calculated. The number of hidden layers, number of nodes, and type of training function with the minimum error were considered as the best options. Based on the obtained results, the effect of these factors on the prediction accuracy is very considerable. The following diagrams reveal the regression coefficients between predicted as well as observational data and the number of different layers and nodes for the four functions utilized.

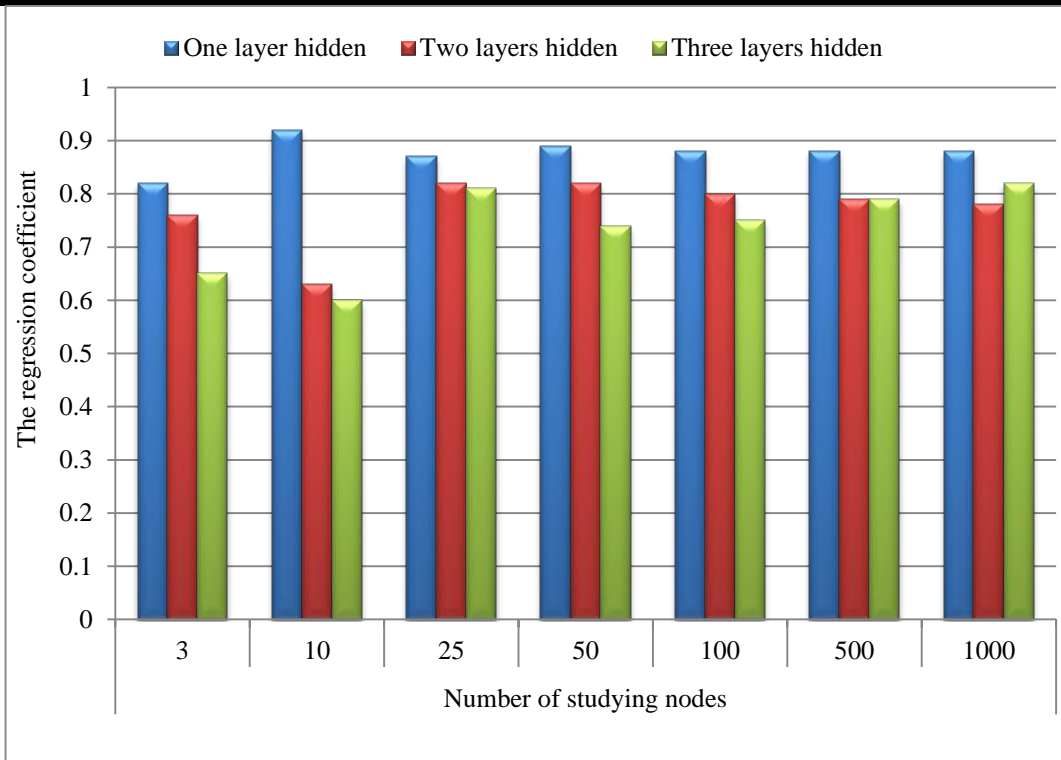


Fig.3: Comparing the prediction regression coefficient with different layers, sigmoid tangent function with different training nodes

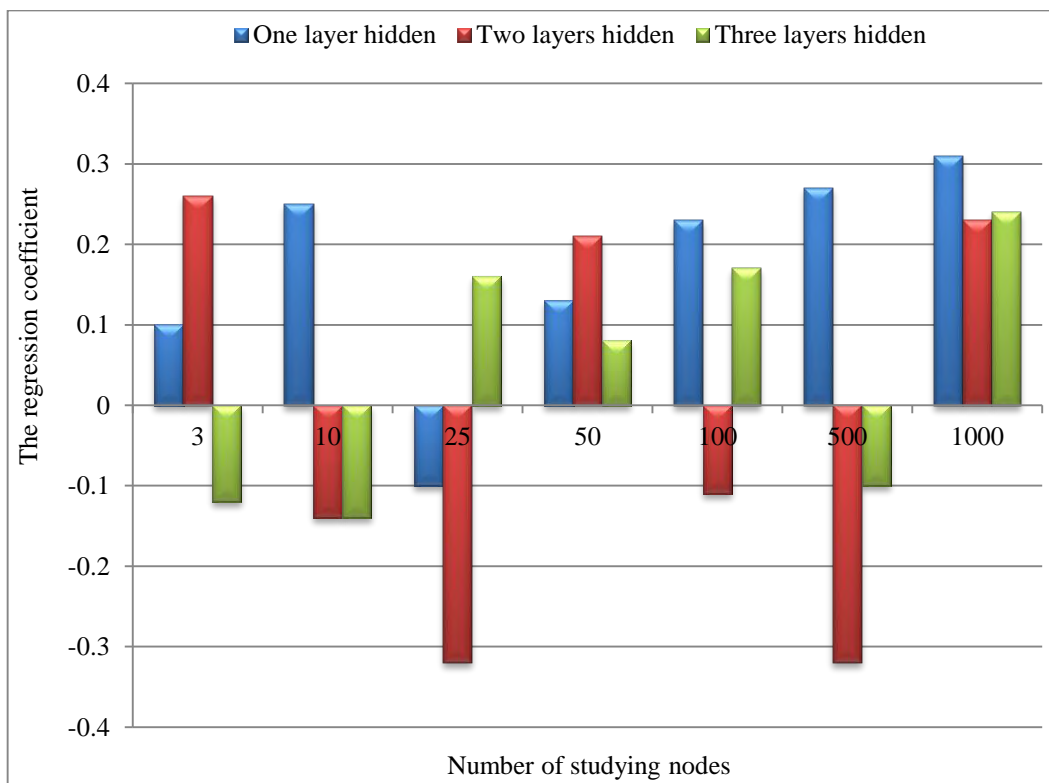


Fig. 4: Comparing the prediction regression coefficient with different layers, sigmoid function with different training nodes

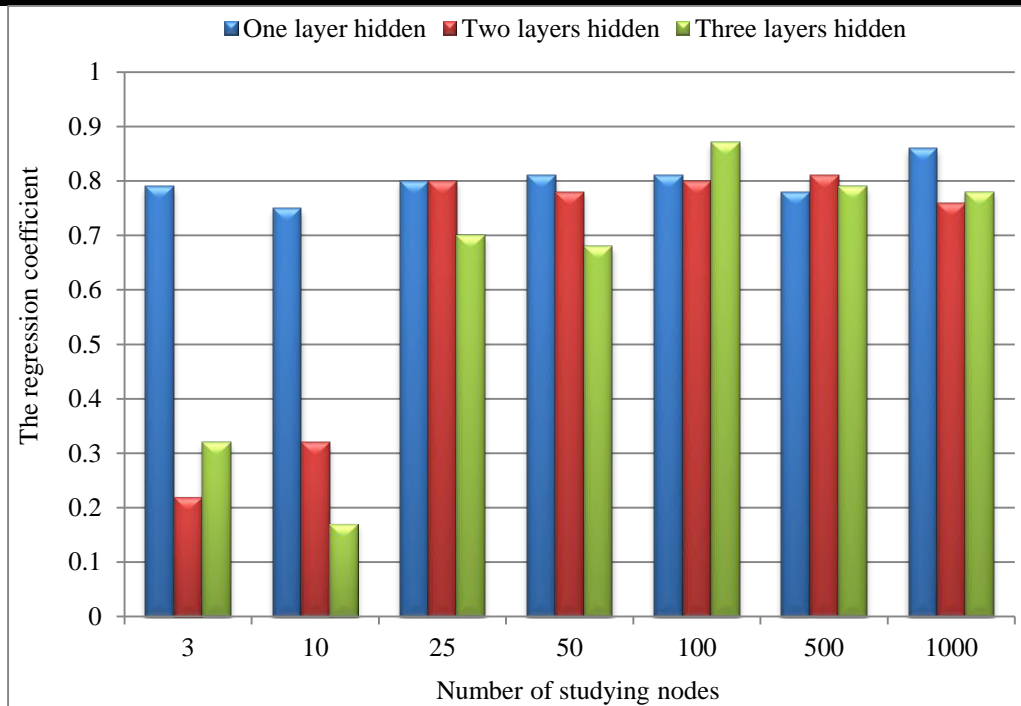


Fig. 5: Comparing the prediction regression coefficient with different layers, linear sigmoid tangent function with different training nodes

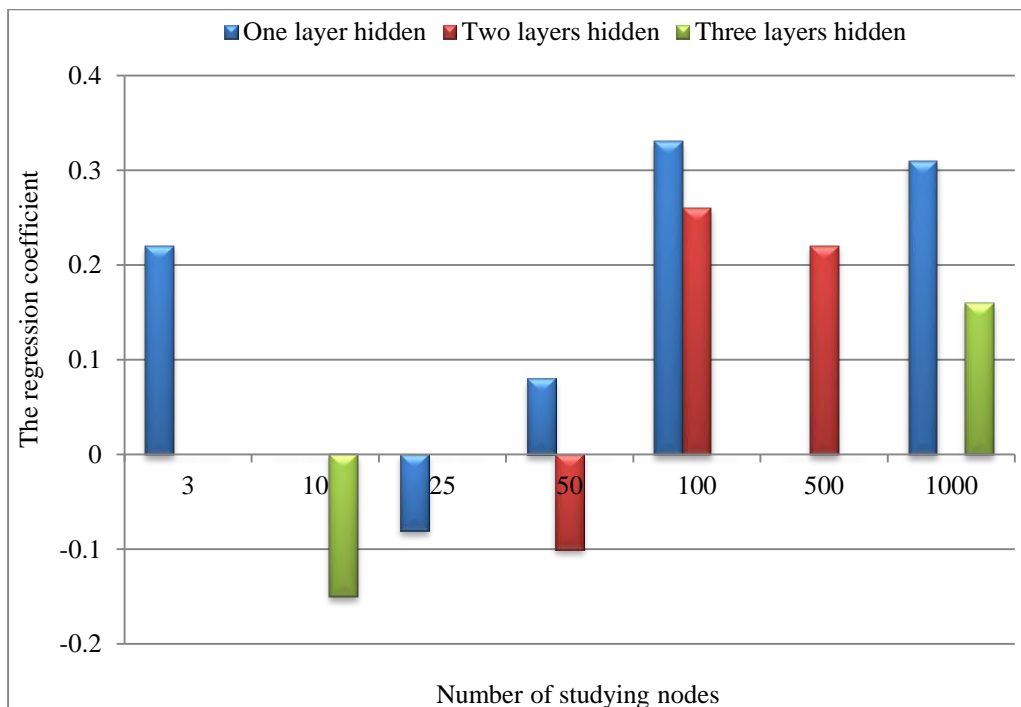


Fig.6: Comparing the prediction regression coefficient with different layers, linear sigmoid function with different training nodes

Based on the results of these diagrams, the extent of changes in error with the different number of hidden layers, number of nodes, and type of training function cannot be neglected. Comparing the results, it was found that 1 hidden

layer in the input, middle, and output along with 10 training nodes with sigmoid tangent function is the most suitable option for predicting COD parameter of Yazd treatment plant. Further, the above figures show that the sigmoid

tangent function has the minimum sensitivity to node change, while the sigmoid function is the most sensitive one. In addition, the sigmoid tangent function has the minimum sensitivity to changes in the number of layers, while the sigmoid function is most sensitive. Based on the

results, sigmoid tangent function is the best function, while the linear sigmoid is the worst function. The following figures demonstrate the training error analysis, validation, and test for the best neural network scenario.

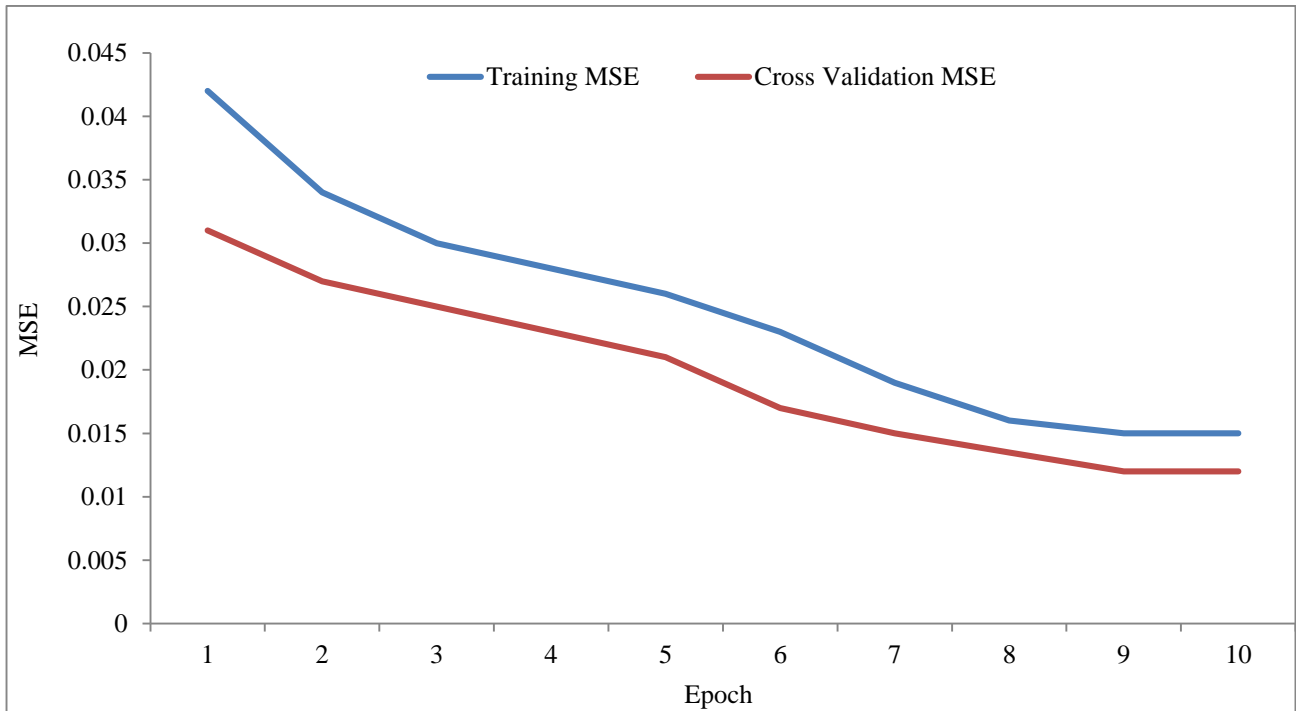


Fig.7: The training error and validation, sigmoid tangent function, one hidden layer and 10 training nodes

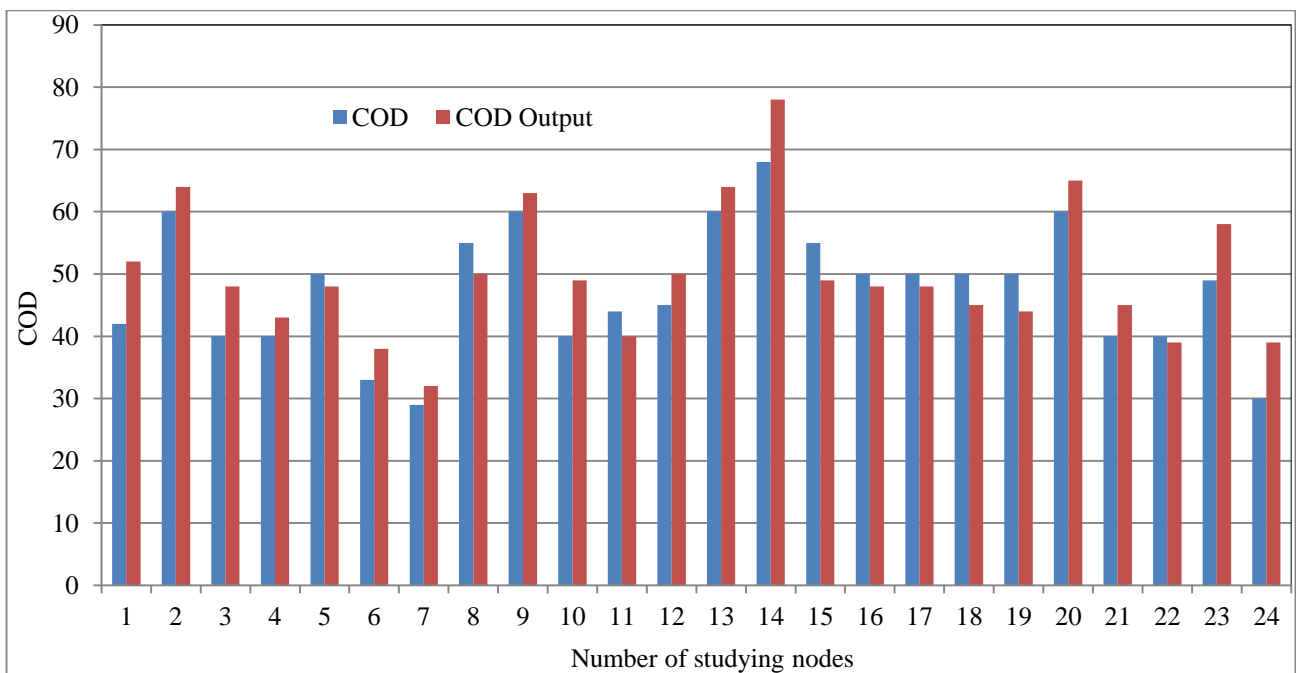


Fig.8: Comparing observational and prediction data, sigmoid tangent function, one hidden layer and 10 training nodes

Table.2: The predicted error analysis, sigmoid tangent function, one hidden layer and 10 training nodes

Reference	Result
MSE	18.95384
NMSE	0.5194133
MAE	4.271379
Min Abs Error	0.813998
Max Abs Error	6.014608
r	0.920182

The regression coefficient 0.92 indicates that neural networks can predict treatment plant performance regarding COD with a high accuracy. However, different researchers should not oversee the effect of different parameters for prediction. If suitable elements and factors are chosen, neural networks can predict COD with a good power. Otherwise, the results will be very unsatisfactory. The results of the research indicate that ANNs are a suitable instrument for predicting the performance of wastewater treatment plants.

IV. CONCLUSION

Use of ANNs can be very valuable for predicting the output COD of treatment plant. As the quantitative and qualitative properties of the input wastewater to the treatment plant, temperature, and other influential parameters in designing wastewater treatment plants are different with those of other treatment plants, it is not possible to employ a neural network trained in a certain treatment plant for other similar plants. It can be stated that a neural network in a treatment plant is considered acceptable when it is trained by correct and acceptable data of the same treatment plant. Further, all factors affecting the networks including number of nodes, number of layers, type of training function, type of network, and type of training rule should have also been investigated. The results of this research indicated that if all factors influencing the neural networks are examined, these networks are able to predict the chemical oxygen demand of the output wastewater leaving wastewater treatment plant in Yazd with a regression coefficient over 92%.

REFERENCES

- [1] Akram, M., Azari, A., Nahvi, A., Bakhtiari, Z., & Safaee, H. D. (2013). Subsurface drainage in Khuzestan, Iran: environmentally revisited criteria. *Irrigation and Drainage*, 62(3), 306-314.
- [2] Cao, G., Li, M., & Mo, C. (2008, December). Prediction of the anaerobic systems based on neural network with multipopulation parallel genetic algorithm. In *Intelligent Information Technology Application*, 2008. IITA'08. *Second International Symposium on* (Vol. 2, pp. 947-951). IEEE.
- [3] Daghighi, A. (2017). Harmful Algae Bloom Prediction Model for Western Lake Erie Using Stepwise Multiple Regression and Genetic Programming, Electronic Thesis, available at: <https://etd.ohiolink.edu/> (last access: 22 February 2018).
- [4] Daghighi, A., Nahvi, A., & Kim, U. (2017). Optimal Cultivation Pattern to Increase Revenue and Reduce Water Use: Application of Linear Programming to Arjan Plain in Fars Province. *Agriculture*, 7(9), 73.
- [5] Dawson, C. W., & Wilby, R. L. (2001). Hydrological modelling using artificial neural networks. *Progress in physical Geography*, 25(1), 80-108.
- [6] Eggen, R. I., Hollender, J., Joss, A., Schäfer, M., & Stamm, C. (2014). Reducing the discharge of micropollutants in the aquatic environment: the benefits of upgrading wastewater treatment plants. *Environmental science & technology*, 48(14), 7683-7689.
- [7] Ginn, T. R., Simmons, C. S., & Wood, B. D. (1995). Stochastic-Convective Transport with Nonlinear Reaction: Biodegradation With Microbial Growth. *Water Resources Research*, 31(11), 2689-2700.
- [8] Haghiri, S., Daghighi, A., & Moharramzadeh, S. (2018). Optimum coagulant forecasting by modeling jar test experiments using ANNs. *Drinking Water Engineering and Science*, 11(1), 1-8.
- [9] Han, H. G., & Qiao, J. F. (2012). Prediction of activated sludge bulking based on a self-organizing RBF neural network. *Journal of Process Control*, 22(6), 1103-1112.
- [10] Jacques, D., Šimůnek, J., Mallants, D., & van Genuchten, M. T. (2018). The HPx software for multicomponent reactive transport during variably-saturated flow: Recent developments and applications. *J. Hydrol. Hydromech*, 66(2), 211-226.
- [11] Karlebach, G., & Shamir, R. (2008). Modelling and analysis of gene regulatory networks. *Nature Reviews Molecular Cell Biology*, 9(10), 770.
- [12] Mahadevan, R., & Schilling, C. H. (2003). The effects of alternate optimal solutions in constraint-based genome-scale metabolic models. *Metabolic engineering*, 5(4), 264-276.
- [13] Mjalli, F. S., Al-Asheh, S., & Alfadala, H. E. (2007). Use of artificial neural network black-box modeling for the prediction of wastewater treatment plants performance. *Journal of Environmental Management*, 83(3), 329-338.

- [14] Moles, C. G., Mendes, P., & Banga, J. R. (2003). Parameter estimation in biochemical pathways: a comparison of global optimization methods. *Genome research*, 13(11), 2467-2474.
- [15] Nahvi, A., Daghighi, A., & Nazif, S. (2018). The environmental impact assessment of drainage systems: a case study of the Karun river sugarcane development project. *Archives of Agronomy and Soil Science*, 64(2), 185-195.
- [16] Nguyen, T. T., Yoon, W. J., Lee, N. Y., & Ju, H. (2017). Integration of a microfluidic polymerase chain reaction device and surface plasmon resonance fiber sensor into an inline all-in-one platform for pathogenic bacteria detection. *Sensors and Actuators B: Chemical*, 242, 1-8.
- [17] Reinoso, N. (2017). Forecasting Harmful Algal Blooms for Western Lake Erie using Data Driven Machine Learning Techniques. (Electronic Thesis or Dissertation). Retrieved from <https://etd.ohiolink.edu/>
- [18] Segre, D., Vitkup, D., & Church, G. M. (2002). Analysis of optimality in natural and perturbed metabolic networks. *Proceedings of the National Academy of Sciences*, 99(23), 15112-15117.
- [19] Xing, B., & Pignatello, J. J. (1996). Time-dependent isotherm shape of organic compounds in soil organic matter: Implications for sorption mechanism. *Environmental toxicology and chemistry*, 15(8), 1282-1288.
- [20] Zhao, X. M., Wang, R. S., Chen, L., & Aihara, K. (2008). Uncovering signal transduction networks from high-throughput data by integer linear programming. *Nucleic acids research*, 36(9), e48-e48.

Two Decades of Developmentalism: Bottlenecks and Plans of State Intervention in Brazil in the Second Half of the Twentieth Century

Sergio Francisco Loss Franzin¹, Fabrício Moraes de Almeida², Laura Borges Nogueira³

¹Teacher of Basic, Technical and Technological Education in the Federal Institute of Rondonia. Master in Letters. PhD in the Regional Development and Environment by the Federal University of Rondonia.

²PhD in Physics (UFC), with post-doctorate in Scientific Regional Development (DCR/CNPq). Researcher of the Doctoral and Master Program in Regional Development and Environment (PGDRA/UNIR). Leader of line 2 — Technological and Systemic Development, and Researcher of GEITEC — Federal University of Rondonia, Brazil.

³Teacher of Basic, Technical and Technological Education in the Federal Institute of Rondonia. Master in Regional Development and Environment.

Abstract— *This work takes as its theme public policies on development. It aims an overall analysis of the most urgent issues of political and economic plans launched in Brazil in the second half of the twentieth century. Specifically, the intention is to discuss the establishment of government policies in combating bottlenecks in the national economy through the Plans. This is an article based on concepts of development and the major general lines of the development plans in this country. Kon's works (1999) are the fundamental theoretical basis. We notice that Brazil experienced two very different decades, the 1970s and 1980s: the first focused investment for economic growth; the second, turned to fighting inflation. Because of discourses and appointed limits, developmentalism occurred, but no development in the strict sense. Between public debt and inflation addiction, which were parallel in the two mentioned decades, (still) rests the same issue in the country: What is development? What is the country's development?*

Keywords— *Development. Bottlenecks. State. Planning.*

I. INTRODUCTION

Big issues related to government plans always exist; there are always some threads that express ideologies, while inducing the perception of an urgent need for investment to tackle problems from different orders. The big issues, however, are sometimes activated by external policy models and discourses. This is a problem of world order. The relentless pursuit of development is not an invention of Brazil. According to Sachs (2000), the “development” came to existence in the most important era of the United States and through that country, after the Second World War, more specifically on January 20th, 1949, when it launched the political campaign in a global level which turned it into a role model for the world. That happened

on President Harry Truman's inauguration day, with the following statement: “We must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas” (p. 59). The apparent American solidarity is the marketing that induces the selling of a capitalist model, which is based on the immediacy of budget credits and sinks in long-term debt. In the long term, there is also a naturalization of coexistence of developed and underdeveloped countries, with ties of dependence and increasing distancing of economic moats.

We immediately raise the issue of import development to shed light on the conditions of the country in its economic planning. In the history of the creation of Development Plans, the major bottlenecks in economy appear in different ways in public policies, drawing us to the following question: what are these bottlenecks and how are they addressed when predicting investment and government intervention guidelines in Brazil?

The diagnosis on planning is always essential for the recognition of the positive and negative aspects that practice teaches. But there is another evaluation, a previous one, of proposals review, in order to understand the conditions of its emergence, the context of its application and the expectations generated by any new proposal. The Planos Nacionais de Desenvolvimento – PNDs (National Development Plans) are a rich source of public policies, controversy, ideology and even utopian aims abundant, and they require critical unveiling to better substantiate the history of economic development in the country. This study might seem a little late for each Plan, but it is not so for the historical context and the expectations of new plans, drawn up with every change of

government, crisis or simply need or interest in incrementalism, interventions and changes of all kinds. From the PNDs I, for instance, to the price-freeze orthodox plans, the examples are many, and they are complex and often controversial. One of the expectations is that there is an unresolved developmentalism on the national scenario.

This is a bibliographic study that aims to analyze the most urgent issues regarding political and economic plans launched in Brazil in the second half of the twentieth century. Specifically, the intention is to discuss the establishment of government policies on tackling bottlenecks in the national economy through the Plans during the 1970s and 1980s.

II. NATIONAL DEVELOPMENT PLANS

Before starting the analysis of Metas Plan, we make a digression about the conditions of development in the world. Berman's work (1986) is appropriate. In two of his chapters he examines development's fundamentalism and unravels the myth of appearances in this process. In "Goethe's Faust: The Tragedy of Development", he exposes the conceptual foundations of global developmentalism through the ideological profile of the character Faust. Ownership is highlighted as one of the principles of power; and each person's effort, as individual capital in the wake of development (p. 48-9). The latter requires policy and control. In the capitalist axis, its premise is the exploitation of workers. What matters are outcomes and not people or processes. This form of development is condemnable according to the essence of Faust: "It is as if the development process, even when it turns the empty land into a stunning physical and social space, recreated the empty land in the heart of the same fomenter. That is how the tragedy of development works" (p. 66).

In the chapter "Petersburg: the modernism of underdevelopment", Berman (1986) talks about a look-like capitalism. The project designed by the dictator Pedro I, for the foundation of St. Petersburg, viewed the Russian city as a "political theater" and "everyday life as a spectacle", for the death of more than 150 thousand workers was the means to make sculptural works so that they could be used by an elite that was in opposition to a crowd of strangers. It was a way of seeking hegemony at the expense of wonder. Berman (1986) saw it as a "bizarre modernity" (p. 174) that should prompt people to feed such form of expression. By reference to the Bronze Horseman from Alexander Pushkin's poem (1833), he shows the motivation to keep the movement desire in the heart of society, ranging from the congeniality of the aristocrats and the threshold of the uprising of the people.

A form of surrealism then was maintained, which raised as fascination work what was cemented in the ground of the low classes.

The National Development Plans, in Brazil, often reveal some tendency to reach prestige, up to the point of resignation, when they seek to overcome chronic problems, such as poverty and misery (in part byproducts of inflation) appears desperately. Through a utopia of magnitude they try to reach the long crossing that separates the predatory development of sustainable development. For the scope of this study, that crossing would still be at a great distance.

The goal here is not to describe the plans, but to reveal what they highlight as appeal or trend during their period of existence. First, we must distinguish development from developmentalism. Sachs (2000) brings concepts in chronological order, conditioned to ideologies and social states historically settled in often biased chains. He differentiates an American developmentalism of self-indulgent marketing from another concept that unfolds progressively until the modern and necessary assumption that implies sustainability and equity. He proceeds from an evolutionary theory to reach the sociology of sense. That is, he starts from the precarious sense that development is a continuous transformation that reaches the problematic of the term in the minefield of politics, economy, science, technology and other topics of social life within the paradigm of complexity.

Development, beyond the sense of transformation, of movement, is a historical process that depends on the context in which it is employed. Thus, there is industrial development, social, economic, regional development. But the term is also capable of, while only a noun unit, represent the whole complexity of issues that it entails. Sachs (2000) demonstrates a conditioned and addicted concept first, and then gets to the expectation of what the term may represent universally: when he relates it to the ideal of world leadership of the United States after World War II, he criticizes colonialism, which separates developed from underdeveloped ones; when he analyses the United Nations' (UN) concept in 1960's, he subjects the term to social issues, particularly regarding the improvement of quality of life. He cites UN conclusions in the *Report of the 1969 Meeting of Experts on Social Policy and Planning*, from 1971, to show the other side of the same process: "The fact that development leaves in its way, or somehow even creates, large areas of poverty, stagnation, marginality and a real exclusion of social and economic progress is too obvious and too urgent to be ignored" (p. 68). The assertion is

confirmed in view of the regional inequalities and of the large pockets of poverty in countries like Brazil.

The first assumption to be considered, with the progress of the concept, is that development is not summed up to economic growth. According to Schumpeter (1997, p. 70), “[...] the economic status of a people does not emerge out of simply previous economic conditions, but uniquely out of a previous whole situation.” It is understood that the economic situation is one of the social issues and they are seen as intertwined permanently. To alienate one from the other stops the correct apprehension of this debated concept here; it alienates a Nation’s proposals. The concept has changed, according to Amaro, cited by Moreira and Crespo (2012, p. 39), because of the following circumstances:

- (i) the frustrations of the Third World countries due to the evolution of their development;
- (ii) increasing signs of social malaise in developed countries;
- (iii) the awareness of environmental problems caused by development;
- (iv) irregularities of economic growth in the decades following the “golden years”;
- (v) the multiplication of various crises in socialist countries.

The historical context compels to revisionism. For a perspective of “developmentalism”, which is the controversial practice of the concept or concepts of development, we simply have to look at the reverse side of the Development practiced mainly since last century. Sachs (2000) highlights the production of waste from polluting factories and poison pesticide; the shortages resulting from unsustainable exploitation; the violent capitalist domination, which devalues forms of social life in favor of invasive economic power of market, in order to demonstrate a certain perversion of the term. He contrasts valuation and devaluation:

The fragile individual, whose survival depends necessarily on the market, was not an invention of economists, nor was born to Adam and Eve, as these argue. It was a historic setting. It was created by the economic project that redesigned humanity. The metamorphosis of autonomous men and women into a devalued “economic man” was, in fact, a precondition for the emergence of the economic society, and is a condition that must be constantly renewed, reconfirmed and deepened so that the reign of the economy can continue. The devaluation is the secret of economic value and can only be created with violence and a

permanent confrontation with whoever opposes it (p. 74).

Devaluation extends to culture, groups’ ways of life, autonomy, social equity, once they oppose economic growth proposals. Developmentalism is a negative result of development proposals based solely on capital expansion, even when indirect, through targeted investments, putting aside urgent bottlenecks such as health, education, housing, safety and environment, causing them to be in a more severe situation, besides science, technology, culture and other issues of social context. Developmentalism is expressed, for example, in inflation risks, in environmental degradation, in low scientific and technological production and in other factors of blatant stagnation, retrogression, dependence and many kinds of (political, governmental) disorder. In the two most alarming decades of the second half of the twentieth century, we highlight two very different facets of Brazil, in the wake of developmentalism: a debt in favor of prospect of economic growth and uncontrolled and excessive vicious circle of inflation.

2.1 BRAZIL-POTENCY IDEOLOGIES

Every organization requires planning. It is a governance assumption and is not limited to only one kind. The Development Plans specialize in the perspective of problem solving and/or in the opportune use of contemporary opportunities. Their success, however, depends not only on their configuration, but also on the choices made and management conditions that may be established, in addition to occurrences of internal and external scenarios.

According to Gremaud and Pires (1999, 41), the establishment of action programs is a tradition that started in 1950: “[...] in the Kubitschek period, Metas Plan; Trienal Plan, during Goulart’s presidency; PAEG during Castelo Branco’s term; and PED (Strategic Development Plan) during Costa e Silva’s period.” The National Development Plans became mandatory through the Complementary Acts 43 and 76, in 1969, and should last as long as a president’s term. The document Metas e Bases para a Ação do Governo immediately preceded PND I, in 1970, under President Emilio Garrastazu Médici, and worked as a complement of that document. That was the period of the “military coup”, taken place in 1964, and was followed by an internal coup to maintain the military in power, especially with public debate’s restrictions by the Institutional Act 5 (AI-5), from December 1968.

Before, during Juscelino Kubitschek’s government, with the evolution of ideologies of the country in a utopian proportion of “50 years in 5”, the

intention was, according to Mendonça (1988, p 51), to promote an “acceleration of capitalist accumulation” in the short term and, in the medium term, raise the quality of life. This ideology of fast growth continued in the first PND, highlighting that the Gross Domestic Product (GDP) should increase at over 7% per year. According to the document, quoted by Gremaud and Pires (1999, p. 44), a self-challenge was set to culminate in the ideas of splendor that insisted in emerging: “[...] Brazil not only aims to grow. It desires, till the end of the century, to be part of the developed world.” It is necessary to analyze what the implications of these ideologies of splendor are, as Mendonça says (1988, p 75.):

the period between 1962 and 1977 was a whole economic crisis, and from the inflection produced in 1964, a calculated recession was carried out, and it was considered necessary for the restoration of the economic cycle. Its result would be — between 1968 and 1974 — known as “the Brazilian miracle”, whose essence meant nothing but the assurance of Pharaonic profits to (domestic and foreign) monopolistic companies.

The government interventions were necessarily given in favor of the economic situation and can be specified as Gremaud and Pires (1999) expose:

- Funding from many banks (BNB, BASA etc.), with longer terms;
- Creation of tax benefits;
- Creation of the public enterprise where there should be the private national enterprise (231 from 1968-74) / creation of sectorial holdings;
- Creation of investment funds: Funds 157;
- Expansion of the agricultural frontier and land use;
- Creation of incentive funds (BEFIEX).

The tax benefits to industries, still according to Gremaud and Pires (1999, p. 49), were:

exemption of import tax on capital goods with no national similar ones, IPI exemption on capital goods, credit in the IPI value for the acquisition of domestically produced capital goods, accelerated depreciation of capital goods domestically manufactured, preferential financial support by official credit institutions and priority granting to be examined by the Customs Policy Council in case of change in import duties.

The bottleneck of economy, in this sense, would be the lack of development in local market, agriculture and industry — especially in the latter. Brazil aimed to be launched into the “nuclear age”, into the “Second Industrial Revolution” and into the “space era”, surprisingly, once the country could barely keep its feet on the ground. Although there was what is considered the “economic miracle”, between 1968 and 1973, when the GDP, according to Gremaud and Pires (1999), increased at an average of 11.7% per year (12.7% in industry), some problems that became chronic as time passed by emerged: external debt, tax burden increase (from 22.4 between 1965 and 1969 to 24.7 % between 1970 and 1973), dumping of society in decisions about the course of national economy and stagnation or fall of the minimum wage. Therefore, the “economic miracle” did not promote development in its broadest sense, agriculture increased only 4.9% annually between 1970 and 1973 and social inequality prevailed again.

According to Suzigan et al, cited by Gremaud and Pires (1999, p. 56), PND I had a triple ideology: “a) a national strategy for integrated development, b) a development strategy for the northeast, via tax incentives, c) implementation of a strategy of occupation and consolidation of the Amazon”. The plan contained guidelines for promoting the development of backward or stagnant regions, especially in frontier expansions in the Amazon, and industrial development in the Northeast. Some problems became emblematic. For example, the expected integration of the Amazon with the rest of the country by the Transamazônica Highway was lost along the way, for it still has not been finished. Mendonça (1988, p. 83) sums up an era as follows:

The crisis of the [economic] “miracle” was marked by two peculiarities: that was a debt crisis and a crisis of breath exhaustion of the state in trying to maintain growth. The existence of foreign companies occupying a prominent place in the economy of the country created a link abroad that had a great impact on the creation of this crisis. Multinational companies imported many basic materials of capital goods generating a deficit in the commercial balance. Also, as they had the same amount of profits here, they resulted in capital flight that was high for the Balance of Payments.

The creation of a power or simply investments in production process are not sufficient to promote development. According to Furtado (1974, p. 95-6), “[...] the global diffusion of technical progress and the resulting increase in productivity do not tend to liquidate

‘underdevelopment’”, considering that policies of centralization of benefits favor small groups, and corruption and mismanagement cripple Plans or slaughter them in their course. According to Mendonça (1988), the working class in 1974 dealt with a wage squeeze; problems related to the health sector increased child mortality and epidemics, the basic-needs grocery package was extremely expensive and housing increment was hindered by the diversion of resources from popular housing construction to the construction of luxury properties. Each of these problems requires a detailed investigation if the intention is to make a comprehensive survey of facts and deeds that have marked and guided the country in that period.

The PND II was introduced by the Government Ernesto Geisel in 1974, valid up to the end of the decade, according to Gremaud and Pires (1999 b). That was a time of international oil crisis and breaking of agreements with the Bretton Woods group, involving the International Monetary Fund (IMF) and the World Bank. Brazil would continue its discourse of developmentalism for continued growth. The fields of activity of PND II (BRAZIL, 1974) were:

- a) Modernization of economy, especially in the Mid-South region, focusing on energy, transport and telecommunications;
- b) Development of domestic sources of energy and metallurgy;
- c) Internal colonization policy through Poloamazônia and program of integrated areas in the Northeast region, among other alternatives;
- d) Improvement of income distribution, with poverty reduction;
- e) “integration with world economy.”

In practice, Gremaud and Pires (1999 b) affirm that a positive point is that PNDII kept GDP growing; a negative one is that there was once again the foreign debt at the expense of the State, that received private debt prior to expiration and took them over from International creditors under floating rates and unstable exchange. Intervention measures and problems are recurrent between PND I and II. On one hand, the bottlenecks involving, in sum, regional inequality, public debt, inflation and insufficient industrialization; on the other hand, the points of germination, seen as the increment of international capital and exploitation of potentials for industry. Education, that is part of the five sectors elected by the Joint Commission between Brazil and the United States in the 1950s to compose Metas Plan, as exposed by Lafer (1997), was again little significant or practically inexistent in both periods. On the other hand, energy,

transport, food and basic industry were highlighted, in particular energy and industrialization matrices.

According to Mendonça (1988), the PND II came to birth with the imperative challenge to maintain or recover the “economic miracle”. Industrial growth had fallen from 10 to 4.5% per year and the government-owned corporation would have to reorient the capital accumulation from the consumer goods sector towards the production goods sector. We notice again that focus on industrialization was one of the strongest tendencies of economy. Gremaud and Pires (1999 b) affirm that the oil shock influenced payments and productive structure in Brazil; then they conclude that investments had as one of the priorities the establishment of large companies through mergers or takeovers that, according to Mendonça (1988), are forms of oligopolistic market. According to her, the definition of a new industrial sector (with priority given to areas of steel, hydro, basic chemistry and minerals) generated instabilities; the Plan was launched without considering the external scenery; political resistance occurred, and speculation invaded the financial market. The pointing scenario was this:

The Brazilian economy followed an increasingly speculative trail. At this point in time, as the demand for durable consumer goods was still under the effects of the expansion period, the exceeding of the country’s own producing capacity was likely to happen. These facts and the increasing of costs caused producers to prefer to ensure their profit based on the price increase, not venturing new investments. This behavior, that affected inflation fatally, was ratified during PND II. [...] The economy recession setting deepened. (p. 88-89)

Developmentalism is characterized by not solving social problems, by the incrementalism of the public sector, by sectorial favoring to private companies, inflation worsening and increase in state debt.

The PND III, the period between 1980 and 1985, crossed again the same problems as before: social inequality and low sector and/or regional growth, according to the Basic Document (BRAZIL, 1979). Gremaud and Pires (1999 b) summarize the problem with the following symptoms: energy crisis, public debt in payments, enlarged external debt, alarming inflation and severe unemployment. The new Plan estimates investments: to the sectors of Agriculture and Supply, according to the same authors, through incentives to production, research, innovation and improvement of living conditions of rural workers, including “[...] the

incentive to forestry and agroforestry for food and energy” (p. 98);to the industrial sector, continuous incentives to productivity and focus on increasing exports and supply of consumer goods; the energy sector is greatly highlighted, being expected the discouragement to the production of energy by means of oil and coal by-products and the encouraging of nuclear, hydropower and other “clean” forms of energy, besides ethanol production; to the social sector, in education, culture, health, housing, employment and worker’s compensation, nevertheless, generic expectations of improvement. Also, according to Gremaud and Pires (1999 b, p. 99), the

definition of the plan was damaged, since the establishing of quantitative targets did not happen, because of the determinant restriction imposed by the crisis in the Balance of Payments, primarily related to the costs of external debt and its evolution, whose determinants were out of the government control — second oil shock, increase in the U.S. interest rates, U.S. recession and sharp drop in terms of trade.

Thus, Gremaud and Pires (1999 b) say that the Plan was abandoned in 1982, with the country going through the same problems of social inequality and internal and external debt. Until that point, there was an investment fixture almost in the bottlenecks and germination points, being far from the “economic miracle” period, from 1969 to 1973. According to Furtado (2005, p. 89-90),

the idea of economic development is a mere myth. Thanks to it, it has been possible to divert attention from the basic task of identifying the basic needs of the community and of the possibilities that provide men the advance of science, to concentrate them in abstract goals, as are investments, exports and growth.

This observation is valid throughout the flow of developmentalism, which considers development only what is related to the capital, dealing with other issues as mere supporting bases. Only more recently the minimalist concept has been replaced by a network of concepts — of social, cultural, regional, scientific, technological, educational and economic development. The lack of quantitative targets or not fulfillment of the proposed ones keep the same ones in a single path, opening craters in the germination points (overexploitation of natural resources, fiscal and wage squeeze, use of foreign capital) and penetrating only the surface of bottlenecks (deficit of

health and education, social and regional inequality and innovative, technological and industrial insufficiency).

2.2 THE INFLATIONARY VICE

Brazil came out of the period of military dictatorship in 1984, with chronic problems. In 1986, during the government of José Sarney, the Cruzado Plan was launched. The scenario, according to Kon (1999), was chaotic, because of a larger inflation allied to droughts and frosts in agriculture. The rate, which was 40% per year in 1978 and 90% in 1980, reached 100% in 1981 and 1982 and 220% in 1983 and 1984. With drastic measures, the Cruzado Plan was established, as the author continues (p. 109-112):

- a) Replacement of Cruzeiro with Cruzado, with the currency conversion in the order of Cr\$ 1,000.00 to Cz\$ 1.00;
- b) Price freezing for an undetermined period, involving the general population to reach control;
- c) Conversion of contractual obligations according to currencies conversion;
- d) Conversion of wages considering their average value and purchasing power, with an additional bonus of 8%;
- e) Conversion of rents, installments and school dues also by the principle of the average;
- f) Control of monetary adjustment (wages, contracts, savings) by indexation or de-indexation values according to the Consumer Price Index (CPI);
- g) Creation of a new CPI, for the conversion of data between Cruzeiros and Cruzados;
- h) Establishment of a new fiscal policy, in relation to the conversion of taxation, wage bonus and reporting systems of income tax;
- i) Creation of interbank deposit from a new monetary and credit policy;
- j) Settlement of an exchange rate without freezes;
- k) Establishment of unemployment insurance.

In general, the fundamental bottleneck was inflation, with risks to reach 300% per year according to Kon (1999) or, according to Macarini (2009), over 400%. The freeze and its associated measures to introduce the control of inflation occurred under risk, in view of the increase in aggregate demand and insufficiency in aggregate supply, besides the increase in the public deficit, as evidenced by Kon (1999). For the poor class, there was a decrease in uncertainties related to their purchasing power, since the salary adjustments never followed the inflation indices, while the creation of the unemployment insurance consisted of a palliative income redistribution policy; for those who accumulated capital,

speculation cooled until a new inflationary process was generated.

The correction of such a complex problem, which was the collapse of the national economy, could not be done by mere proposition and in a minimalist way. Instabilities required a correction of the Cruzado Plan, known as “Cruzadinho”, which brought a Metas Plan involving a rise in income tax, opening of compulsory loans and investments incentives, among other measures. Late in 1986, that is, before the completion of one year, the Cruzado Plan 2 was launched, and according to Kon (1999), that happened especially to carry out a realignment of prices and taxes, in view of the “slowing growth” and “tax evasion”. However, inflation was reactivated from 7.7% per year in 1986 to 1,000% in price increase; in interest rates, it reached 2,000% per year. Regarding external debt, the government decreed a unilateral moratorium in February 1987.

Two new plans would be launched in the Sarney era. The Bresser Plan, inaugurated by the Finance Minister Bresser Pereira, in the first half of 1987, according to Carvalho (1999), had as one of its purposes to promote a new price freeze for 90 days, associated with wages corrective measures, market and exchange prices, among other measures. A Unit Price Reference (URP) was established at a ratio of 1 to 100 Cruzados. The goals were, according to Carvalho (1999, p. 128):

- a) ensure economic development and full employment;
- b) redistribute income between households and regions more fairly;
- c) fight inflation and achieving a reasonable price stability;
- d) achieve trade surplus that allowed the negotiation of external debt in a sovereign manner.

The Consistência Macroeconômica Plan (PCM) was launched, aiming the gradual GDP growth, increase of credit in the trade balance, inflation control and better income distribution for the period between 1987 and 1988 — that is, it fights practically the same bottlenecks as ever. In the same period, in August 1987, Programa de Ação Governamental was also launched (PAG) to be valid between 1987 and 1991, in order to “[...] achieve sustainable development and achieve success in combating inflation” (p. 142), as Carvalho exposes (1999).

Carvalho (1999) also reports that, with the inauguration of the new Minister of Finance, Maílson da Nobrega, Verão Plan was launched in January 1989. The main measure was clearly expressed in the statement by

President José Sarney on January 15, 1989, according to the journal *Revista de Economia Política* (1989, p. 127): “[...] I want to make a call to all for a total battle against the inflationary process, with the toughest weapons and deepest measures ever taken in this country to face this problem”. Sarney adds in the same statement that inflation could reach 1,500% per year and that “[...] no State has ever had its institutions preserved in a situation like that” (p. 128). Was that the time for a new shock? The country implemented another currency, the Cruzado Novo, through the Provisional Measure 32 (BRAZIL, 1989), for the same reason as before (from Cz\$ 1,000.00 to NCz\$ 1.00), and promoted a new price freeze for an indefinite period. The remaining matters – exchange control, foreign debt trading and price realignment followed, among other measures. According to Moraes (1999, p. 177), the GDP growth between 1980 to 1989 was only 2.2% per year on average, justifying what they qualified as the “lost decade”.

A new political phase began in March 1990, by the inauguration of President Fernando Collor de Melo. With it, Brasil Novo Plan, or Collor I Plan, formalized through a series of Provisional Measures of liberal approach, as demonstrated by Moraes (1999). The control of cartels and trusts and of price and wages adjustments formed a backbone of political organization intervention. There were short-term freezes and increase in the prices of communication services and fuel supply. We must also highlight the determination of the exchange rate by the market itself, the institution of Cruzeiro replacing Cruzados Novos at the rate of Cr\$ 1.00 for NCz\$ 1.00, besides the confiscation of savings worth more than Cr\$ 50,000.00. In February 1991, inflation reached, according to Moraes (1999), 20% per month, revealing weaknesses also of the Collor Plan in relation to this bottleneck. Between January and April 1991, Collor Plan II was in effect, restarting the price correction and freeze, raising public tariffs. The minister then, Zelia Cardoso de Mello, was replaced in May 1991 by Marcílio Marques. The new minister abandoned the practice of price freezing and inflation reached 1,158% in 1992. Then, there was the president’s impeachment on corruption charges.

By the end of 1992, with the inauguration of Vice President Itamar Franco in succession to the deposed president, begins a new era, that of neoliberalism. The Real Plan had as one of its goals the control of inflation and again replaced one currency with another, but new directions were given and could not be analyzed in this short essay. It is, therefore, the object of another work, as well as the other Plans from the other eras of the Brazilian Government.

III. FINAL CONSIDERATIONS

During the period of 1968 to 1991, two trends of developmentalism existed: the one from the 70s focused on the ideals of magnitude that the “economic miracle” then raised; and the one from the 80s, got stuck by inflationary figures that turned it into the “lost decade”, since the low economic growth contrasted with the high national and international public debt. If in the first case there was an overoptimistic patriotism because of industrialization, once not satisfied, the second was an agonizing effort to overcome an announced chaos, with galloping inflation.

The objectives of industrial growth and better income distribution were not achieved in the first phase: either there were no established objective goals to pursue, or they were abandoned through the way, when established. Thus, there was a period of financial stability and economic growth, but development remained precarious. Systems to control inflation by freezing prices and other sudden forms of State intervention were only palliative, since the periods of peace were too short. State intervention did not led to governance and vices of fiscal policies remained. Within a precarious management, severe corruption problems arose.

Developmentalism reigned in place of development in the first phase because Brazil was not able to address the points of germination (availability of resources, opportunities for exports, GDP growth), promote the overcoming of social and regional inequalities; and in the critical phase of inflationary vice, there was an increased debt and not enough progress in addressing social issues. We also notice a linear path, fairly uneven during the 80s, through which travel public policies without an innovative guideline for the promotion of development. This path continues, but the gap does not seem so announced. Studies on the Real Plan until the National Policy for Regional Development today would be quite auspicious for a broader view of the complex conditions of the country.

From Goethe’s Faust to the Petersburg of Peter I, as references in the wake of development, there is a path that repeats itself in different ways on the national scene, since social issues remain unresolved in Brazil — despite economic growth — and the ideals of magnitude dissolve in historical ills. The stigma of developmentalism is this controversial condition of failure due to repeated mistakes, either by lack of preparation, or by a suspicious form of corruptive accommodation. Between public debt and inflationary vice, coexisting during the decades 1970 and 1980, (still) rests the same issue in the country: What is development? What is the country’s development?

REFERENCES

- [1] BERMAN, M., 1986, *All that is solid melts into air: the adventure of modernity*. São Paulo: Companhia das Letras.
- [2] BRAZIL., 2014, Presidency of the Republic.. **Institutional Act 5/1968**. Available in: <http://www.planalto.gov.br/ccivil_03/AIT/ait-05-68.htm>. Access: 30 jan. 2014.
- [3] _____. _____., 1969, **Complementary Act 43/1969**. Available in: <http://www.planalto.gov.br/ccivil_03/ACP/acp-43-69.htm>. Access: 30 jan. 2014.
- [4] _____. _____., 2014, **Complementary Act 76/1969**. Available in: <http://www.planalto.gov.br/ccivil_03/ACP/acp-76-69.htm>. Access: 30 jan. 2014.
- [5] _____. _____. 1971, **First National Development Plan**. Rio de Janeiro: IBGE Chart Service.
- [6] _____. _____. 1974. **Second National Development Plan (1975-1979)**. Brasília.
- [7] _____. _____., 1979. **Third National Development Plan (1980-1985)**. Brasília, 1979.
- [8] _____. _____., 2014. **Decree-Law 2.284/1986**. Available in: <http://www.planalto.gov.br/ccivil_03/decreto-lei/del2284.htm>. Access: 30 jan.
- [9] _____. _____., 2018, **Provisional Measure 32, converted into Law 7.730/1989**. Available in: <http://www.planalto.gov.br/ccivil_03/MPV/1988-1989/032.htm>. Access: 30 jan.
- [10] CARVALHEIRO, N., 1999, **The Bresser (1987) and Summer(1989)**: persistence in the pursuit of stabilization. In: KON, A. (Eds.). *Planning in Brazil*. São Paulo: Perspectiva.
- [11] FURTADO, C., 1974, **Analysis of “model” Brazilian**. 4. ed, Rio de Janeiro: Brazilian Civilization.
- [12] _____. 2005, **The myth of economic development**. Rio de Janeiro: Continuum.
- [13] GREMAUD, A. P. e PIRES, J. M., 1999, “Targets and Bases” and the First National Development Plan— NDP I (1970-1974). In: KON, A. (Eds.). **Planning in Brazil**. São Paulo: Perspectiva.
- [14] _____., 1999b, **Second National Development Plan — NDP II (1975-1979)**. In: KON, A. (Eds.). **Planning in Brazil**. São Paulo: Editora Perspectiva.
- [15] KON, A., 1999, **The Cruzado Plan**. In: KON, A. (Eds.). **Planning in Brazil**. São Paulo: Editora Perspectiva.

-
- [16] LAFER, C., 1997, Planning in Brazil: observations on the Target Plan (1956-1961). In: LAFER, B. M. *Planning in Brazil*. Rio de Janeiro: Perspective.
- [17] MACARINI, J. P., 2009, *The economic policy of the Sarney government: the Cruzado Plan (1986) and Bresser (1987)*. Campinas: Unicamp.
- [18] MENDONÇA, S. R. de., 1988, *State and Economy in Brazil: development options*. Rio de Janeiro: Grail.
- [19] MORAES, A. C. de., 1999, New Brazil Plan. In: KON, A. (Eds.). *Planning in Brazil*. São Paulo: Perspective.
- [20] MOREIRA, S. B. e CRESPO, N., 2012, *Development economics: the traditional approach to new concepts of development*. In: Journal of Economics. Vol. 38, n. 2, year 36, Curitiba: UFPR, May/August.
- [21] REVISTA DE ECONOMIA POLÍTICA., 1989, *Plan Summer*. Vol. 9, n. 2, [s. l]: [s. n.], April-June.
- [22] SACHS, W. 2000, *Dictionary development: guide to knowledge as power*. Petropolis: Voices.
- [23] SCHUMPETER, J. A., 1997, *Theory of economic development*. New York: New Cultural.

Strategic Planning: a model based on Systems Engineering

Herlandí de Souza Andrade^{1,2}, Geilson Loureiro^{3,4}

¹Faculdade de Tecnologia de Guaratinguetá, Brazil

²Faculdade Anhanguera de Pindamonhangaba, Brazil

³Instituto Nacional de Pesquisas Espaciais, Brazil

⁴Instituto Tecnológico de Aeronáutica, Brazil

Abstract—This work has the main motivation to propose an approach based on Systems Engineering to expand the scope of Organizational Strategic Planning. The proposed method was idealized considering the approaches of Chiavenato & Sapiro (2003) and Loureiro (1999). It is considered that the proposed method was more adequate than the traditional models previously applied.

Keywords—Strategic planning, Strategy, Systems engineering.

I. INTRODUCTION

Traditional strategic, tactical, and operational planning processes focus on three types of stakeholders: the shareholders, customers, and competitors of the organization. In addition, the metrics derived from this process are hardly deployed to the abilities of the organization's individuals and groups. This work has as main motivation to attack these two opportunities, scope and depth, using a systemic approach to expand the scope of Strategic Planning and at the same time, it proposes to deepen the definition of organizational metrics towards the competence required of people.

In Strategic Planning, all strategies should go in a balanced way to meeting the strategic objectives. Strategic Planning shows a static picture of a future planned for the organization. Lacking Strategic Planning, however, tools to analyze the relationship between objectives and prospect the evolution of these objectives. These types of tools are the essence of Systems Engineering. The goal setting process is complex and dynamic. Organizations do not just pursue a goal, they need to satisfy a huge amount of requirements imposed on it by the environment and the different stakeholders. The objectives, too, are not static, as they are in continuous evolution, modifying the organization's relations with its environment. Thus, it is no exaggeration to say that organizations are rationally planned structures to achieve goals. In general, in Systems Engineering, the first step is to always identify the stakeholders of a particular system and what its needs are, and then draw up

a list of specific requirements for the system. These system requirements resemble organizational goals. Thus, in System Engineering, the system functions and all its other physical characteristics are formatted to meet, in a balanced way, the requirements of the stakeholders.

Strategic Planning lacks the tools to shape strategies once the strategic objectives have been defined. In Systems Engineering, on the other hand, after establishing the requirements of the stakeholders, several functional and physical modeling tools are applied, in order to conceptually shape the product or system to be developed, as stated above. As both disciplines have important tools for analyzing and defining actions, the most appropriate ones can be used in each situation, thus making a broader approach to achieve the desired result. In fact, the concern should be with the concept and not with the tools themselves.

According to Stevens et al. (1998), Systems Engineering will define the future of modern business. This is because a good system engineering system represents a real advantage, enabling organizations to satisfy their stakeholders in a competitive way. And according to Chiavenato & Sapiro (2003), undoubtedly conquering new market spaces is the result of superior strategies. The chronicle of business clashes between companies is rich in fascinating examples of daring actions, cunning, strategic and systemic reasoning, and also dedication.

This paper aims to present a Systems Engineering approach for the elaboration of Organizational Strategic Planning. Systems Engineering is a collaborative multidisciplinary approach to derive, develop and verify a balanced solution / system throughout the life cycle to satisfy the expectations of stakeholders (Loureiro, 1999). Systems engineering is generally used for the development of complex products or systems. Strategic Planning is a process of formulating organizational strategies, in which the organization and its mission are sought in the environment in which the organization is operating (Chiavenato & Sapiro, 2003).

In this paper, we start from the premise that organizations are complex systems that can be evolved by Systems

Engineering. Another premise is that the traditional Organizational Strategic Planning process does not include necessary aspects covered by Systems Engineering, such as the analysis of the needs and expectations of all stakeholders, the mapping of processes, the analysis of risks, the unfolding of objectives and goals, allocating them in the processes that generate them, in order to attend all stakeholders in a balanced way, among others.

II. LITERATURE REVIEW

2.1 STRATEGIC PLANNING

The term strategy, from the Greek word *strátegos*, was used to define a position (the general in command of an army), over time came to designate "the art of the general", meaning the application of the general's powers in the exercise of its function (military art). 450 BC, by the time of Pericles, the strategy designated managerial skills, leadership, oratory and power. By the time of Alexander the Great (330 BC), it meant the use of forces to defeat the enemy.

This shows that the concept of strategy has been applied in a scenario of war. The generals began to plan military actions before taking action. About 500 BC a book on the art of war was written by Sun Tzu, a Chinese general. In this book is portrayed the preparation of war plans, the variation of tactics, the army in march, the terrain, the strengths and weaknesses of the enemy, the organization of the army, among other important points.

According to McCraw (1998), the adaptation of the term military strategy to the business area began after the Industrial Revolution in the nineteenth century, when organizations began to use military concepts of strategy in their business operations.

There are many concepts of strategy, by different authors, let's look at some of them:

- Business Strategy means a pattern of objectives and key policies to achieve them, expressed in a way to define in what business the company is, or should be, and the type of company that it is or should be (Andrews, 1980).
- Business Strategy can be defined as the determination of a company's long-term goals and objectives and the adoption of courses of action and allocation of the resources needed to achieve those goals (Chandler, 1976).
- Business strategy means competitive advantage. The only goal of Strategic Planning is to enable the company to gain, in the most efficient way possible, a sustainable margin over its competitors. Corporate strategy means trying to change the power of a company over its competitors in the most effective way (Ohmae, 1982).

- Competitive strategy is, in essence, the development of a broad formula for how a company will compete, what its goals should be, and what policies are needed to achieve those goals (Porter, 1986).
- Business strategy is a comprehensive master plan that establishes how the organization will achieve its mission and objectives (Wheelen & Hunger, 1989 apud Chiavenato & Sapiro, 2003).
- Business strategy is the standard, or plan, that integrates the main goals, policies, and sequences of actions of an organization into a coherent whole (Quinn, 1992).
- Strategy is the means employed, the way forward, that the company chooses to achieve a goal, a goal (Valadares, 2002).

As for Strategic Planning, it can be defined as the continuous process of, systematically and with the greatest possible knowledge of the contained future, to make current decisions that involve risks; to systematically organize the activities necessary to implement these decisions and, through organized and systematic feedback, to measure the outcome of these decisions against the expectations fed (Drucker, 1984).

And yet, Strategic Planning is the managerial process of developing and maintaining a workable fit between an organization's goals, capabilities and resources, and the opportunities of a constantly changing market. The goal of Strategic Planning is to shape the business and products of a company so that they enable the desired profits and growth (Kotler, 2000).

Also, according to Chiavenato & Sapiro (2003), Strategic Planning is a process of formulating organizational strategies in which the organization seeks to insert its mission in the environment in which it is working. Strategic Planning is related to medium- and long-term strategic objectives that affect the direction or visibility of the organization. But, applied in isolation, it is insufficient, because we do not only work with immediate and operational actions: in the Strategic Planning process, all the strategic, tactical and operational plans of the organization must be elaborated in an integrated and articulated way. Planning should maximize results and minimize deficiencies, using principles of greater efficiency, effectiveness, and effectiveness. They are the main criteria of management. In short, strategy points the way. Strategic Planning tells you how to walk in it.

2.2 SYSTEMS ENGINEERING

A system is a set of interrelated components, which interact with one another, in an organized way, toward a common purpose. The components of a system can present themselves in various ways, being people, organizations, procedures, software, equipment, etc.

Every system exists in a larger supersystem context (a collection of other systems, thus forming a supersystem). Managers of a super system define policies, set goals, determine constraints, and define the costs that are relevant. (NASA, 1995)

Similar to strategy, Systems Engineering also originated in a war scenario. According to Brill (1998), the origin of the discipline of Systems Engineering occurred in the late 1940s and early 1950s, with the junction between the theoretical foundations of systems science and the experience of World War II.

In the case of Systems Engineering, this is mainly used for the development of complex products, since its first use was for the development of missiles in the late 1950s. It is also used in several sectors of the economy, but its great applicability in the aerospace and aeronautics industry is observed, as can be seen in the case of projects, integration and testing of satellites, aircraft projects, aerospace missions, among other applications.

Systems Engineering consists of two important disciplines: the domain of technical knowledge in which the engineering system operates and the management of Systems Engineering. In this case, the focus is the management of the engineering system.

In the case of Systems Engineering, it can be said that it is a robust system, designed to design, create and operate systems. In simple terms, it consists of identifying and quantifying system goals, creating alternative systems concepts, changing solution performance, selecting and implementing best solutions, verifying that the solution is properly built and integrated, and by post-implementation, ensuring how well the system achieves its goals. An engineering system is performed in line with a management system. The main role of an engineering system is to provide information that the management system needs to use to make the right decisions (NASA, 1995).

Three definitions are commonly used for Systems Engineering:

- A logical sequence of activities and decisions that transform operational needs into descriptions of system performance parameters and the preferred system configuration. (MIL-STD-499A, 1974)
- An interdisciplinary approach encompassing the technical effort to evolve and verify an integrated and balanced lifecycle solution in a people, product, and process-based system that meets customer needs. (EIA Standard / IS-632, 1994)
- A collaborative interdisciplinary approach that stems, evolves and verifies a balanced solution to the life cycle, in which it satisfies customer

expectations and meets the public's acceptability. (IEEE P1220, 1994)

In short, Systems Engineering is a collaborative interdisciplinary and multidisciplinary approach to derive, evolve and verify a balanced solution / system, along the life cycle, that satisfies the expectations of stakeholders (Loureiro, 1999).

One of the goals of Systems Engineering is to show that the system is designed, built and operational, and that this system fulfills its purpose of cost effectiveness, in the best possible way, considering performance, cost, time and risk. The cost effectiveness of a system combines cost and effectiveness concepts in the context of its objectives. System engineering has some dilemmas (NASA, 1995):

- Reduce costs x keep risks: performance should be reduced.
- Reduce risks x keep costs: performance should be reduced.
- Reduce costs x maintain performance: greater risks should be accepted.
- Reduce risks x maintain performance: Greater costs must be accepted.

The process of Systems Engineering is the heart of the management of Systems Engineering. Its purpose is to provide a framework, with a flexible process, that transforms requirements into specifications, architectures and basic configurations. The discipline in this process provides control and traceability to develop solutions that meet customer needs (DSMC, 1983 apud Loureiro, 1999). The Systems Engineering process is a top-down, comprehensive, interactive, and recursive process of problem solving, applied sequentially through all stages of development, which is used for (DSMC, 1983 apud Loureiro, 1999):

- Transform needs and requirements into a set of product and process specifications (add value and more details at each level of development).
- Generate information for decision makers.
- Provide inputs to the next level of development.

The core of the Systems Engineering process consists of requirements analysis, functional analysis and development synthesis. All these activities are balanced by techniques and collective tools, called system analysis and control. Systems Engineering controls are used to track decisions and requirements, maintain technical bases, manage interfaces, manage risks, track costs and schedules/schedules, track technical performance, verify requirements are met, and review / audit progress (SMC , 2001 apud Loureiro, 1999).

III. PROPOSED APPROACH TO STRATEGIC PLANNING

The scope of the proposed method for Organizational Strategic Planning presented here is based on the model of Loureiro (1999), representing the systems engineering tools, and the Chiavenato&Sapiro (2003) model, representing strategic planning activities.

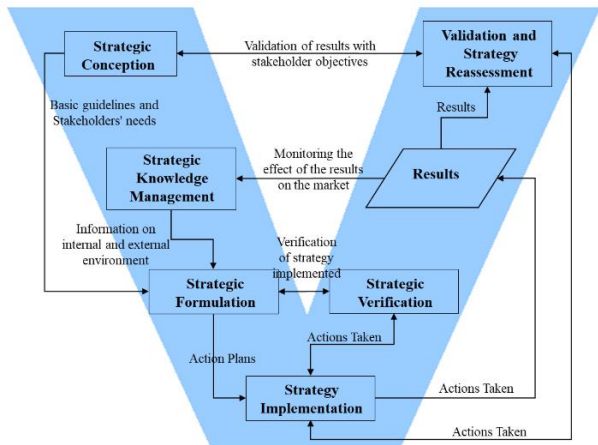


Fig.1: Generic model of the systems engineering approach for the organizational strategic planning

The left side of the "V" has as main product the definition of the strategy of the organization. On this side, the items of strategic design, strategic knowledge management and strategic formulation are allocated. Alluding to the PDCA Cycle, it is observed that this side is associated with the planning stage, which represents the idealization of the necessary actions, to make the company competitive. Alluding to the "V" of Systems Engineering, this is the side of systems architecture.

At the base of the "V" is the implementation of the strategy, which represents the execution and integration of the actions defined in the strategic formulation. The basis of the "V" represents the stage of execution of the PDCA cycle, in which the actions take place, properly speaking. The basis of the "V" is the construction of the system, in Systems Engineering.

On the right side of the "V" is the verification and validation of the strategy, which will evaluate if the planned actions are being executed and if they are producing the expected result. Also, it is at this stage that the actions of improvement are taken, in order to make feasible the defined actions or adequacy of the strategy, in face of the reality of the market. This side represents simultaneously the verification and improvement steps of the PDCA cycle. This side of the "V" represents the side of verification and testing in Systems Engineering.

The method aims to build a sustainable organization and consists of the steps in the flowchart shown in Table 1,

according to Andrade (2008) and Andrade & Loureiro (2017).

Table.1: Summary Flowchart of Organizational Strategic Planning Steps

A SYSTEMS ENGINEERING APPROACH FOR STRATEGIC BUSINESS PLANNING, INTEGRATING PRODUCT, BUSINESS PROCESS AND ORGANIZATION	
Description	Objective
Identification of Stakeholder Needs and Expectations	Know the factors that contribute to add value to stakeholders
Strategic Design	Determine business, declare mission, design vision, identify values, define management policies and identify and map business processes.
Strategic Knowledge Management	Carry out external and internal diagnostics, construct and analyze scenarios and analyze risks from the above analyzes.
Establishment of Strategic Objectives	Analyze the results of steps 1, 2 and 3 and consolidate the strategic objectives, critical success factors and effect their unfolding.
Strategic Formulation	Based on item 4, elaborate strategies and strategic actions, through Brainstorming, 5W2H Action Plan and Skills Development Plan.
Strategy Implementation	Implement the strategic actions defined in the 5W2H Action Plan and Skills Development Plan.
Strategic Verification and Validation	To monitor the implementation of the strategic actions contained in the action plans, the progress of the strategies in relation to the objectives and their results. If you have not fulfilled the actions of the plan or the results diverge, propose actions to correct course using the DCA.

Strategic reassessment	Evaluate the adherence of the implemented actions and their results and propose actions to correct the strategy or review the strategy, in face of the new needs of the external or internal environment.
------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

It is worth remembering that people are often encountered when trying to formulate, implement or evaluate a strategy. People can be the competitive advantage, but they can also be the obstacle to their effective realization. This is because, when it comes to a strategy, its evaluation must cover from the stage of strategic intention, external and internal strategic knowledge management, strategic formulation to implementation of the strategy in terms of performance and execution as it is being placed in practice; but the final step almost always refers to the results that it can achieve. All this is done through people. You do not formulate or implement a strategy without people. They are the essential stakeholders in this task (Chiavenato & Sapiro, 2003).

IV. FINAL CONSIDERATIONS

In this work, a method was developed for Organizational Strategic Planning, based on a Systems Engineering approach, using reference models from both disciplines, as previously mentioned.

The method was applied in 3 organizations, being a steel industry, a business management consulting firm and a public organization with research in the aerospace sector. In these situations, the method was more adequate than the traditional models previously applied.

It is suggested for future work the development of decision support systems to assist in the management of strategic knowledge, especially regarding external diagnosis and scenario construction.

REFERENCES

- [1] ANDRADE, Herlandí de Souza. **Uma abordagem da engenharia de sistemas para o planejamento estratégico organizacional**. 2008. 135f. Tese de Mestrado - Instituto Tecnológico de Aeronáutica, São José dos Campos.
- [2] ANDRADE, Herlandí de Souza; LOUREIRO, Geilson. **Planejamento Estratégico: uma abordagem de Engenharia de Sistemas**. Balti :Novas Edições Acadêmicas, 2017, v.1. p.111.
- [3] ANDREWS, Kenneth Richmond. **The concept of corporate strategy**: revised edition. New York: Richard D Irwin, 1980.
- [4] BRILL, J.H. **Systems engineering**: a retrospective view. New York: John Wiley & Sons, 1998.
- [5] CHANDLER, Alfred. **Dupont**: Strategy and structure: chapters in the history of the american industrial enterprise. Cambridge: The MIT Press, 1976.
- [6] CHIAVENATO, Idalberto; SAPIRO, Arão. **Planejamento estratégico**: fundamentos e aplicações, da intenção aos resultados. Rio de Janeiro: Elsevier, 2003.
- [7] DRUCKER, Peter. **Introdução à administração**. São Paulo: Pioneira, 1984.
- [8] ELECTRONICS INDUSTRY ASSOCIATION. **EIA 632**: Processes for engineering a system, 1997.
- [9] INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS. **IEEE 1220**: use standard for application and management of the systems engineering process. New York, 1995.
- [10] KOTLER, Philip. **Administração de marketing**: a edição do novo milênio. São Paulo: Prentice Hall, 2000.
- [11] LOUREIRO, Geilson. **A system engineering and concurrent engineering framework for the integrated development of complex products**. England: Loughborough University, 1999.
- [12] McCRAW, Thomas K. **Creating modern capitalism**: how entrepreneurs companies and countries triumphed in three industrial revolutions. Cambridge: Harvard University Press, 1998.
- [13] NASA. **System engineering handbook**. Washington, DC, 1995. (NASASP-2007-6105)
- [14] OHMAE, Kenichi. **The mind of the strategist**: the art of the japanese business. New York: McGraw-Hill, 1982.
- [15] PORTER, Michel E. **Estratégia competitiva**: técnicas para análise de indústria e da concorrência. Rio de Janeiro: Elsevier, 1986.
- [16] STEVENS, Richard et al. **Systems engineering**: coping with complexity. London: Prentice Hall Europe, 1998.
- [17] UNITED STATES. Department of Defense. **MIL-STD-499A**: military standard management engineering. Washington, DC., May. 1974.
- [18] VALADARES, Maurício Castelo Branco. **Planejamento estratégico empresarial**. Rio de Janeiro: Qualitymark, 2002.

Casting Design Optimization for Steam Turbine Emergency Stop Valve (ESV) Housing with Computational Casting Simulation Method

Agus Krisnowo ¹, Khamda Herbandono ², Rudias Harmadi ³, Budi Nofiantoro. F⁴

¹Principle Engineer, Centre of Technology for Machinery Industry, TIRBR, BPPT, Jakarta, Indonesian

^{2,3}Specialist Engineer, Centre of Technology for Machinery Industry, TIRBR, BPPT, Jakarta, Indonesian

⁴Senior Engineer, Centre of Technology for Machinery Industry, TIRBR, BPPT, Jakarta, Indonesian

Abstract— Design optimization casting emergency stop valve steam turbine, has been done with casting simulation using Magmasoft v5 software. By simulation, some casting design parameters are changed to get more optimal results. Optimization of the design of castings in this study, obtained by improving the design through changes in pouring system using bottom pouring and optimization of riser design. The result of four design casting simulation ESV housing versus filling velocity, solidification, and porosity have the same trend of location defect that is in the flange and middle body valve connection area. However quality of the simulation results, in design # 4 has a better quality of casting results based on the color gradation seen in the range of 80-90%. Although, there is still a potential defect in critical areas that have low castability. This results can be used as input for the further casting improvement and NDT inspector guidance.

Keywords— Design optimization, Casting simulation, Filling Velocity, Solidification, Porosity.

I. INTRODUCTION

One part of the steam turbine that has a vital function is the Emergency stop valve (ESV). Emergency stop valve (ESV) steam turbine has the main function as a valve (throttle valve). This component must be able to drain and stop the vapor flow quickly and completely, either automatically or manually when needed. ESV components are enclosed by an ESV housing that serves to maintain pressure to prevent leakage and as a protective part of ESV from foreign objects. The ESV housing material is made from JIS G5151 Grade SCPH2 steel which is resistant to pressure and high temperature. While the manufacturing process of ESV Housing steam turbine is done by using the casting method (sand casting) and its completion with machining process. ESV housing is divided into 4 (four) segments top, middle, bevel and lower casing. Of the four segments, middle ESV housing is a critical part because of its slightly complicated

contour form, so it often fails when foundry. One of the causes of the failure of the cast process is the error in designing the foundry system, thus impacting the defects resulting product, whether it is a defect dimensional, pores, or crack. The failure of the cast process will have an impact on quality, cost and delivery.



Fig.1: ESV Housing

With the advancement of computing technology today, many developed software that can be used to help the design process and simulation of casting. This computational method of product development is very advantageous than the use of conventional methods (trial & error) [1]. The current casting simulation software has been widely accepted as an important tool in the design and development process of casting products that can improve casting yield and casting quality [2] [3]. In this research, the optimization of ESV housing design will be done by using Magmasoft software v5. Some design parameters still follow the user's design, and some other parameters will be optimized by reference to the

standards required for JIS G5151 Grade SCPH2 and ASTM A 609 quality level materials. Its main focus is on improving cast quality against crack and porosity defect.

II. RESEARCH METHOD

This research is a design development of ESV product castings that have been manufactured but there are still defects (rejected) crack and porosity in some parts. Therefore, the approach of optimizing the design of the castings (improvement) is done by using the comparison method between the initial castings with the product castings optimization results using software Magmasoft V5. In this case, it will be done three alternative design improvement and optimization of the best design alternative. The steps that will be done are:

- Design review: perform analysis of design drawings. From this picture can be done analysis, which parts need to be modified so that the casting process is more optimal.

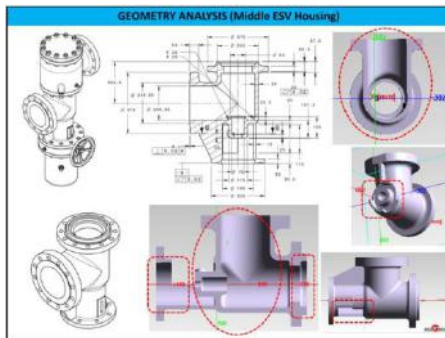


Fig.2: The ESV part needs to be done modification

- Design modifications: modify the system or parts of parts that could theoretically improve the performance of the casting process. Some of the improvements made are [4][5]:
 - Gating system
 - Position and height of riser
 - The sharp geometry shook me
 - Profile flange
- Design optimization: through the utilization of Magmasoft v5 software, simulation of modified design is done until the optimum design results are obtained. The effect of pouring system change with bottom up system and reduction of riser height up to less than the tip of shrinkage that occurs in riser area will be analyzed its effect on casting quality. As illustrated in Figure 3.

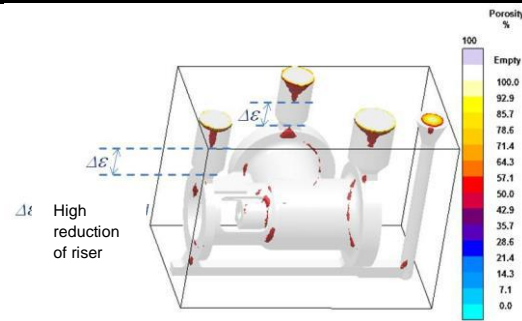


Fig.3: Potential area for improving yield casting

III. DESIGN AND ANALYSIS CASTINGS SIMULATION

Design Optimization, includes design and castings simulation for:

- Design # 1: initial casting (rejected)
- Design # 2: the first design improvement alternative
- Design # 3: second improvement design alternative
- Design # 4: optimization of design improvements

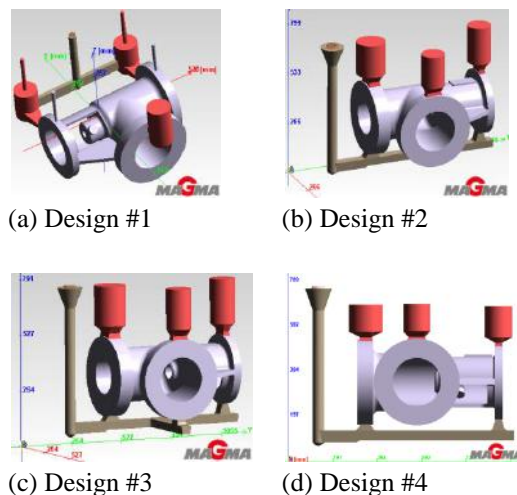


Fig.4: 3D Gating System Design

In this study there are four designs analyzed, as shown in Figure 4. Design # 1 is the initial design, where the product from the ESV middle housing has been casted, without casting simulation and the result fails. The initial design drawings were analyzed using magmasoft and the results were compared with non-destructive test results - Ultrasonic Test (NDT-UT) casting products, as shown in Figure 5.

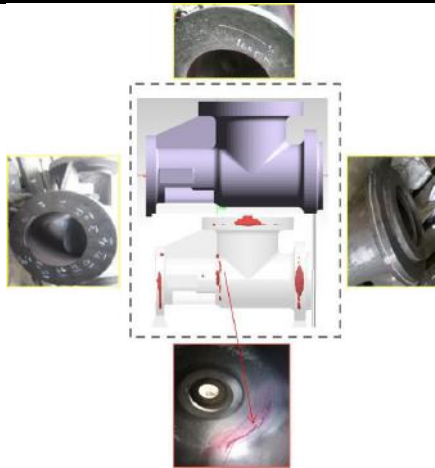


Fig.5: NDT-UT Product vs Magmasoft Comparison

Comparative analysis can be seen that the suitability of location of NDT-UT porosity cavity with potential location of Magmasoft simulation result defect, that is in third area of radial flange direction and area of body valve center. Porosity is a type of defect that is commonly encountered in the presence of cavities in casting products that can be caused by:

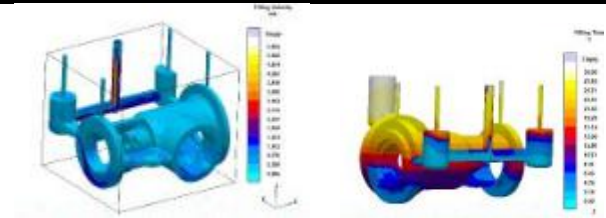
- Gas content of the melt
- Gas and air entrapments due to filling
- Shrinkage of metal during solidification and cooling
- Combination of these

Initial analysis results need to be changed pattern with consideration of flow improvement to minimize turbulence during liquid metal filling by changing side pouring to bottom pouring and castability design improvement by providing additional machining allowance in flange area. In addition, different wall thickness variations lead to varying cooling rates, to compensate for shrinkage and to seek for directional solidification to require an adequate riser system.

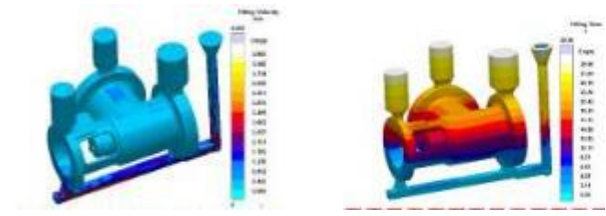
The concept of design change is poured into Design # 2 (using 2 ingate) and Design # 3 (using 3 ingate). The simulation results of Design # 2 and Design # 3 are almost the same in quality but Design # 2 has higher yield casting. So Design # 2 was chosen to be optimized again to increase its casting yield to Design # 4.

3.1 Filling Velocity Analysis

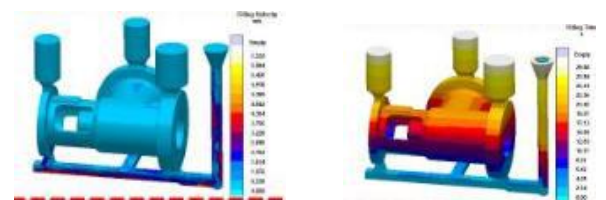
In general, casting filling velocity causes gas wrapping and slag inclusion, and it influences quality of casting parts directly [6]. In this paper, filling velocity of three design casting ESV housing was researched on with magmasoft, and the simulation results were analyzed. The best filling effect can be gotten, when the velocity (v) is equal to filling time (t). As a result, it could offer better casting parameters for design casting ESV housing.



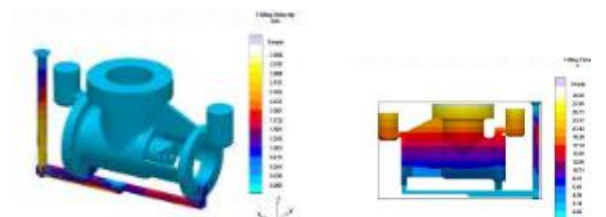
(a) Velocity and Time Filling design #1



(b) Velocity and Time Filling design #2



(c) Velocity and Time Filling design #3



(d) Velocity and Time Filling design #4

Fig.6: Velocity and Time Filling

Tapper runner design # 2 and # 3 still cause slight turbulent flow, this can be solved by extending the tapper, beyond the first ingate (design # 4).

3.2 Solidification Analysis

When the liquid metal is poured into the mold, it immediately fills the cavity in the shape of the mold and there will be compaction / hardening of the metal liquid [7]. Solidification begins at a temperature indicated by liquidus and is completed when the solidus is reached [8][9]. As shown in Figure 7.

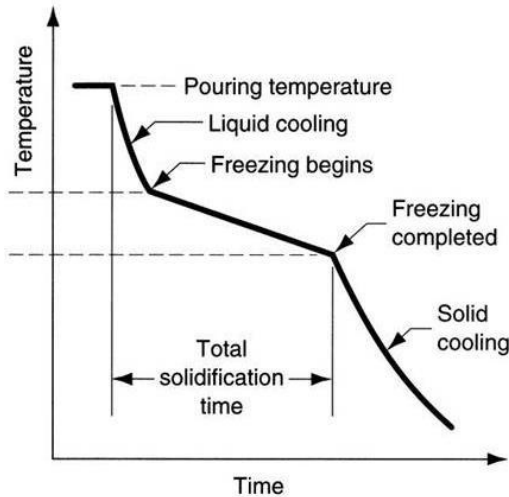


Fig.7: Total Solidification Time

So the design of the gating system and the time of pouring become critical parameters. Figure 8 shows the behavior of the solidification process of the four designs performed.

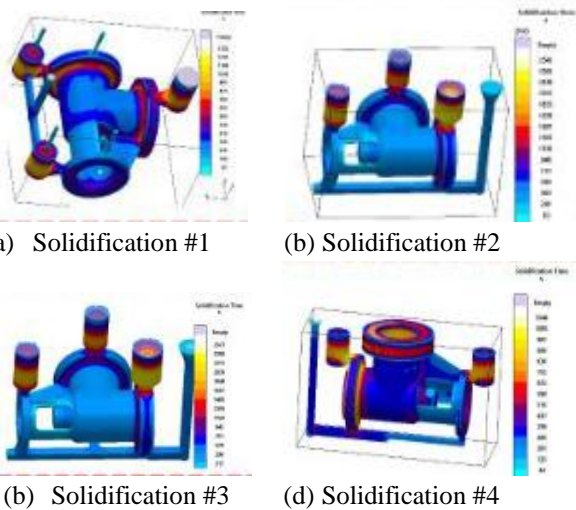


Fig.8: Solidification Design #1 to #4

Design #2 and #3 show more directed solidification, and better than design #1. The improvement analysis is done in design #4.

3.3. Porosity

Porosity may be the most often occur and common complaint of casting users, because porosity in castings contributes directly to about reliability and quality. Porosity in castings is due to bubbles being trapped during solidification [10]. Porosity sources include entrapped air during filling, centerline shrinkage that occurs during the final solidification, blowholes from unvented cores, reactions at the mold wall, dissolved gases from melting and dross or slag containing gas porosity.

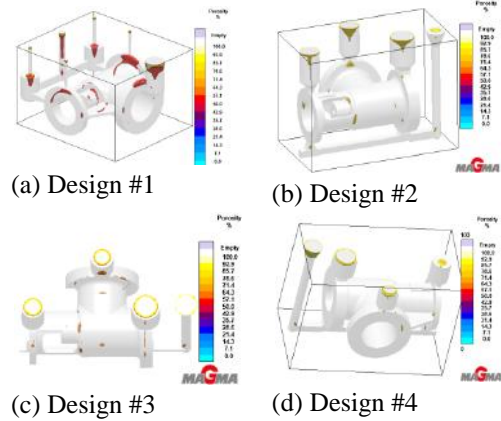


Fig.9: The Result of Design Simulation vs Porosity

The results of Design Simulation vs Porosity, the four designs of ESV housing have the same potential trend of area location flow that is in the flange and middle body valve connection area. In the quality of the simulation results, the maximum potential defects are shown in Design # 1 and at least in Design # 4. The quality of castings on design # 4 is better, this can be seen based on the color gradations seen in the range of 80-90%. However, there is still a potential defect in the critical area, because it is difficult to get a free from defect (sound casting) simulation result due to the casting profile which has low castability with some wall thickness variations and right angles (90°), as shown in Figure 10.

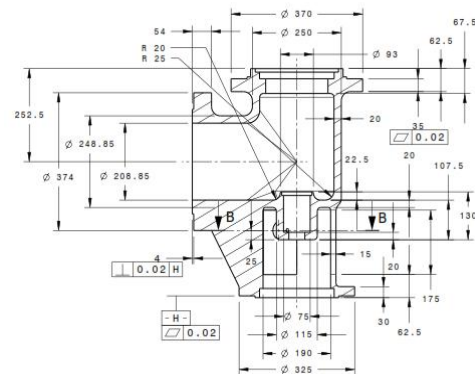


Fig.10: Cross Section Drawing

By using magmasoft software various designs of system castings computationally can be simulated, to get the most optimum design in terms of quality and efficiency. The simulated casting software Magmasoft can also predict critical areas of potential defects that may arise during casting. So it can be used as input for the effort of preventing the impact of defect risk during the casting process, for example by the use of chill and sand chromite on the walls of the critical casing to assist the foundry production process.

IV. CASTING PROCESS AND TESTING

The ESV middle casting process, from making wooden pattern to foundry, is shown in Figure 11 to Figure 13. Figure 11 shows the wooden pattern results from the middle ESV section. Figure 12 shows the ESV middle table mold and Figure 13 shows the results of ESV middle part casting



Fig.11: Wooden pattern middle part ESV



Fig.12: Mould box middle part ESV



Fig.13: Casting result middle part ESV

The test of the mid-cast results by using dye penetrant and ultrasonography test can be seen in Figure 14 and Figure 15.



Fig.14: NDT - UT Inspection

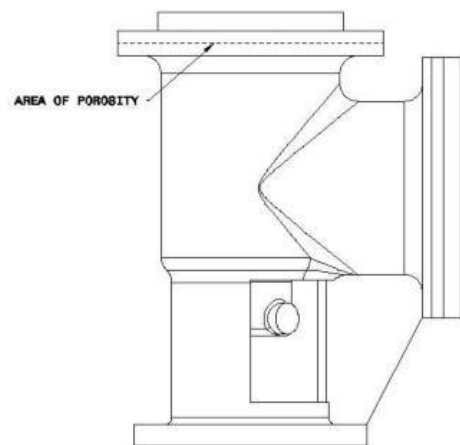
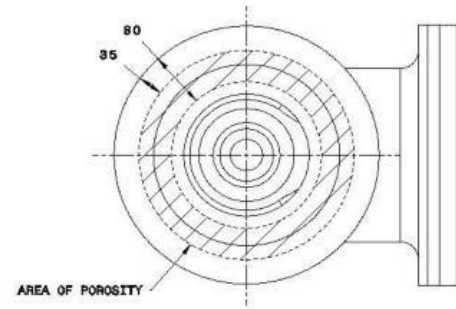
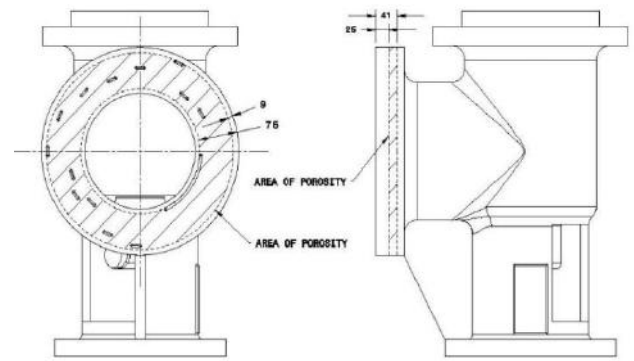


Fig.15: Area of Porosity

Final casting middle part ESV are shown in Figure. 14. Ultrasonografi test and dye penetrant test were performed on the final casting. The test confirmed that there is still a defects (crack) in flange area the casting result that better than initial design result. The results of this experiment indicate the suitability of the location of defects between the simulation results and the test results. Therefore it can be used as casting improvement input and NDT inspector guidance for the critical area of further casting process.

V. CONCLUSION

Optimization and design selection using the computational casting simulation method (MagmaSoft) can produce design castings that can improve the quality of castings. The simulation results can also be used as inputs in conducting preventive actions to prevent

potential defects occurring during the casting process execution.

Design # 4 is the preferred design that can reduce the potential for defects, but from ultrasound and dye penetrant test results, flange defects are still present, therefore other efforts are needed to improve the quality of casting, for example by the use of chill and sand chromite on the walls of the critical casing to assist the foundry process

REFERENCES

- [1] Gaumann, M., *Investment Casting Simulation*, Calcom, USA, 2002
- [2] Guo, Z., et al., *Modelling of Materials Properties and Behaviour Critical to Casting Simulation*, Elsevier-Materials Science and Engineering A 413-414, 2005
- [3] Barzilai Philippe, et al., *Simulating Foundry Operation To Increase Speed And Accuracy*, Advanced Manufacturing Technology, Vol.25, No.02, 2004
- [4] Rajender Singh, *Introduction to Basic Basic manufacturing Processes and Workshop Technology*, N.A.I Publishers ISBN 978-81-224-2316-7, India, 2006
- [5] Nandogopal, M. et al, *Study of Sand Casting Gating System*, IJRERD SN: 2455-8761, Vol 02-Issue 11, India, November 2017
- [6] Pariona, M.M., et al., *Numerical Simulation for Prediction of Filling Process In a Sand Mould*, Revista Latinoamericana de Metalurgia y Materiales, 28(2), 99-110, 2008
- [7] Vijayaram,T.R., et al., *Numerical Simulation of Casting Solidification in Permanent Metallic Molds*, Journal of Materials Processing Technology 29-33, 178, 2006
- [8] Krack, R., *Using Solidification Simulations For Optimising Die Cooling Systems*, Germany, 2007
- [9] Mr. B.M. Anjikhane, Prof. N.D.Misal, MM. Gore , Review paper on Simulation of Solidification Process in casting and optimization of Riser, International journal of application or Inovation in Engineering & Management (IJAEM), Volume 4, Issue 5, May 2015.
- [10] Ferencz Peti, Lucian Grama, Analyze of The Possible Causes Of Porosity type Defect in Aluminium High Pressure Diecast Part, Scientific Bulletin of the Petru Maior University of Targu Mures, Vol. 8, no. 1. 2011

Social Innovation by Tourism Strategy in the Western Amazon

Sâmia Laise Manthey Benevides, Flávio de São Pedro Filho, Maria José Aguilar
Madeira, Irene Yoko Taguchi Sakuno, Valeria Arenhardt

¹Master's Degree student in Administration at the Federal University of Rondônia (UNIR). Holder of CAPES scholarship. Technician at Eletrobras Energy Company in Rondônia State, Brazil. Member of the Research Group on the Management of Innovation and Technology (GEITEC/UNIR/CNPq), Brazil.

²PhD in Business Administration from the University of São Paulo, Brazil. Professor of Production Management at the Federal University of Rondônia (UNIR), and Coordinator of the Research Group on the Management of Innovation and Technology (GEITEC/UNIR/CNPq), Brazil.

³PhD in Management at the University of Beira Interior (UBI), Covilhã, Portugal.

⁴Doctorate student in Political Science at the Federal University of Rio Grande do Sul (UFRGS). Master in Regional Development and Environment by UNIR. Member of the Research Group on Management of Innovation and Technology (GEITEC / UNIR / CNPq), Brazil. E-mail:

⁵Master in Business Administration. Professor at the Federal Institute of Rondônia, Brazil. E-mail:

Abstract— *This work concerns the strategies of social innovation focused on the concept of inbound tourism and hospitality in Rondônia State, Brazil. The general objective is to study the main strategies for qualifying as a tourist attraction. The specific objectives are to: point out the strategic elements to (1) qualify the facilities for inbound tourism and hospitality in the scenario;(2)examine the perspective on the implementation of the strategic elements in practice; and (3)indicate the elements of social innovation in support of the strategy of qualification to the concepts of inbound tourism and hospitality. This study is supported by the Theory of Planned Behaviour and concepts of inbound tourism, hospitality, creativity and innovation. It adopts the method of a case study which is both qualitative and quantitative in nature. As part of the methodological procedure, workshops were held for 28 stakeholders in Rondônia's tourism, during which questionnaire data were collected from answers using the Likert Scale, participant observation was conducted and documents were analysed to enable the causal relationship to be critically assessed. A SWOT matrix was imposed upon the survey report. The tourist potential in the scenario has consequently been acknowledged, together with a need for the strategic planning of its attributes; valid elements for social innovation which use qualifying strategies for inbound tourism and hospitality are indicated; Possible public-private partnerships with the third sector and society could together create an ideal form of intervention. This study is of interest to both the public and the private sector, to academia and the community. It can contribute suggestions for the planning and management required for tourism to*

develop as well as outline strategies for social innovation.

Keywords— *Tourism. Inbound tourism. Hospitality. Rondônia. Social innovation.*

I. INTRODUCTION

The National Tourism Plan published by Brazil (2013) presents promotional strategies for the sector, leading to the prospect of economic and social development and the eradication of poverty. It contains management guidelines that encourage dialogue with organizations in civil society while promoting social innovation, entrepreneurship, job creation, and regionalization by a multidimensional aggregate. This study focuses on issues related to forms of social innovation by tourism, from a valid and oriented perspective. It considers the significance of tourism to the integrated development of the region, given the positive impact that this field of activity already presents at this early stage.

Data published by Brasil (2013) point out that the tourism sector, in terms of growth, outperformed the Brazilian economy; it represented 3.7% of the Brazilian Gross Domestic Product (GDP), and generated 8.3% of jobs in the country; as well as increasing the credit granted by financial institutions. The trend of Brazilian tourism is to increase. Investment in social innovation, when related to tourism, makes a significant contribution to socioeconomic development. Lima (2011) notes that investment of this nature in European countries indicates exponential growth for GDP, and this has roused the University to undertake research on the topic.

II. OBJECTIVES

The above factors imply elements which are directly relevant to the State of Rondônia, in the northern region of Brazil. This State has a tourist potential that the economy might exploit, considering its current living conditions and immediate economic, social and cultural situation. Nevertheless, obstacles to this development remain, because the actors involved are not sufficiently prepared to move forward. With this in mind, this study aims to answer the following research question: How could we describe the strategies to encourage social innovation by inbound tourism and hospitality in the State of Rondônia? To answer this question, we propose (a) as a general objective the study of the key strategies for qualifying as a tourist attraction for inbound tourism and hospitality; and (b), as specific objectives: (1) to point out the strategic elements in qualifying for inbound tourism and hospitality in the scenario under study; (2) to analyze the perspective from which the implementation of the strategic elements in practice will take place; and (3) to indicate the elements of social innovation in support of a qualification strategy for inbound tourism and hospitality. The task rests on Planned Behaviour Theory and invokes the concepts of inbound tourism, hospitality, tourism, creativity, innovation, SWOT analysis, with the support of theories that allow state of the art interpretation.

III. THEORETICAL AND CONCEPTUAL REVIEW

The definition of tourism presented by Esteves (2015) refers to phenomena and relations emerging from the interaction between tourists and service providers, government, communities, universities and organizations in the process of attracting, transporting, receiving and managing tourists. The term 'inbound tourism' presented in Freire (2015) is defined as a business process where practices connected with the permanent presence of people going to/at a destination are managed. It consists in providing services and products of interest, desire and necessity for visitors and a set of organizational and logistical elements arranged for receiving them, which involves the complexity of human reception activities supported by a tangible infrastructure where tourists

meet residents. To Pezini et al (2014), in Brazil it is an alternative to other kinds of social, economic, cultural and political development once its effectiveness depends on an urban infrastructure (transportation, security, law), community awareness, and the manually-skilled labor and hospitality of the place where tourists are received.

The term hospitality is related to the act of receiving and giving shelter to a traveler. For Pimentel (2012), it includes all the receptive touristic-social machinery held by agencies, sectors, companies or individuals who have contact with visitors and offer structures and services. The effectiveness of the hospitality encourages social participation, involvement and the sharing of experiences between cultures, customs, values and people; it is a socio-cultural and professional phenomenon that needs investment and strategy to be effective.

The study by Wada (2012) brings a strategic approach to managing the experience of hospitality; it sees it as the convergence of private, commercial and social activities. The private activity is related to the host's knowledge and care of the physiological and psychological needs of the visitor. The commercial activity concerns the search for financial results, production and certain profit. The social activity involves the reception of a guest by strangers, with the fundamental features of reciprocity and the status and prestige of the tourist.

Wada posits that the creation of value for the marketing of products and services in tourism depends on the understanding by the stake holders of the effect of their behaviour, values, history and context. The stakeholders are asked to provide the best possible service in inbound tourism and hospitality; so the training of the actors involved and meeting the needs of visitors contribute to the behavioral predictability which improves results in tourism.

3.1 Theory of Planned Behaviour applied to tourism

The Theory of Planned Behaviour (TPB) formulated by Fishbein and Ajzen and presented in Gomide (2014) is used to explain the relationship between attitude and behaviour and has been used in different studies; to apply it to tourism is innovative. The theory determines the following constructs: (1) attitude to behaviour; (2) subjective standards; and (3) perceived behavioral control, as indicated in Table 1.

Table.1: Definition of Constructs of the Planned Behaviour Theory

Constructs	Description
Attitude	Degree of personal assessment, favorable or unfavorable, in relation to behaviour. It consists of cognitive, affective and behavioral elements.
Subjective norm	Perception of the expectations that individuals or relevant groups have about the behaviour – influenced by social pressure.
Perceived Behavioral control	Belief of the individual about the degree of ease or difficulty in adopting a behavior. It evaluates how deeply the subject considers the problems and the situational factors of an action.

Source: Adapted from Silveira e Maia (2015).

This knowledge is useful for implementation of projects and programs aimed at changing people’s behaviour in order to achieve a defined objective. Table 2 below highlights the strategic elements or operational indicatives for effective process management, which focuses on helping the tourism experience to improve.

Table.2: Application of the Planned Behaviour Theory to inbound tourism and hospitality

Concept	Application to Tourism	Operationalization
Aims to predict the individual’s behaviour in a given situation.	Aims to predict the behavior of a tourist.	Know and analyze why the tourist has a determined attitude and subjective norm using internet tools and social networks.
Individuals are rational, use available information and assess the consequences of adopting a behavior.	Offers the tourist an experience that meets or exceeds his expectations. Provides information and assesses the satisfaction of the customer.	Know the goals, interests and needs of the tourist, seeks to serve her/him, assesses the customer perception and proposes improved alternatives.
The behavioral intention is defined by attitude, social pressure and individual beliefs.	Leads the individual to believe that the tourism experience will bring positive results and evaluations; recounts or recalls the positive experience of other people.	Invest in services, infrastructure, marketing, inbound tourism facilities and hospitality.
Individual perception of the effort required to adopt a behaviour given the resources available and their own ability.	Facilitates access and provides the required resources to the tourist for her/him to decide on a certain tour package, period of time or region.	Submit price proposals, facilitate the payment, invest in marketing, ease the access.

Source: Prepared by the author on the basis of Gomide (2014) and Silveira e Maia (2015).

The concepts of Planned Behaviour Theory applied to tourism are aimed at modifying the behaviour of the actors that relates to inbound tourism and hospitality, which, together with the concepts of creativity and innovation, will satisfy visitors and meet their needs and expectations.

3.2 Creativity and Innovation applied in Tourism

Sanmartin (2012) presents creativity as an individual characteristic resulting from a combination of skills and attitudes that favor the deepening of experience. It is a perception that conditions can make changes in everyday life. The person who creates has mental processes, motivation and learning which, along with environmental and cultural influences, foster the development of new ideas. A predisposition to create is related to the risks that the individual is able to take and the barriers that s/he can surmount, coupled with the ability to use innate skills, learned skills and motivation. Creative innovation occurs when professionals are encouraged to contribute their own ideas to a project in a continuous process that helps a culture of innovation to develop. With creativity, the individual can break up an existing pattern and introduce something new.

For Sanmartin (2012) innovation occurs when the implementation of a creative idea generates the desired result. Innovation is the result of a systematic process, measured and managed strategically, defining design criteria, objectives, deadlines and responsibilities. Innovation, as diffused by the Oslo Manual and presented in Pedro Filho (2016), lies in the implementation of a new or improved product, good or service. A new process, marketing or organizational method in business practices can restructure the workplace or a firm’s external relations. Innovation is characterized by the incorporation, combination or synthesis of knowledge in products, processes or significant and valued but unpublicized services.

The discussion of creativity and innovation in tourism is relevant in view of the intensified competitiveness in this industry, and the products and services offered by inbound tourism. To Esteves (2015), tourism becomes innovative by the incorporation of technologies for developing skills, raw materials, services, and a management model adopted by the suppliers. Innovation must be present throughout the tourism system, through its economic performance, demand, technology, organizational strategy, individual entrepreneurship and the role of the state, as described below in Table 3:

Table.3: Innovation Forces in Tourism

Innovation elements	Description
Competitiveness	Replace holiday activities and destinations; reduce barriers such as costs; increase the business investment; treat innovation as a survival factor; innovate processes.
Economic performance	Innovation generates economic performance; prioritize the incremental investment process; explore opportunities gained from Information and Communication Technology (ICT).
Tourism demand	Changes in working hours, age structure and income lead to the growth of demand for tourism; the high tourist flow calls for innovation to increase the supply of services;
Technology	Tourism depends on the technology acquired; the internet has revolutionized information and sales processes; the workforce needs innovation in its services and organizational structure
Organizational strategy	Strategic objectives influence the attitude to innovation activities; centralizing organizations produce incremental innovation and entrepreneurial organizations produce radical innovations;
Individual entrepreneurship	Opportunities exist for entrepreneurs to develop new products and processes; They can be used to innovate on behalf of the organization or open their own business with their own ideas;
State role	The state is responsible for managing and marketing tourist destinations; for financial support for regional economic development programs; for the infrastructure supporting effective public-private partnerships; and for ensuring a safe political and regulatory environment.

Source: Adapted from Esteves (2015).

Initiatives in each of these elements will strengthen tourism and the resulting local developments. These elements are forces that enhance innovation in tourism, demanding that the expected impacts should be generated by strategic management.

3.3 Social Innovation as a strategy for integrated local development

Studies in Emmendoerfer et al (2011) and Correia et al (2015) present social innovation as an economic restructuring strategy that appears to meet the demands and solve social problems at the institutional, organizational and individual levels by diminishing the power of the state. This innovation involves social intervention as a way of developing and adopting technologies or arrangements by which social relations can be transformed, promoting inclusion by creating jobs and improvements in the general standard of living. These two authors believe that individuals and organizations can bring about social innovation when excluded individuals become responsible for the decision-making in the design and creation of goods and services, and can develop the autonomy to form new relationships in the home and at work. The organization becomes an agent for social innovation by forming new

divisions and ways of coordinating work, presents structural configurations in networks or projects; expands the interaction of the public and private sectors; and allows stakeholders to meet the collective and social responsibilities of mediation.

To Emmendoerfer et al (2011), one sign of social innovation in tourism is the substitution of macro national policies for regional policies so as to minimize the socioeconomic impact of generating employment, promoting the local culture and income and preserving the natural resources. Correia et al (2015) point out that when it contributes to the generation of methodologies, productive initiatives, and democratic and participatory policies, social innovation leverages local resources for development; It presents proposals for emphasizing social and environmental solutions that involve the social actors in processes of awareness, mobilization and learning; promotes local development by creating ideas that meet the necessities and aspirations of the individuals, transforming policy and practice; moreover, the mobilization and coordination to find solutions and tackle regional demands strengthen local self-belief and enrich the collective consciousness.

To Lima (2011), the power of social innovation is the perception by society of a gap between what exists and

what should exist; the search for solutions and training of agents mobilizes the exploitation of the regional potential present in the context of life. All this potential can be also applied to promote the development of tourism in Rondônia.

3.4 Concepts of SWOT Analysis

SWOT analysis is a system for evaluating the strategic position of a subject (often an organization) in relation to its Strengths, Weaknesses, Opportunities and Threats. The analysis assesses the current state by considering the external environment (where opportunities and threats come from) and the internal environment (where the Strengths and Weaknesses are apparent). The strengths and weaknesses are weighted according to internal factors, namely human resources and their capacity, knowledge and skills, and physical resources through the installation of equipment, technology and other things. The opportunities and threats are analyzed with regard to external factors that may block the achievement of the proposed objectives. These variables must be known and strategies adopted to minimize their impact when negative and enhance their influence when positive; the adoption of these strategies will characterize the competitive advantage (NETO, 2011). This methodology will be applied to the present study in order to assess the perspective from which consider the implementation of strategic elements to the present object of study.

IV. METHODOLOGY

The objective of this research is to characterize the valid strategies for social innovation that would improve in bound tourism and hospitality in the State of Rondônia. Works by Gil (2010) and Marconi and Lakatos (2011) suggest that this will apply social research of both qualitative and quantitative types, or mixed methods

research, as Creswell calls it (2010), according to which qualitative and quantitative data are collected in sequence and lines of relationship are drawn between them later. This research analyzed the data generated in a 30-hour training workshop aimed to raise awareness of inbound tourism and the hospitality required to attract local tourism in 28 strategic representatives of public and private initiatives and of the third sector. The participants were selected by the Business Council of Tourism and Hospitality of the State of Rondônia – CONETUR – by an anonymous random process which, according to Creswell (2010) constitutes a quasi-experiment. It is a descriptive statistical sample composed of 4 government representatives, 4 representatives of travel agencies, 4 hotel representatives, 4 representatives of bars, 4 restaurant representatives, 4 representatives of the third sector and 4 representatives of tourist agencies. By its creative friction the workshop stimulated the construction of projects for the development of tourism in the state focused on innovation, which will also be used as a data source for this study.

The technique to be adopted will be field research according to the guidelines contained in Marconi and Lakatos (2012) which specify that information or knowledge about a problem is selected from the observation of facts and phenomena. The study may be classified as quantitative descriptive field research, since it consists of an empirical investigation whose purpose is to analyze the characteristics of the phenomenon under study, using formal methods and techniques for data collection.

In compliance with the ethical recommendations, we distributed consent statements, guaranteeing the anonymity of the participants. Diagram 1 below details the methodological procedures adopted in this research.

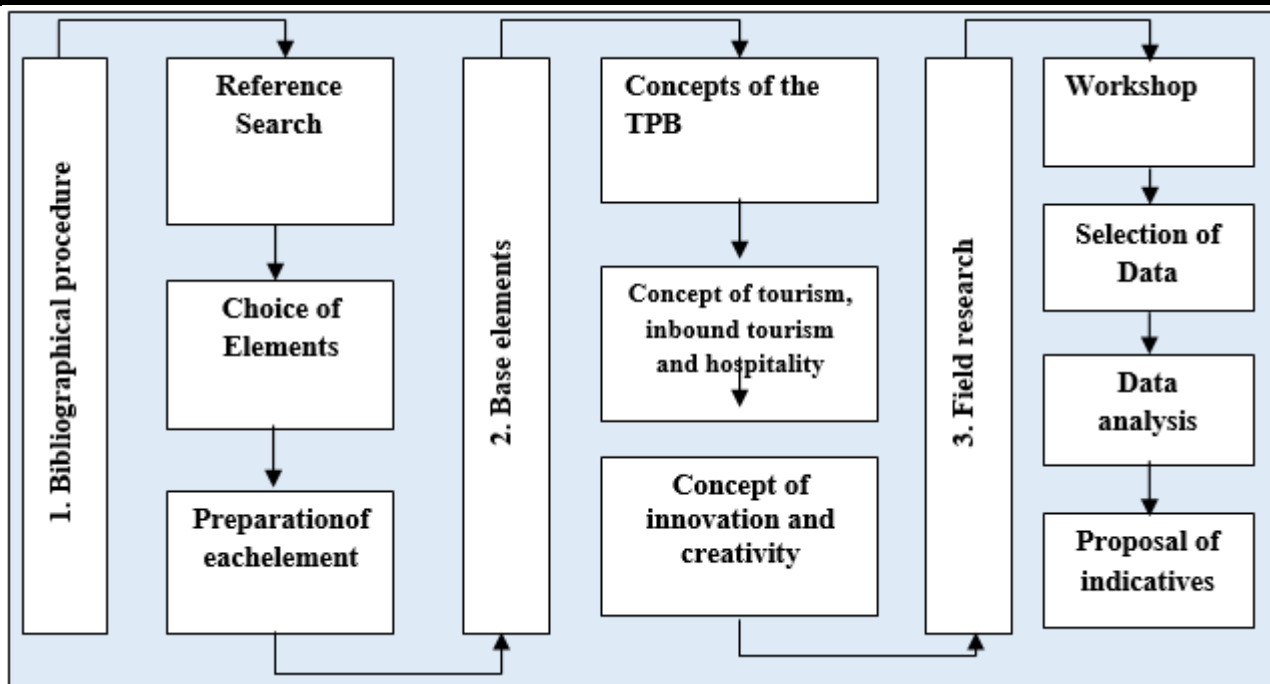


Diagram.1: Methodological procedures adopted in the research

Source: Adapted by the authors from Luna (2015).

4.1 Method

Marconi and Lakatos (2011) indicate that a research method is a set of rational procedures that guide thought to reach valid knowledge. It is an arrangement needed to produce certain data. For the preparation of this research, based on Creswell (2014) the Case Study method was applied. For an author, a case study is a comprehensive qualitative methodology which allows a researcher to explore a limited system over a certain period, through the collection of in-depth detailed data, involving multiple sources of information. The characteristic of this method is the identification of a specific case delimited by a specific location and events, which focuses on a problem or concern; the depth analysis of a particular issue or problem. Cases are described in detail and themes, issues or situations are identified.

The research considered as it case study a strategy workshop focusing on innovation on inbound tourism and hospitality, for leaders in the tourist activities specified above. The concern was to characterize strategies for social innovation in tourist hospitality in the State of Rondônia. The problem was to be analysed through participant observation of the events and the critical use of data from the application form and by the analysis of projects prepared by the participants..

4.2 Adopted Procedures

The procedures used for data collection were participant observation, which according to Marconi and Lakatos (2011) involves interaction between the researcher and the participants with the aim of collecting data. The

researchers become part, integrating, sharing and analyzing the social conditions, perceiving conflicts and tensions; and establishing communication links with the actors involved in the situation under study.

A structured questionnaire containing 36 statements compiled by the authors was also distributed to the participants. Of the statements, 7 referred to the identification of personal characteristics collected at a nominal range, as defined in Oliveira (2001). The other 29 related to the theme and were intended to identify by scale the perception by the group of its own ability to apply creativity and innovation to inbound tourism and local hospitality in view of the concepts learned. Its design was structured to allow responses on a Likert scale of 5 points. The reliability of the form is related to its validation through Cronbach's Alpha program 0.923.

The third procedure was the analysis of documents produced by the participants. The analysis of the data resulting from participant observation, the questionnaire responses and the elaborated projects were analyzed by means of the SWOT matrix. The use of diverse data sources aimed at validating the research or triangulating the findings. To Azevedo et al (2013), the combination of quantitative and qualitative methods reduces the risk of skewing the research and increases the credibility of the conclusions.

4.3 Likert scale

The Likert scale was used because it allows researchers to measure the strength of belief among the participants about a particular object, the force with which these

beliefs are held and the value attached to the object, as shown in Oliveira (2001). This scale features assertions related to the object under study that will be evaluated according to the degree of agreement. Thus, TA refers to Totally Agree, PA - Partially Agree, I - Indifferent, PD - Partially Disagree and SD - Strongly Disagree. According to Oliveira (2001), the advantage of the Likert scale is that it indicates the direction of the respondent's attitude to each statement, which is related to the purpose of the present work.

V. STUDY OF THE SOCIAL INNOVATION FOCUSED ON PROPOSED QUALIFYING STRATEGIES

The state of Rondônia, as highlighted in Figure 1, is located in northern Brazil. It has 52 municipalities and its capital city is Porto Velho. According to the Brazilian Institute of Geography and Statistics (IBGE), in 2015 the state had an estimated population of 502,748 people. According to Brasil (2014), the GDP in 2012 represented 12.7% (an amount of R\$ 26,024 million) of the total for the Northern region, putting this state in 3rd place in the rankings. In economic terms, it spends 28.5% on public administration and defense and social security; Farming takes up 20.5%; Trade, 12%; and Construction, 11.1%. Aggregating economic activities by sector in 2012, the participation in services accounted for 61.2% of its income; Farming accounted for 20.5% and Industry for 18.3%.



Fig.1: State of Rondônia, northern Brazil

Source: Internet of public domain

Pedro Filho (2013) indicates that the State of Rondônia has the potential for ecotourism owing to its natural attractions. Aiming to learn about and exploit this potential, the workshop was arranged to train local

leaders in tourism. As noted above, a questionnaire containing 36 statements was administered. Table 4 presents 7 of these, which elicit demographic data about the socio-economic situation of the respondents.

Table.4: Demographic data of the respondents

Indicator	Result	Percentage %
Age Group	40 to 52 years old	47
Gender	Female	65
Education	Completed Higher Education	35
Number of people residing in their home	1	35
Family income	4 to 10 on minimum wages	47
Home location in the State	North	53
Length of residence in the State	More than 10 years	76

Source: Questionnaire elaborated by the authors.

Based on the data it is possible to infer that the participants are persons established in the State and possibly to learn the characteristics of the region. They are educated, live in a have socioeconomic situation that indicates compatible stability for the position of leadership, with an established career and of an age that commands an adult audience. These variables indicate the probability of sharing the public interest in the proposed topic; the capacity to absorb, assimilate and disseminate the ideas worked on; access to resources for the taking action in their professional area; as active

members of society, they know the local characteristics and are able to monitor people's actions and prompt the government to act.

Table 5 below discriminates between the assertions applied to the respondents and seeks to assess their perception of inbound tourism, hospitality, behavioral intention, creativity, and innovation. Then, Table 7 lists the projects developed during the workshop. The confrontation between these data and the theory will be examined in order to indicate the key strategies to qualify for inbound tourism and hospitality in Rondônia.

Table.5: Answers of the respondents to the assertions

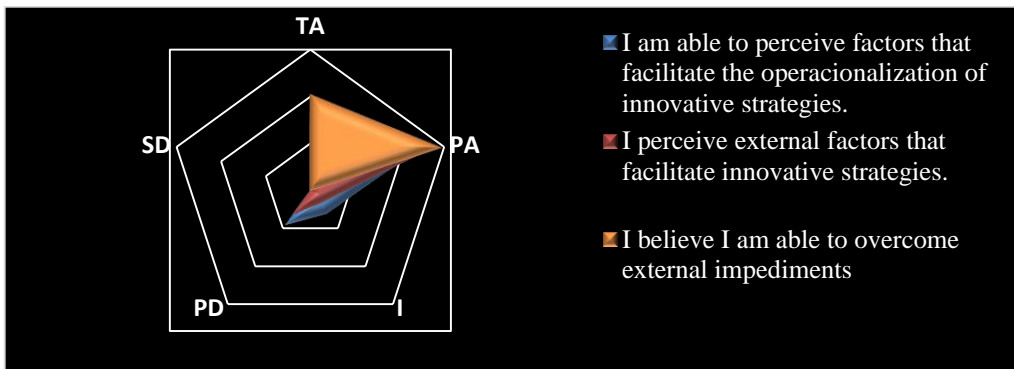
Assertions	Response sem %				
	CT	CP	I	DP	DT
1. The development of innovative strategies is possible.	100	0	0	0	0
2. I believe I can contribute with innovative strategies.	76	24	0	0	0
3. Based on past experience I believe I am able to innovate on inbound tourism.	59	41	0	0	0
4. I am aware of people or organizations nearby with innovative strategies.	47	47	0	0	0
5. I am able to influence those close to me to adopt innovative strategies.	59	41	0	0	0
6. I understand the factors that encourage the implementation of innovative strategies	29	41	12	18	0
7. I perceive internal factors that encourage the implementation of innovative strategies.	44	44	6	6	0
8. I perceive the external factors that encourage innovative strategies.	33	47	7	13	0
9. I believe that these will be valued by the organization when it adopts innovative strategies.	76	18	6	0	0
10. I perceive impediments to operationalizing innovative strategies.	38	19	25	19	0
11. I perceive internal impediments to operationalizing innovative strategies.	47	18	18	12	6
12. I perceive external impediments to operationalizing innovative strategies.	35	24	24	12	6
13. I believe I am able to overcome the internal impediments	41	59	0	0	0
14. I believe I am able to overcome the external impediments.	29	53	0	12	6
15. I believe that I will be criticized for not adopting innovative strategies.	41	35	12	0	12
16. I believe that inbound tourism contributes to local development.	82	18	0	0	0
17. It is possible to overcome problems and find alternatives in local social segments.	71	18	0	12	0
18. I believe that Rondônia has potential for tourism development.	88	13	0	0	0
19. Rondônia has local resources to promote inbound tourism.	29	59	0	6	6
20. I am able to develop new and useful ideas for the promotion of tourism.	59	29	6	6	6
21. I can present adaptable and fulfilling ideas for tourism.	41	47	0	12	0
22. I realize that my cognitive models of local tourism have been expanded.	47	35	12	0	6
23. I can operate and produce knowledge for local tourism.	47	41	0	12	0
24. I am able to solve complex problems by developing creativity.	31	56	0	6	6
25. I believe that inbound tourism is an important segment for tourism.	88	13	0	0	0
26. I believe that hospitality is the act of welcoming.	93	7	0	0	0
27. I am able to offer services for inbound tourism and hospitality in Rondônia.	50	38	0	6	6
28. I am able to implement new products or improved services	56	31	6	6	0
29. I can incorporate, combine and / or synthesize knowledge in services.	63	25	6	6	0

Source: Questionnaire prepared by the authors based on the theoretical framework.

Subtitle: Items 1 to 15 measure the behavioral intention. Items 16 to 19 assess local inbound tourism. Items 20 to 24 analyze creativity and items 25 to 29 measure innovation, inbound tourism and hospitality.

These data will be compared with the indicatives of the theoretical framework to meet the general and specific objectives. The constructs of attitude and subjective norm were measured by items 1 to 5 in Table 2 and the perceived behavioral control was measured by items 6 to 15. By analyzing the constructs of attitude and subjective norm, it was found that the respondents are likely to adopt innovative behaviors in inbound tourism and hospitality. The construct of perceived behavioral control was also confirmed by the respondents, and therefore a behavioral intention among the participants of the workshop can be claimed.

The only items that the individuals agreed on partially are related to the receiving influence of the environment. Influences can be internal or external to the organization, but items 6, 8 and 14 confirm, according to Graphic 1, that these influences are external factors that may hinder the respondent's ability to innovate and be creative. External factors are environmental conditions that negatively affect the achievement of the objectives and are considered by the participants to be related to the government.

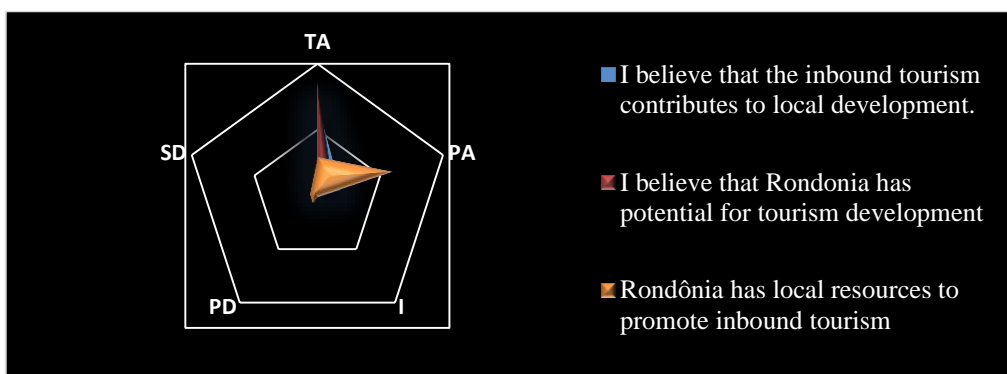


Graphic.1 – Behavioral intention of the participants

Source: The authors.

Items 16 to 19 of Table 2 evaluate inbound tourism; their intention was to measure the perception of the respondent of the possibility of investing in local inbound tourism. It is shown in Graphic 2 that the respondents perceive tourism as a factor of local change, which Rondônia is capable of instituting. However, it was pointed out in item 19 that not everyone believes the

State to have the necessary resources. Such resources are those of urban infrastructure; the encouragement of cultural activities; making the physical environment more attractive; state investment in tourism. These statements are consistent with the discussions in the group during the workshop when the researchers applied participative observation.

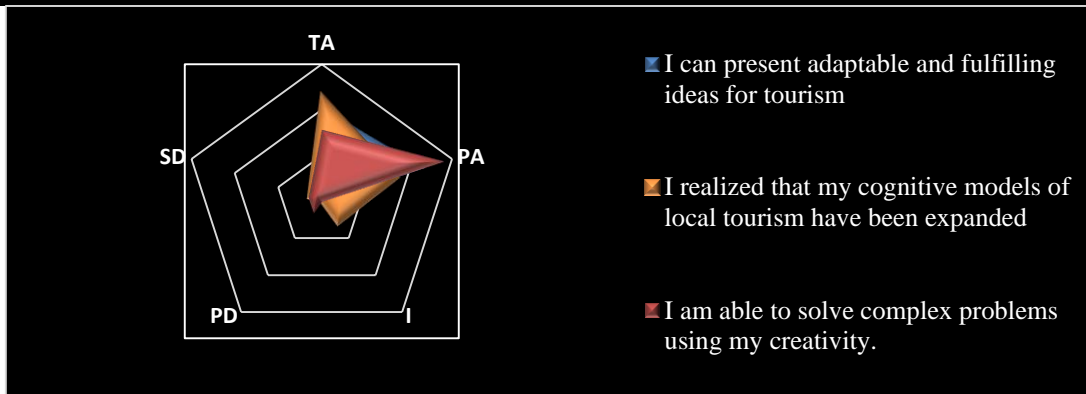


Graphic.2: Local inbound tourism

Source: The authors.

Items 20 to 24 aim to measure the respondents' perceptions of creativity concepts. The data show that most of the respondents perceive themselves capable of adopting creative attitudes, though they find themselves

only partially prepared to present adaptable and fulfilling ideas and solve complex problems, as pointed out in Graphic 3.

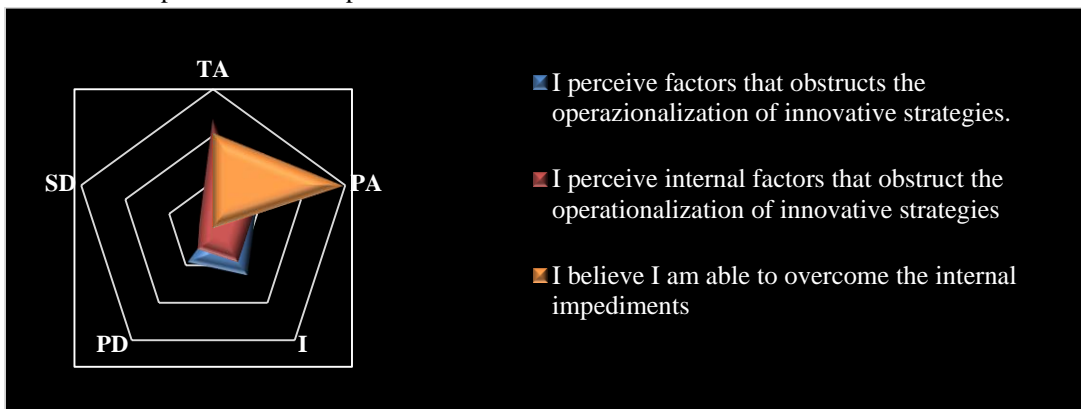


Graphic.3: Perceptions of creativeness

Source: The authors.

It is possible to relate this difficulty to the organizational platform. Items 10 and 11 in Table 2 confirm this hypothesis; here, participants claim to realize the existence of internal impediments to operationalize

innovation and in item 13 they indicate their difficulty in overcoming the internal impediments, as shown in Graphic 4.



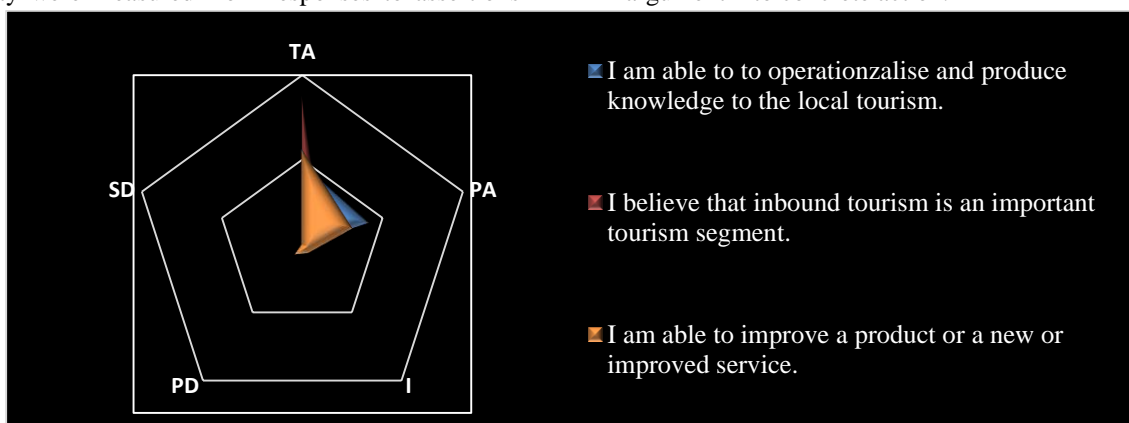
Graphic.4: Perception of the internal impediments to innovation

Source: The authors.

To change these contextual factors, the training of personnel, the opening of space for discussion, the stimulation of creativity to share organizational challenges and a search for creative strategies to solve problems seem to be necessary.

The perceptions of innovation, inbound tourism and hospitality were measured from responses to assertions

25 to 29, listed in Table 2, are in according the Graphic 5 in below. The predominance of a fitness behavioral favorable to a qualified service, simplified product or improvement in inbound tourism and hospitality is noted; this indicates a belief that inbound tourism is an important segment of tourism, which could turn logical argument into concrete action.



Graphic.5: Perceptions of innovation, inbound tourism and hospitality

Source: The authors.

Table.6: Projects elaborated by the workshop participants

Representatives	Description of the projects
Travel agencies	Create City Tour Porto Velho with a script that includes 15 attractions in Porto Velho (already mapped), including food, transportation, cultural, musical and regional dance presentations, graphics and tour guide.
Public agencies in state government	To adopt in the State of Rondônia 4 tourist cores, following the guidelines of the Ministry of Tourism: Porto Velho and Candeias do Jamari (1); Guajará and Mamore (2); Vale do Guaporé (3) and Circuit BR 364 (4); to Create and manage websites to publicize segments, products and tourist services; to identify and mapping the attractions of each core; to develop a Municipal Tourism Plan; to deploy the Tourism Plan through the creation of municipal and state laws; and to create a Work Plan to create a route to each Core. Create Cores.
Public agencies in local government	Upgrade Municipal Tourism Plan 2010/2011 prepared by the city of Porto Velho using the compensation from the Santo Antônio and Jirau Hydroelectric Plant, currently filed. Present the plan to the City Council in order to create public policies for the promotion of municipal and state tourism activity. Implement the proposals of the Tourism Plan. Conduct a survey of economic research that lists the gains generated by the tourism industry.
Third party	Restoration and expansion of the Parque Circuito de Porto Velho. The structure should include a stage for presentations; a fitness space for performing exercises; space for sporting events; building space for table games; a children's play area that includes equipment for developing motor skills; comfort stations; a wooded space for public meetings; craft stalls and an outdoor food court;
Hotels and accommodations	Training to qualify labor (in travel agencies, hotels, restaurants, taxis, newsagents); investment in urban infrastructure (making the external environment more attractive, cleaning, transportation, safety, health, accessibility, signage, public squares and parks) and tourism infrastructure (hotels, restaurants, revitalization of the Feira do Porto, Madeira Mamore Railway).
Bars and restaurants	Creation of a themed restaurant with regional characteristics on the edge of the Madeira River. Gathering local historical artefacts for room decoration; menus with typical dishes of the region; space for regional artistic presentations.

Source: Elaborated by the authors from the projects presented by the workshop participants

The projects indicate the need of innovation in the public and private sectors. In the private sector a demand is identified for new services and products to add to local resources; this would require an entrepreneurial attitude, high quality services and products. The public initiative should promote policies for local tourism, the updating of the municipal plan for tourism and investment in the urban infrastructure, to include transportation, security,

the creation of public squares, parks, and leisure activities, given the available resources.

5.1 Strategic elements for the qualification of inbound tourism and hospitality in Rondônia

The data generated by the answers to the questionnaire, combined with those from the documents prepared by the participants and the theoretical reference indicate as strategies the following items.

Table.7: Strategies to qualify inbound tourism and hospitality in tourism

Elements	Theory	Strategy for qualification
Competitiveness	Replace current holiday activities and destinations; reduce barriers and costs; increase business investment; consider innovation as a survival factor; innovate processes.	Create holiday itineraries that include local tour packages; offer advantageous prices; create new services such as a Porto Velho City Tour;
Economic performance	Innovation generates economic performance; hence, prioritize the	Adopt planning strategies to achieve the desired financial results; understand

	incremental investment process; and explore opportunities created by Information and Communication Technology.	the behaviours, values, history and context of the stakeholders; meet customers and assess their perceptions; propose improvement alternatives using the internet;
Technology	Tourism depends on the technology acquired; the internet has revolutionized information and sales processes; innovation is needed in the workforce, services, and organizational structure.	Include regional hotels in search engines; create websites with photos and accommodation options; add values for easy access, purchase and to stimulate interest; invest in the training of manpower;
Organizational strategy	Strategic objectives influence the attitude toward innovation activities; centralizing organizations produce incremental innovation and radical innovations are contributed by entrepreneurial organizations	Create organizational space for discussion, encourage creativity in employees; implement incremental innovations; implement radical innovations;
Individual entrepreneurship	There is space for entrepreneurs to develop new products and processes; they can be deployed to innovate on behalf of organizations or they can open businesses of their own.	Invest in new services and products; invest in new work processes; create networks of crafts persons and local businesses.
Role of the State	Be responsible for the management and marketing of tourist destinations; give financial support to regional economic development programs; build infrastructure for effective public-private partnerships; ensure a conducive political and regulatory environment.	Carry out policies to promote local tourism, upgrade the municipal tourism plan; invest in urban infrastructure; manage tourism marketing, qualify specific sectors; partnering.

Source: Prepared by the author on the basis of the theoretical framework, questionnaire and design.

5.2 Analysis of the perspective of the application of the strategic elements to the reality studied

For the preparation of this analysis we chose the SWOT matrix. The overview reveals the natural potential of the

state, the interests of the private sector and the need of management by the government with a view to administering the resources and enhancing the sector.

Table.8: SWOT analysis for the implementation of strategic elements to the object of study.

	1. Strengths (S)	2. Weaknesses (W)
Internal factors	1.1 Potential for inbound tourism in Rondônia; 1.2 Presence of projects for inbound tourism and hospitality; 1.3 Interest from the private sector in investing in structures for inbound tourism and hospitality; 1.4 A rich culture and abundant resources, hospitable population.	2.1 Lack of technical qualifications among suppliers and labor; 2.2 High costs of services, hotels and restaurants that make local tourism impossible; 2.3 Absence of sightseeing tours or vacation destinations with local attractions; 2.4 Lack of confidence from the private sector to invest in products and regional services;

External factors	3. Opportunities (O)	4. Threats (T)
	3.1 Plenty of natural beauty to encourage ecotourism; 3.2 Location in the Western Amazon, a region of international interest; 3.3 The economic potential of tourism for the public and private sector; 3.4 A geographic location that favors international tourism (Bolivia, Peru, Venezuela, Argentina).	4.1 An outdated Municipal Tourism Plan; 4.2 Absence of public policies to encourage state tourism; 4.3 Precarious urban structure; 4.4 Precarious disclosure of state tourist potential; 4.5 Difficulty of access; 4.6 Devaluation of culture and local resources among residents.

Source: The authors

The SWOT matrix demonstrated the key areas that require management. The challenges are to manage external threats and weaknesses and leverage the strengths and opportunities. The establishment of a partnership between the public and private sector is a strategic move in developing local tourism.

5.3 The elements of social innovation that would help install the qualification strategies for inbound tourism and hospitality

Social innovation is an economic restructuring strategy that appears to meet the demands and solve social problems. It involves social intervention as a manner of development and the adoption of technologies that transform social relations, promote inclusion, create jobs and improve people’s standard of living. This section addresses the following question: What elements of social innovation will support the qualification strategy for inbound tourism and hospitality? Table 9 below summarizes the possibilities for meeting the demands identified in the survey.

Table.9: Social innovation elements

Strategy	Social innovation elements
1.Competitiveness	1.1 create tourist centers in the state; 1.2 map the tourist attractions of the poles; 1.3 implement a state tourism plan.
2.Economic performance	2.1 seek investment from regional financial institutions; 2.2 foster social interaction and an appreciation of the local culture; 2.3 strengthen ties with the region, recover and preserve local resources.
3. Technology	3.1 innovate in products and services and present consistent prices in competition; 3.2 provide environmental solutions that involve social actors in the process mobilization; 3.3 empower marginalized groups, suppliers and local hand work;
4. Organizational strategy	4.1 make labor relations flexible; 4.2 bring to the organizational platforms the ideas of social actors; 4. 3 attend to social problems;
5.Individual entrepreneurship	5.1 income generation to groups linked to art and culture; 5.2 income distribution and strengthening of local trade; 5.3 creation of craft networks and local businesses.
6. Role of the state	6.1 adoption of regional policies that minimize the socioeconomic impact of the changes; 6.2 develop a civic sense in the population, increasing the sense of belonging and security; 6.1.3 promote people's involvement in planning;

Source: The authors, on the basis of the theoretical framework and data survey..

Innovation involves social intervention, adopting technologies and arrangements that can transform social relations. Individuals and organizations become agents who contribute to decisions, take initiatives and build new relationships. When applied to tourism innovation can be detected from the adoption of regional policies that minimize the socioeconomic impact of change to generate employment, promote the local culture, raise incomes and preserve the natural resources. It exploits the regional resources, contributes to the generation of methodologies, and produces initiatives and democratic policies; It presents environmental solutions which involve social actors in mobilizing and learning processes. Local beliefs and collective consciousness are strengthened. Unlike social challenges, it increases the perception of power which enables efforts to be mobilized to solve problems. All these initiatives are possible if tourism in Rondônia receives investment.

VI. CONCLUSION

Rondônia is has a great potential for tourism. Natural, social, cultural and economic resources require planning and management. This research mentioned throughout the elements needed to improve inbound tourism in the region; the perspectives from which these elements were applied to its present situation were analysed and the strategies for social innovation by tourism were characterized. The establishment of partnerships between the public and private sector, the third sector and society allows effective, democratic and participatory intervention. Investment in inbound tourism and local hospitality is able to restructure the economy of the state, generate employment, raise income and increase the people's standard of living. Investment in the requisite infrastructure for inbound tourism and hospitality will attract a demand for projects to be funded, which would be reflected in increased the state revenue and the consequent strengthening of the state's economic potential. The resources from these actions could be invested in urban infrastructure, public awareness of inbound tourism, and the rehabilitation of the State's culture to preserve and maintain the historical heritage. Investment in public policies for marketing tourism in the region, starting with urban planning to facilitate access, promote a civic sense in the population, and encourage social inclusion through art, will attract national and international tourists.

The study demonstrates that is possible to implement strategies for social innovation by investing in inbound tourism and hospitality. It incorporated valid guiding elements of action planning, management and the implementation of planning in public and private institutions, with consequent benefit to society. In this context, the participation of the University is considered

important, for it can provide the free knowledge necessary to carry out strategic planning and the preparation and the training of managers who will be leaders in both the private and public spheres.

ACKNOWLEDGEMENTS

We thank the University of Beira Interior, Faculty of Social and Human Sciences, Department of Management and Economics, Post-Doctoral Programme in Management and Economics, with a focus on Management Strategy for Innovation and Sustainability, Covilha, Portugal. Site: http://www.ubi.pt/Entidade/Ciencias_Sociais_e_Humanas

REFERENCES

- [1] Azevedo, Carlos E. F.; Oliveira, Leonel G. L.; Gonzalez, Márcio, M. A. A.(2013). Triangulation strategies: goals, possibilities, limitations and its closeness with pragmatism. **IV Meeting of Teaching and Research in Management and Accounting - Enepq**. Brasília, November.
- [2] Brasil. (2013). Ministry of Tourism. National Tourism Plan 2013-2016: tourism doing much more for Brazil.
- [3] Brasil. (2014). Government of the State of Rondônia. Department of Planning, Budget and Management. Management of the Observatory and Regional Development. **Gross Domestic Product (GDP) of the State of Rondônia – 2002 to 2012**. Porto Velho.
- [4] Correia, Suzanne E. N. ;Falção, Mariana C.; Oliveira, Verônica, M. ; Castillo, Leonardo A. G. (2015).Community Base Tourism as Social Innovation: congruence between constructs. **Magazine of Tourism and Cultural Heritage – PASOS**. Vol. 13, n. 5, pp. 1213-1227.
- [5] Creswell, John W. (2010). Research Projects: qualitative, quantitative and mixed methods. Porto Alegre: Artmed.
- [6] Creswell, J.(2014).**Qualitative Research and Research Project**: choosing among five approaches.Porto Alegre: Penso.
- [7] Emmendoerfer, Magnus Luiz; Silva, Fernanda Cristina da; Lima, Afonso Augusto T. de F. de C. (2011). Evidences of Social Innovation in Public Management of tourism in Minas Gerais – Brazil: The model of tourist circuits on analysis. **PASOS – Magazine of Tourism and Cultural Heritage**. Vol. 9, n. 2. pp. 397-410.
- [8] Esteves, Telmo. (2015). Tourism Innovation in Lisbon. (Master's dissertation). Master in Business Strategy. **Universidade Europeia**. Lisbon.
- [9] Freire, Marcia A. (2015).Hospitality in professional training in tourism in Rio de Janeiro: searching for

- analytical categories. Master's Program in Hospitality. **Anhembi Morumbi University**. São Paulo: USP.
- [10] Gil, Antônia Carlos. (2010). **How to design research projects**. São Paulo: Atlas.
- [11] Gomide, Camila Sant'Anna. (2014). Attitudes, subjective norms and perceived behavioral control of a university population in relation to water consumption: analysis in the light of planned behaviour (TPB). Master's dissertation. **Federal University of Viçosa**. Administration Postgraduate Program, 2014. Available on <<http://www.locus.ufv.br/bitstream/handle/123456789/6618/texto%20completo.pdf?sequence=1&isAllowed=y>> Accessed on April 11, 2016.
- [12] Lima, Robson Pereira de. (2011). Community Base Tourism as Social Innovation. (Doctoral thesis). Postgraduate Program in Production Engineering, COPPE. **Federal University of Rio de Janeiro**. Rio de Janeiro: COPPE.
- [13] Luna, Zehedina Feitosa de. (2015). **Innovation in the SMED system process as a competitive strategy in a factory**. Porto Velho: GEITEC.
- [14] MarconI, Marina de A. Lakatos, Eva M. (2011). **Scientific methodology**. São Paulo: Atlas.
- [15] Marconi, Marina de A. Lakatos, Eva M. (2012). **Research Techniques**. São Paulo: Atlas.
- [16] Neto, Eduardo Ribeiro. (2011). Swot Analysis - Strategic Planning for Implementation Analysis and Training of a Maintenance Team in an Industrial Segment Company. São João Del Rei. **Postgraduate Center of the Pitágoras Faculties**.
- [17] Oliveira, Tânia Modesto V. de. (2001). Scales of Attitude Measurement: Thurstone, Osgood, Stapel, Likert, Guttman, Alpert. **Administration online: practice, research and teaching**. v.2, n. 2.
- [18] Pedro Filho, Flávio de S. (2016). Strategy workshop for inbound tourism and hospitality with a focus on innovation. (Handout). **Master's postgraduate program in administration – PPGMAD**. Federal University of Rondônia. Porto Velho: PPGA.
- [19] Pedro Filho, Flávio de S. (2013). Paradigms and strategic perspectives for indigenous ecotourism in Rondônia. **Tourism virtual magazine**. Rio de Janeiro, v. 13, n.2, Aug.
- [20] Pimentel, Raphael Felipe Diniz. (2012). Brazilian hospitality at international tourism market. **Academic Magazine of the Tourism Innovation Centre**. Rio de Janeiro: COPPE.
- [21] Pezini, Raquel; Manosso, Franciele C.; Bizinelli, Camila; Gândara, José M. G. (2014). Inbound Tourism: an analysis of city tours in Curitiba. **Tourism Vision and Action Electronic Magazine**. Vol 16, n.3, Sep-Dec.
- [22] Sanmartin, Stela Maris. (2012). **Creativity and Innovation in Company**: from the potential to creative action. São Paulo: Trevisan.
- [23] Silveira, Mariana O. da; Maia, Maria L. A. (2015). Variables that influence the use of bicycles and the beliefs of planned behaviour theory. **Revista Transportes**. V. 23, n 1.
- [24] Thiollent, Michel. (2011). Action research methodology. São Paulo: Cortez.
- [25] Wada, Elizabeth K. (2012). Hospitality. **Tourism: strategic planning and management capacity – regional development, production network and clusters**. Barueri: Manole.

Gentrification and Environmental Justice in Nigerian Cities

Ogbonna Chukwuemeka Godswill*, Aguguo Godlives Ukachukwu

Department of Urban and Regional Planning, Abia State Polytechnic Aba, Nigeria

*Email: emeka14feb@yahoo.com

Abstract— *Gentrification is a process of urban revitalization by which the original inhabitants of an area are displaced, owing to the purchase and upgrading of their deteriorated properties by the middle or high income households. An aspect of gentrification that is of particular interest to Nigerians is the issue of displacement, with its attendant socio-economic alienation of the poor from the city, which has evoked some environmental justice concerns. Focusing on the city of Aba, this study examined gentrification and the environmental justice question in Nigerian cities. The study adopted survey research design, making use of qualitative and quantitative methods to analyse gentrification. Cluster and simple random sampling techniques were used to select 158 displaced household heads of gentrified buildings across the various neighbourhoods in Aba, who were surveyed. Data collected were analyzed with appropriate parametric tests using SPSS. Findings show that about 698 households are displaced in the city every year due to gentrification, with an annual displacement rate of 7.5%. This gentrification induced displacements have been found to constitute significant environmental injustice to the low income city residents as it leads to their dislocation from kin, and communal heritages; forces them to move into substandard housing at the urban fringes; and constrains some to relocate to the rural areas, limiting their abilities to cope with life's challenges. The study therefore recommends among other things, that the Town Planning Authorities should create a platform to educate owners of rundown properties to adopt the model of market-led gentrification as presently practiced in Lagos city.*

Keywords— *Aba, Displacement, Environmental justice, Gentrification, Nigeria.*

I. INTRODUCTION

Gentrification is a concept developed by sociologist Ruth Glass in 1964 by which she sought to explain the socio-demographic changes in residential neighbourhoods in London, where working class low income dwellers were

being displaced by middle income earners. Certain circumstances surrounding the urbanization process of the London inner city had necessitated the middle/high income earners to buy individual residential housing units from low income working class owner-occupiers or from landlords with small property holdings within the older parts of the city. Over time, the process of gentrification transforms both the physical character of the neighbourhood as well as the socio-economic and demographic characteristics resulting in an upscale, culturally elegant, professional community (Glass, 1964). Hence, gentrification connotes transformation of the rundown, inner-city, low-income neighbourhoods into wealthy areas, usually associated with population change and improvements to the built environment (Crieckingen & Decroly, 2003). Hamnett (1984) defines gentrification as the invasion by middle-class or higher-income groups, of previously working-class neighbourhoods or old and deteriorated communities, and the replacement or displacement of many of the original occupants. It involves the physical renovation or rehabilitation of deteriorated housing stock and upgrading it to meet the requirements of the new owners – a process which leads to a significant appreciation in the value of the environment as well as the price of the housing stock.

Three main theoretical concepts have been discussed in literature to explain gentrification: socio-cultural approach or consumption-orientated theory (Ley, 1994; London and Palen, 1984); the economic approach – the rent gap theory and the value gap theory (Smith, 1987; Hamnett, 1984); and the political interventions theories (Lees, 2008; Haase et al., 2010). Due to accession of wealth, ‘tertiarisation’ of jobs which followed after the Second World War, modern society began to be shaped by diverse lifestyles and various types of households. These socio-cultural shifts and their consequences on market demands as Ley (1994) identified, are the basis of the socio-cultural approach that describes the process of gentrification as the displacement of inhabitants of an area by groups of ‘new lifestyles’ that emerged due to the structural transformation towards the

post-industrial city. Ley (1994) focused on the characteristics and consumption patterns of people and identified a social group that emerged from the economic and socio-cultural changes, namely 'gentrifiers' or the 'new middle class'. As a result, the structure of the district adapts to those new requirements, and people who do not belong to those new lifestyle-groups, are not able to afford their living environment anymore and are forced to leave. Hence, gentrification occurs due to different perceptions of life.

Neo-Marxists such as Smith (1979; 1987) argued that gentrification is the result of the uneven development of many major Western industrial cities in terms of the overvaluing of the suburbs over the inner city. He therefore applies rent-gap theory to explain the depreciation of inner-city property values due primarily to suburbanization and de-industrialization, and why gentrification occurs. The rent-gap theory describes the disparity between the actual capitalized ground rent (land price) of a plot of land given its present use, and the potential ground rent that might be collected under a 'higher and better' use (Smith 1987) as basis for urban renewal. Smith, in his analysis, has shown that when the gap is sufficiently wide, real estate developers, landlords, and other people with vested interests in the development of land perceive the potential profit to be derived from re-investing in inner-city properties and redeveloping them for new tenants. Thus, the development of a rent gap creates the opportunity for urban restructuring and gentrification. The value gap theory was developed by Chris Hamnett and Bill Randolph in 1984, and defines the gap between the 'tenanted investment value', describing the actual value of the building that is based on rental incomes, and the 'vacant possession value', which describes a potential value the buildings would attain if transformed to an owner-occupied dwelling (Hamnett, 1984). According to the theory, older and decrepit apartment buildings in inner-city districts are bought by investors, who in turn proceed to modernise and transform them into condominiums, and then resell those revitalised houses with higher profit margin.

Political interventionist theories which link gentrification to policies of urban containment and inner-city resurgence such as: urban renewal; urban redevelopments; and new housing policies, have been introduced (Haase et. al., 2010). Referring to gentrification in positive terms as urban regeneration and urban sustainability, and avoiding the class constitution of the processes involved thereby neutralising the negative image that the process of gentrification brings with it, politicians withhold effects like social displacement and homogeneity of gentrified districts (Lees, et. al., 2008).

Rather, they refer to its benefits as a revitalisation of urban districts and diversion of poverty concentrations (Maloutas, 2011). This understanding perhaps informed the frequent application of urban renewal by most city-authorities in Sub-Saharan Africa to address the housing/ infrastructure problems of the inner-cities.

Hybrids theorists like Damarius (1983) and Hamnett (1984), after comparing various theories on gentrification, highlighting Smith's in particular, with residential location theory, posits that there are five main explanatory factors of gentrification, which are: first, the impact of increasing city size coupled with changes in the trade-off between preference for size and accessibility; second, changes in the demographic and household structure of the population; third, lifestyle and preference shifts; fourth, changes in the relative house price inflation and investment; and lastly, changes in the employment base and occupational structure of certain cities (Hamnett, 1984).

The process of gentrification can be associated with both positive and negative consequences depending on perceptions, and the category of urban residents mostly affected. Gentrification has been largely successful in improving the quality of the physical environment as well as in increasing the prospect of more tax revenue to government with the increased income of the new dwellers (Paul, Abimbola, & Femi, 2017). Also, due to mixture of different social groups, concentrations of poverty may be reduced and as the number of educated people in the community increases, the crime rate of the area reduces, which may equally lead to an improved image of the urban district (Hogskola, 2012). However, gentrification creates other problems such as the displacement of the original owners/occupiers of inner-city housing with the attendant loss of social diversity within the neighbourhood, loss of affordable housing for low-income earners and the inevitable commercialization of housing not only in the gentrified areas but also in adjoining neighbourhoods (Granger, 2010). The 'very poor' urban dwellers often face the harsh consequences of gentrification. Homelessness and hunger arising from demographic displacements and joblessness are the immediate results of most urban renewal and gentrification projects in Sub-Saharan Africa. Almost all natural cities in Sub-Saharan Africa are first established by very low income dwellers (Ezema et. al., 2016). Social equity demands that for modernization and urban improvement to force the 'very poor' out of their heritage, provision for resettlement should be made available, affordable and timely. However, experience over the years has shown that both the city authorities and the new

occupants of the 'hijacked cities' neither have any link with, nor make any contribution to ease the resettlement plights of the displaced poor (Agbaje, 2013). This is where the issue of Environmental Justice comes to question.

Environmental Justice Concerns must be embedded in pursuit of sustainable development in Nigeria. Environmental justice has been severally defined. Hogskola (2012) stated that environmental justice (EJ) is the fair treatment and meaningful involvement of all people regardless of race, colour, sex, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations, and policies. Environmental justice is about social transformation directed towards meeting basic human needs and enhancing the quality of life—economic life, health care, housing, human rights, environmental protection, and democracy. Environmental justice can be traced to environmental rights. There is international recognition of environmental rights (Hogskola, 2012). The right to the environment can be traced to the United Nations Conference on the Human environment and the Stockholm Declaration which emerged from it. Principle 1 of the Stockholm declaration states that "Man has a fundamental right to freedom, equality and adequate conditions of life; in environment of quality that permits a life of dignity and well being" (United Nations, 1992). The point at which a particular activity alters the environment and radically affects the way of life and economic well being of those who live within its vicinity, or poses danger to health and life, is the threshold at which the right to a clean environment is breached (Nwanna, 2012).

In an influential article, Hamilton (1995) identified three broad categories of explanations for environmental justice correlations: pure discrimination, economic efficiency, and political action. The pure discrimination theory holds that firms make production choices, including pollution emissions, based partly on their differential preferences for the welfare of different groups. If firms put a greater weight on the welfare of whites, they may systematically steer pollution into minority communities. Similarly, focused on firms' behaviour, the second explanation is that firms locate their pollution-generating facilities on the basis of economic factors that maximize their profits rather than on the basis of demographics per se. Examples might be access to inexpensive land, to transportation networks, or to other firms in their supply chain. The third explanation which is rooted on political action, and simply summarized as "coming to the nuisance," essentially reverses the causality. Regardless of the reason pollution occurs in an area, local

residents will find it undesirable. Accordingly, demand for real estate in the area will fall, and consequently so too will real estate values. The poor, being unwilling (or unable) to pay the higher housing costs required to obtain a clean environment, are the most likely to remain, or even to move in. This explanation follows the logic of Tiebout (1956), in which households "sort" into areas by their willingness to pay for public amenities. It was introduced into the environmental justice literature by Hamilton (1995). This approach continues to receive the most attention from economists and town planners interested in environmental justice questions, so it will be given the most attention in this study. By the logic of this socio-economic process, poor households sort into the community because their priority is affordable housing, which allows them to save money for other necessities, so their willingness to pay for the environment is relatively low. In contrast, wealthier gentrifiers bid up housing prices according to their willingness (capacities) to pay, harming the poorer (former) settlers who must now pay higher rents (Sieg et al., 2004). Consequently, if the dynamics of Tiebout (1956) sorting plays an important role in explaining observed environmental justice correlations, it would appear to push back the locus of injustice from an environmental question to a more general question about the distribution of wealth, hence political action is to be held responsible.

The rate at which the core-areas of most Nigerian cities are being gentrified particularly in the past two decades is alarming, and has caused great concern among city planners and the civil society at large (Nwanna, 2012). In Nigeria, the political corruption that characterized the era of oil boom has created a class distinction with wide gap between the majority low income (poor) class and less upper income (elite) class, and a near complete disappearance of the middle income class. The resultant effect is prevalence of poverty, which in this sense refers to the deprivation of elements necessary for human survival which include clean water, food, affordable housing, health, and self-dignity (National Planning Commission, 2004). An aspect of gentrification that is of particular concern to city watchers in Nigeria is the issue of physical displacement as well as social and economic alienation of the poor from the city. The basic character of gentrification in Nigeria is such that wealthy individuals and companies offer 'attractive prices' to poor landlords of older buildings in the cities and purchase their properties. Then both the original landlord and his tenants are given notices to vacate the property, usually within a period not more than six months. Thereafter, the building is demolished and a new edifice is

erected there. As this happens, the environmental quality of the neighbourhood improves and property taxes begin to rise. Then many long-term homeowners in neighbouring properties are unable to keep up with increasing property tax rates. In the process, commercial and residential landlords often increase rent to continue earning a profit on their investment property. Other Landlords also increase rent prices because they know that renovations to the surrounding area will increase the attractiveness of their property. Eventually the poor, low income tenants are systematically displaced. Displaced residence often times find it difficult to get adequate housing at a price relative to what they were paying before, hence they are frequently forced to move into substandard housing in suburban areas, or relocate to the rural areas. Ultimately, the city's demographic profile changes. The once indigenous sociological community is destroyed and replaced by another. What is perhaps one of the most disheartening effects of gentrification in Nigerian cities is that people who once owned gracious homes in the gentrified areas, which may have needed a little maintenance, loses such property forever, while their financial proceeds may end up being utilized to pay for rented accommodation in some remote

community with very low rent regime, and any remainder utilized for household upkeep. These processes evoke a sense of environmental injustice being perpetrated on the indigent property owners and low income tenants in Nigerian cities. Unfortunately there exists no empirical study on the socio-economic and environmental effects of gentrification on the low income residents in Nigerian cities. With samples drawn from the city of Aba in South-eastern Nigeria, this study therefore examined gentrification and its implications for environmental justice for the low income city dwellers in Nigeria.

II. STUDY SETTING

The study was based on samples drawn from the city of Aba, in the south-eastern part of Nigeria; fig.1 shows the location of Aba and other major cities in Nigeria. Aba was selected for this study because of its high rate of inner-city gentrification. Moreover, the city of Aba is a good representation of the prevailing characteristics of most Nigerian cities in terms of physical development, housing, urban infrastructure, urban governance, land use development, rate of urbanization, and socio-economic development.



Fig.1: Map of Nigeria showing major cities, including Aba

Source: [www. Mapsofworld.com](http://www.Mapsofworld.com)

Among all major cities in Nigeria, one can only distinguish Abuja – federal capital territory, Lagos, Calabar, Port-Harcourt, Akure, Warri, and Kaduna in terms of conscious physical planning. Outside these major planned cities, almost every other city in Nigeria grew organically from

some rural settlement to suburban, and to fully urbanized cities. To this extent, buildings also followed this pattern in terms of their structural contents, standard and sophistication. While some property owners in these cities have upgraded their buildings to synchronize with the

modern skyline, majority others have not been able to do so due to general high level of poverty, high cost of buildings materials, and high construction costs. These less advantaged landlords are therefore under constant pressure by the elite political/business class to sale their old properties, hence the high prevalence of gentrification in Nigerian cities.

III. MATERIALS AND METHODS

This study used qualitative and quantitative methods to analyse gentrification, providing answers to a variety of questions bothering on the causes and consequences of gentrification in Nigerian cities. The spatial distribution of gentrified buildings across the city, as well as the existing building conditions were observed and mapped. Structured questionnaires were sampled on displaced household heads (former landlords and tenants) of gentrified buildings in Aba in the past ten years (2007 – 2016), which constitutes the population of study numbering 6981. The study adopted this time frame because it represents the period in which gentrification has been more prevalent in the study area. These population data were collected through the following method:

1. Thirty research assistants who are final year students of Urban and Regional Planning, Abia State Polytechnic Aba were recruited and trained for the survey
2. List of gentrified buildings in Aba between 2007 and 2016 was generated using building approval registers at the Town planning Authorities, and validated through neighbourhood by neighbourhood survey
3. The contact addresses of the present owners and the original landlords of the gentrified building were compiled with the help of building register and town planning staff in the Aba-North and Aba-South Town Planning Authorities respectively

4. Separate questionnaires were administered to the identified original landlords to compile the list/contact addresses of their tenants/occupiers (the household heads only) in their former buildings
5. Surveys were then scheduled with the original landlords and tenants in their new locations making use of structured questionnaires.

Further data about the population were derived from the combined cross-sectional and disaggregate longitudinal census data for Aba, sourced from the 2006 Population and Housing Census of the Federal Republic of Nigeria Priority Table Volume II. The sample size of approximately 158 was estimated from the population using the model derived by Miller and Brewer (2003). Cluster sampling technique was used to divide the study area into thirty zones following the neighbourhood structure of Aba, and a given number of gentrified buildings (their former landlords/tenants) were selected from each zone proportionately using simple random technique. Data collected were analyzed with appropriate parametric tests using SPSS for Windows, Version 17. Specifically, the Pearson’s Correlation was used to test the hypotheses, and P value of ≤ 0.05 was considered statistically significant.

IV. RESULTS AND DISCUSSION

4.1 Socio- Economic Characteristics of the Former occupants of gentrified buildings

The respondents in this study are the former occupants of the gentrified building in Aba most of whom have been displaced to other properties mainly at the outskirts of the city. The respondents were surveyed to determine: their household sizes; occupation of the household-heads; monthly income of the household-heads; their educational attainment; and number of rooms occupied by each household. The data are presented on table 1.

Table.1: Socio- Economic Characteristics of the displaced occupants of gentrified buildings

Category	Variables	Frequency	%	Variables	Variables	Frequency	%
Household Size	1-3	32	20.5	Number of Rooms Occupied	1	54	34.2
	4-6	85	54.5		2	90	57.0
	7-10	39	25.0		3	12	7.6
	Total	156	100		4 or more	2	1.2
					Total	158	100
Occupation of Head of Household	Public/Civil Servant	17	10.8	Educational Attainment	None	6	3.9
	Privately Employed	46	29.1		Primary	44	28.2
	Craft/Business	65	41.1		Secondary	71	45.5
	Unemployed	30	19.0		Degree	32	20.5
	Total	158	100		PG Degree	3	1.9

					Total	156	100
Monthly Income of Head of Household in Naira (₦)	< 10,000	43	27.4				
	10,000 - 50,000	68	43.3				
	50,001- 100,000	32	20.4				
	101,000 – 150,000	11	7.0				
	> 150,000	3	1.9				
	Total	157	100				

Table 1 show that about 54% of the former occupants of gentrified buildings have household sizes of between four and six persons. This is followed by those with household sizes of between seven to ten persons (25%), while the least is household sizes of one to three persons which constitute about 20%. Their occupational survey shows the dominance of those employ in some vocational crafts and private business which makes up 41% of respondents. Following this are people employed in small scale private firms (29%). Also significant is the fact that about 19% of them are unemployed. When these data are compared with the monthly income statistics of former occupants of the

gentrified buildings as illustrated in figure two, we appreciate the level of poverty among this group of people. About 28% earn less than N10,000 (\$28) per month, 43% of the respondents earn between N10,000 to N50,000 (\$28 to \$139) monthly, while only about 29% earn anything above that, with less than 2% earning salaries above N150,000 (\$420) monthly. Their level of education is just within literacy level with greater percentage (74%) having attained only primary or secondary schools; and about 21% with some college degree. In terms of number of rooms exclusively available to households, 57% occupy two room apartments, 34.2% occupy single rooms, and only about 9% occupy three room apartments or more.

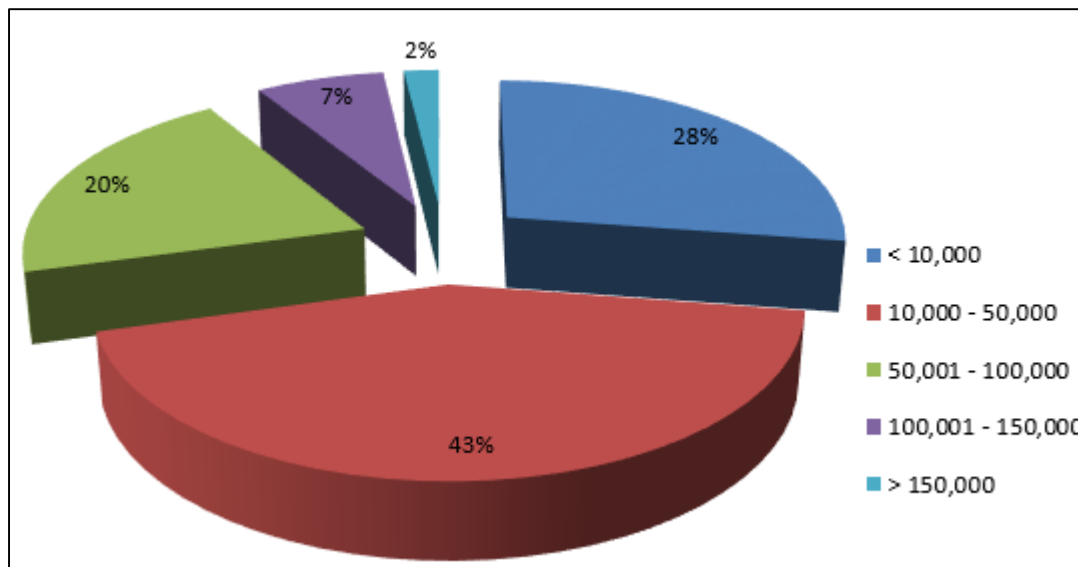


Fig.2: Monthly income of Household heads (₦)

4.2 Rate of Gentrification in Aba

Data on the existing housing stock in Aba was generated through the Priority Table Volume II of the 2006 Population and Housing Census of the Federal Republic of Nigeria, and it shows that Aba-North local government area had 24, 803 houses while Aba-South local government had 92,437, bringing the total housing stock in Aba by 2006 to

117,240 houses. Then, the number of gentrified building in Aba between 2007 and 2016 was derived using building approval registers at the Town planning Authorities, and validated through neighbourhood by neighbourhood survey. Table 2 shows the data.

Table.2: Rate of gentrification in Aba

Local government	Existing housing stock by 2006	Number of gentrified buildings/Percentage of total housing stock										Total
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
Aba North	24,803	*41 / **0.17	44 / 0.18	50 / 0.20	56 / 0.23	72 / 0.29	77 / 0.31	83 / 0.34	102 / 0.41	113 / 0.46	126 / 0.51	764 / 3.1
Aba South	92,437	62 / 0.07	73 / 0.08	84 / 0.09	101 / 0.11	112 / 0.12	136 / 0.15	144 / 0.16	160 / 0.17	168 / 0.18	183 / 0.20	1,223 / 1.32
Total	117,240	103 / 0.09	117 / 0.10	134 / 0.12	157 / 0.13	184 / 0.16	213 / 0.18	227 / 0.20	262 / 0.22	281 / 0.24	309 / 0.26	1,987 / 1.7%
% Mean	0.17%											
* These represent number of gentrified buildings per year												
** These represent percentage of gentrified buildings to total housing stock												

Data on table 2 is illustrated on figure 3, and show that there is progressive increase of number of gentrified buildings in Aba-north L.G.A from 41 buildings in 2007 to 126 buildings in 2016, at the average rate of 0.31% per annum. Likewise, gentrified buildings in Aba-south increased from

62 in 2007 to 183 in 2016 at average rate of 0.13% per annum. In general, 103 buildings were gentrified in 2007 in Aba, and it increased in the subsequent years to 309 in 2016 with average growth rate of 0.17% per annum.

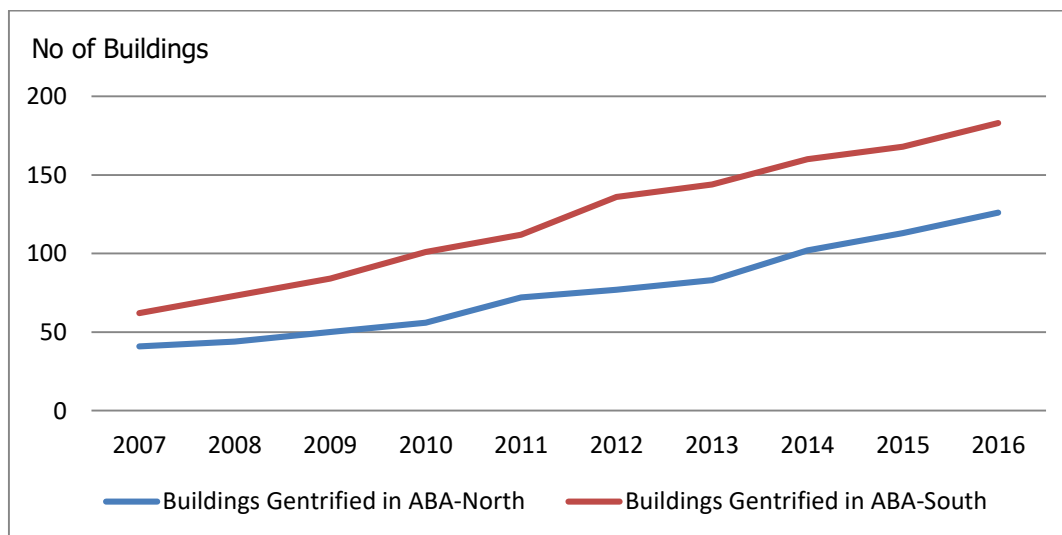


Fig.3: Rate of gentrification in Aba from 2007 to 2016

4.3 Number of Households Displaced From Gentrified Buildings in Aba

The study investigated the level of displacement arising from gentrification of inner-city buildings in Aba in the past ten years, and the result is presented on table 3. Two categories of households were surveyed: the former landlords of the gentrified buildings; and the tenants

occupying the buildings. Whereas about 5.4% of the original landlords were not displaced, a 100% of the tenants were displaced. Some of the original landlords that were not displaced happened to be those who entered into some sort of agreement with the buyers of their properties to possess some portion of it after the redevelopment.

Table.3: Total number of former households displaced in the past ten years

Local government	Number of former households Displaced per year										Total	Mean Rate (%)
Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		
Aba North	164	159	185	202	266	275	282	362	390	463	2,748	6.4
Aba South	201	245	275	343	397	473	493	577	593	636	4,233	8.1
Total	365	404	460	545	663	748	775	939	983	1,099	6981	7.3%
Mean	698, This means average of 698 households displaced each year in the past ten years, due to gentrification											

Table 3 shows that there has been progressive increase in the number of households displaced due to gentrification in Aba in the past ten years. There is an annual displacement rate of 6.4% in Aba-North Local Government, while in Aba-South the annual displacement rate is 8.1%. An average of 698 households is displaced in the entire city of

Aba every year due to gentrification, with an annual displacement rate of 7.5%. Going by this trend as illustrated in fig.4, it means that by the year 2027 about 1,200 households will be displaced annually due to gentrification, and the total households displaced from the city will be over 15,000 in a space of 20 years.

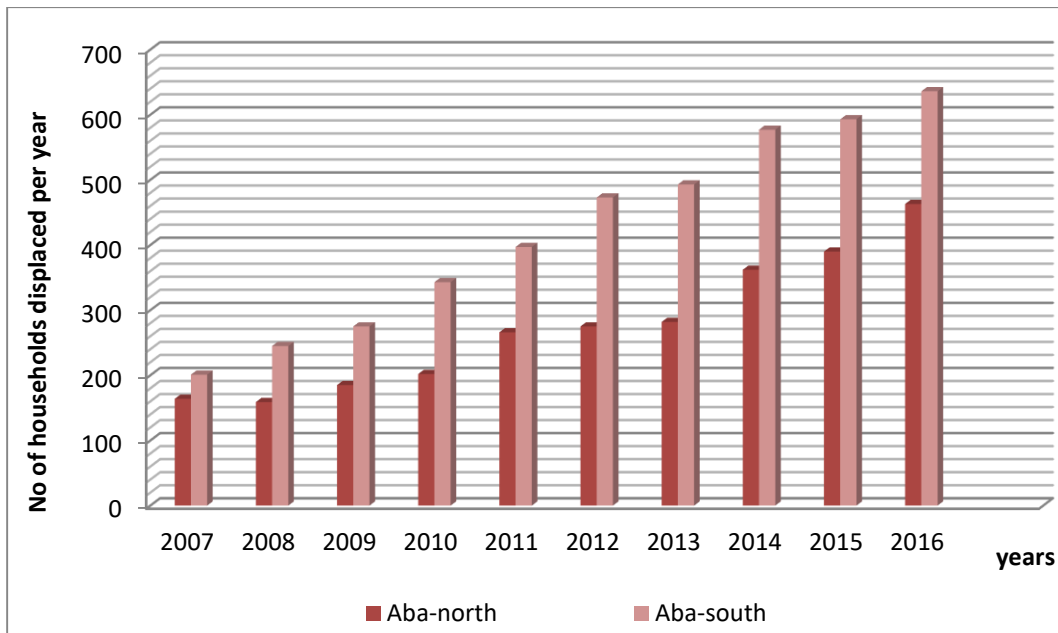


Fig.4: Trend of household displacement due to gentrification

4.4 Causes of Gentrification in Nigerian Cities

The study identified ten major causes of gentrification across cities of the world, as suggested by various authors in literature, and examined same in the study area to determine if they apply in Nigerian situation. The result is shown on table 4, which found seven of the ten listed causes of

gentrification significantly relevant in Nigerian housing market. However, some other factors examined like: pro-urban desire by the upper income class; rapid urbanization and increasing city size; and changing employment/occupational structure of city dwellers were found to be less consequential in predicting gentrification.

Table.4: Causes of gentrification

S/N	Cause	Number Sampled	Affirmative Responses	%
-----	-------	----------------	-----------------------	---

1	Short supply of housing in the face of increasing demand (housing inflation) (Hamnet,1984)	158	134	84.8
2	Pro-urban desire by the upper income class (Helbrecht,1996)	158	43	27.2
3	Wide disparity between the city and suburbs in terms of infrastructure, social services, and standard of living (Marcuse 1986).	158	140	88.6
4	Poverty/financial incapacity of inner-city property owners to upgrade their housing (Hamilton, 1995)	158	139	88.0
5	Profit motive of property investors desiring to utilize the opportunity of rent-gap (Smith, 1987)	158	142	89.9
6	Wide income-gap between the poor and the middle/upper class (Hamnet,1984)	158	127	80.4
7	Rent-gap opportunity of rundown properties at the inner-city (Smith, 1987)	158	135	85.4
8	Direct government policies such as urban renewal/ upgrading (Maloutas, 2011)	158	150	94.9
9	Rapid urbanization and increasing city size (Damaruis, 1983)	158	61	38.6
10	Changing employment/ occupational structure ((Hamnet,1984)	158	35	22.2

The result revealed that over 94% of respondents affirmed that direct government policies such as urban renewal and slum upgrading increase the occurrence of gentrification. These policies improve viability of cities and consequently property value, making inner-city properties attractive to property investors. This is tied with another identified cause of gentrification: profit motive of property investors desiring to utilize the opportunity of rent-gap, which recorded 89.9% affirmation. 88.6% of households surveyed opined that wide disparity between the city and suburbs in terms of infrastructure, social services, and standard of living tend to attract property investors to rundown properties in the downtown areas, and discourage them from investing in suburban properties. This factor is also tied with another identified cause of gentrification which is rent-gap opportunity of rundown properties at the inner-city, which was affirmed by 85.4% of respondents. The richer upper-class of the society is always seeking for obsolete properties downtown, whose owners are too poor to renovate. When such properties are upgraded, rent derivable from them in Aba multiply, sometimes well above 300%. About 85% of respondents also identified short supply of housing in the face of increasing demand as another major factor that causes gentrification. Most Nigerian cities face acute shortage of low cost and medium

income housing, making private investment in housing very profitable, though housing construction in the country is very expensive and out of reach for an average income earner. A related factor fuelling gentrification is wide income-gap between the poor and the upper class of which over 80% of respondents associated with. The few rich people in the country have access to massive wealth, and have capacity to buy-up properties of the poor, who can neither improve their urban properties nor resist the pressure to sale them.

4.5 Effects of Gentrification on Original Property Owners and Occupants

The study examined original landlords/occupants randomly selected from thirty different neighbourhoods in Aba to determine the effects of gentrification on the original owners and occupants of gentrified properties. This was against the backdrop of the direct effects of displacement identified in the literature which include: social dislocation from kin and familiar environment; forced to move into substandard housing, or become homeless; relocation to suburban areas / village; loss of job/ business; Improvement in income; and improvement in standard of housing and environment. The result is presented on table 5.

Table.5: Effects of gentrifications on the original landlords and tenants

S/N	Neighbourhoods in Aba	Number of displaced	Effects and number of respondents so affected					
			Social dislocation	Forced to move into	Relocated to	Loss of job/	Improve d	Improved standard

		occupant sampled	from kin and familiar environment	substandard housing or homeless	suburban areas / village	business	income	of Housing
1	Eziama	5	3	4	3	1	0	0
2	GRA 1	5	2	3	3	0	1	1
3	GRA 2	4	4	4	4	2	0	0
4	Umuocham 1	6	4	5	4	1	0	1
5	Umuocham 2	5	4	4	3	1	0	0
6	Abayi	8	6	7	7	2	1	1
7	Brass road	4	4	4	3	1	0	0
8	Osusu	6	6	6	4	2	0	0
9	Cemetery	4	4	4	4	3	0	0
10	Omuma road	4	3	3	3	1	1	1
11	Samek	4	4	4	4	2	0	0
12	Uratta	4	2	2	2	0	2	2
13	Powerline	5	4	3	4	1	1	1
14	Faulks road	6	6	6	6	3	0	0
15	Eziukwu	4	3	4	2	1	0	0
16	Okeoha	6	5	5	5	2	1	0
17	Factory road	4	4	4	4	1	0	0
18	Aba-owerri road	9	7	8	6	2	1	1
19	Park rd - Azikiwe	6	4	5	4	1	1	1
20	Azikiwe – Ehi road	6	3	5	4	1	0	1
21	Ngwa road	6	4	5	4	2	0	1
22	OgborHill 1	7	5	7	5	2	0	0
23	OgborHill 2	6	4	5	3	1	0	1
24	East road	4	3	4	3	0	1	1
25	Umuola	5	2	3	1	0	1	1
26	Ohuru-Isimiri	4	2	3	1	1	0	1
27	7up - Glass	5	3	4	3	1	0	0
28	Ebenma	4	4	4	4	1	0	0
29	Ukegbu	5	3	4	4	1	1	1
30	Umuokahia	6	2	5	3	1	0	1
	Total / Percentage	158 / 100	*112 / **70.9	134 / 84.8	110 / 70.0	38 / 24.1	12 / 7.6	17 / 10.8
Note: * Number of respondents affected by a particular effect; ** percentage of total respondents affected								

Summary of table 5 shows that out of 158 displaced property owners/occupants surveyed, 112 (70.9%) were socially dislocated from their kin, and familiar environment. These people lost their heritage, their birth-places, or neighbourhoods where they grew up. Some of them moved away from extended family members and community relations, and their children were forced to change schools. 134 households (84.8%) were forced to move into substandard housing, and some were rendered completely homeless. Most of the landlords that sold their properties

used part of their sales to purchase lower quality housing mostly at the urban fringes, whereas the remaining part of their money were usually expended on meeting household needs like previously accumulated debts, payment of school fees, hospital bills, or even daily feeding and maintenance. Other occupants moved away, some to make-shift apartments, others became homeless. 110 households (70%) relocated to suburban areas or their respective villages. Moving back to the village was usually the last option for occupants who can no longer afford to rent house in the

city, and this usually comes with grave consequences as the persons involved are often found to be totally impoverished, depressed, traumatized, and some eventually die prematurely. About 24% of households affected by gentrification lost their jobs. This is a significant number when considered alongside the already very high unemployment rate in the country. The survey on the other hand showed that less than 8% of households affected by gentrification experienced improved income as a result; and 10.8% had improved standard of housing. However, these people may have been medium income earners whose proceeds from their sold properties were substantially adequate to enable them make more profitable investments.

4.6 Gentrification and Environmental Justice

The study utilized the Pearson's Correlation to determine if gentrification induced displacements constitute significant environmental injustice to the low income city residents in Nigeria. The primary assumption in this analysis was that: if a significant number of former occupants of gentrified buildings are dislocated from their kin, displaced to the rural areas/ suburban communities, forced to move into substandard accommodation, or lose their jobs, then environmental injustice has occurred. The study therefore formulated the following null hypotheses:

1. The number of socially dislocated households among displaced residents of gentrified buildings in Aba is not statistically significant
2. The number of households that relocated to substandard housing or rendered homeless among displaced residents of gentrified buildings in Aba is not statistically significant
3. The number of households that relocated to suburban areas or rural areas among the displaced residents of gentrified buildings in Aba is not statistically significant
4. The number of people that lost their jobs among the displaced residents of gentrified buildings in Aba is not statistically significant

For the first hypothesis, the result of the Pearson's Correlation analysis is shown in Appendix- A, and it presents $r = 0.632$, and P value of 0.0001 , which is statistically significant ($P < 0.05$ and 0.01). Hence we reject H_0 , signifying that the number of socially dislocated households among displaced residents of gentrified buildings in Aba is statistically significant. This result implies that gentrification leads to environmental injustice in Nigerian cities by the displacement and social dislocation

of the poor from their kin, and from communal heritages. The analysis of the second hypothesis presents $r = 0.866$ and P value of 0.0001 , which is statistically significant ($P < 0.05$ and 0.01) (see Appendix – A). Hence we reject H_0 , and suppose that the number of households that relocated to substandard housing, or rendered homeless among displaced residents of gentrified buildings in Aba is statistically significant. On the ground of this hypothesis we can equally conclude that gentrification results to significant environmental injustice in Nigerian cities. The result of the third hypothesis shows $r = 0.660$ and P value of 0.0001 , which is statistically significant ($P < 0.05$ and 0.01) (see also Appendix – A). Therefore we reject H_0 . This means that the number of households that relocated to suburban areas or rural areas among the displaced residents of gentrified buildings in Aba is statistically significant. By the strength of this hypothesis we equally infer that there is significant environmental injustice arising from gentrification of inner-city housing in Nigeria. The fourth hypothesis turned out $r = 0.348$ and P value of 0.059 , which is not statistically significant ($P > 0.05$ and 0.01) (see also Appendix – A). Therefore we do not reject H_0 , meaning that the number of people who lost their jobs among the displaced residents of gentrified buildings in Aba is not statistically significant. By this particular result, it means that gentrification does not significantly correlate with loss of jobs for owners/residents of gentrified properties.

The analyses presented under this section show that three out of the four variables investigated (75%) indicated that gentrification of inner-city properties in Nigeria results to some significant environmental injustice to the poor (low income) property owners and residents, by the displacement/ dislocation from their kin, and communal heritages; being forced to move into substandard housing at the urban fringes, or rendered completely homeless; and being forced to relocate to the rural areas, as the last option for occupants who can no longer afford to rent house in the city. And this usually comes with some grave consequences as the persons involved are often found to be totally impoverished, depressed, and traumatized.

V. CONCLUSION AND RECOMMENDATIONS

This study examined gentrification and its implications for environmental justice for the low income city dwellers, with samples drawn from the city of Aba in Nigeria. Findings indicate that an average of 698 households are displaced in the city every year due to gentrification, with an annual displacement rate of 7.5%, and the population group mostly

affected are the low income, most of whom fall below the poverty line. This gentrification induced displacements have been found to constitute significant environmental injustice to the low income city residents as it leads to their dislocation from kin and communal heritages; forces them to move into substandard housing at the urban fringes, or become completely homeless; and constrains them to relocate to the rural areas, limiting their abilities to cope with life's challenges, and sometimes resulting to their absolute hopelessness and death. This study has shown that while gentrification can have positive impacts on an area in terms of improved aesthetics and vitality, upgraded infrastructure, and improved capital base, it can also have negative impacts such as displacement, isolation and social dislocation. Older long-term residents are forced out, driven as much by the disappearance of familiar landmarks and memories as by rising rents, living costs and diminishing services. This results in family or generational separation. It increases homelessness for displaced residents because it is financially hard and sometimes impossible for them to find new housing and pay for moving. Children who are displaced have to change schools, which negatively impacts on their performances in school, not to mention their emotional well being and sense of stableness.

Based on the foregoing, the study therefore recommends the following: Firstly the Town Planning Authorities should create platform to educate owners of rundown properties to adopt market-led gentrification as presently practiced in Lagos city. This concept is similar to a build-operate-transfer (BOT) mechanism. It involves a property owner entering into agreement with a prospective developer to redevelop a rundown property and manage same for a stipulated period of time (usually necessary for him to recoup his investment and profit) after which the property reverts to the owner. And in order to prevent the property owner from total loss of accommodation during the period of the contract, a part of the redeveloped property is usually reserved for him. This measure has capacity to protect indigenous owners of property in downtown areas from being totally displaced. Secondly, the State governments should create City Urban Renewal Authorities (CURA) which will adopt State-led gentrification for improvement of rundown properties. The involvement of government through the CURA initiative would adopt a one-for-one replacement housing policy, whereby for each unit of rundown housing owned by private individuals that is subject for demolition, one new unit of affordable housing will be created and owned by the CURA which will serve for the relocation of property owners and tenants so

affected. Thirdly, while gentrification encourages middle/upper class influx into the inner city, the policy of improving the conditions of the poor urban dwellers should be pursued simultaneously by city authorities. Most Nigerian cities suffer from acute shortage of low income housing. This is where government social housing intervention can focus, by providing affordable low income housing in new layouts inside cities. This could be in form of housing estate for civil servants, residential quarters for primary and secondary school teachers, and corporative society housing. Fourthly, city authorities in Nigeria should evolve conscious housing policies to protect downtown residential land uses from commercial gentrification. The rate at which commercial land uses (consultancy offices, retail stores, and warehouses) are invading and succeeding old residential homes in Nigerian cities calls for serious attention as it is aggravating the already severe housing deficiency. In each of the gentrified buildings there is usually the displacement of residents especially at the ground floor and first floor by commercial activities. To arrest this trend instruments of zoning should be utilized to create residential reservations and applied during urban renewal and upgrading of cities. Lastly, the paper also recommend that rent policies of the local housing markets in Nigeria should be reviewed with the view to protecting low income renters who are constantly under threat of forced eviction in every gentrification process. Policy could specify longer period of quit-notice, say about twelve months or eighteen months, or some sort of compensation in form of relocation to alternative accommodation, or a refund of one year rent equivalent as palliatives.

REFERENCES

- [1] Agbaje, E. B. A (2013). Modernisation, Urban Renewal and the Social Cost of Development. *Mediterranean Journal of Social Sciences*, Vol. 4 (10). Pp. 318-324
<https://doi.org/10.5901/mjss.2013.v4n10p318>
- [2] Bicki, D. and Ozgokceler, S. (2012). Does Gentrification Displace the Urban Poor? The Case of Bursa, Turkey *International Journal of Social Inquiry*, 5(1-2), 25-46.
- [3] Criekingen, M. V. and Decroly, J. (2003). Revisiting the Diversity of Gentrification: Neighbourhood Renewal Processes in Brussels and Montreal, *Urban Studies*, 40(12), 2451-2468.
<https://doi.org/10.1080/0042098032000136156>
- [4] Damarius, R., (1984). 'Rethinking Gentrification: Beyond the Uneven Development of Marxist Urban

- Theory', *Environment and Planning D: Society and Space*. 1: 47-74.
- [5] Ezema I. C., Pearl, A., Opoko, P. A., and Oluwatayo, A. A. (2016). Urban Regeneration through State-led, New-Build Gentrification in Lagos Inner City, Nigeria. *International Journal of Applied Environmental Sciences*, Vol.11(1). Pp.135-146
- [6] Glass, R. (1964). London: Aspects of Change. London: MacGibbon & Kee.
- [7] Granger, R. (2010). What now for Urban Regeneration? *Proceedings Institution of Civil Engineers in Urban Design and Planning*, 163(DP1), 9-16. <https://doi.org/10.1680/udap.2010.163.1.9>
- [8] Haase, A., Kabisch, S., Steinführer, A., Bouzarovski, S., Hall, R. and Odgen, P. (2010). Emergent Spaces of Reurbanisation: Exploring the Demographic Dimension of Inner-city Residential Change in a European Setting in Population, Space and Place (Journal), Vol.16, pp. 443-463
- [9] Hamilton, J. T. (1995). "Testing for Environmental Racism: Prejudice, Profits, Political Power?" *Journal of Policy Analysis and Management* 14: 107-32. <https://doi.org/10.2307/3325435>
- [10] Hamnett, C. (1984). Gentrification And Residential Location Theory: Review And Assessment. In *Geography and the urban environment (Journal)*, Vol. 5, pp. 283-319.
- [11] Hogskola, B. T. (2012). "Causes, developments and consequences of gentrification processes - A case study of the urban district of Hamburg-St. Pauli". European Spatial Planning and Urban Development, Master Thesis, 2011/2012
- [12] Ley, D. (1994). Gentrification and the Politics of the New Middle Class, *Environment and Planning D: Society and Space*, 12(1), 53-74 <https://doi.org/10.1068/d120053>
- [13] London, B. and John, P. (1984). Gentrification, Displacement and Neighbourhood Revitalization. (Albany, N.Y: State University Press of New York).
- [14] Lees, L., (2008). Gentrification and Social Mixing: Towards an Inclusive Urban Renaissance? *Urban Studies Journal*, Vol. 45(12). pp. 2449-2470.
- [15] Maloutas, T. (2011). Contextual Diversity in Gentrification Research. *Critical Sociology Journal*, Vol. 38(1). Pp. 33-48.
- [16] Miller, R. L. and Brewer, J. D. (Eds.) (2003). The A-Z of Social Research. London, England: SAGE Publication, Ltd. <http://dx.doi.org/10.4135/9780857020024>
- [17] National Planning Commission (2004). National Economic Empowerment and Development Strategy (NEEDS), Abuja. p.9.
- [18] Nwanna, C. R. (2012). Gentrification in Lagos State: Challenges and Prospects. *British Journal of Arts and Social Science*. Vol.5(2). Pp.165176. <http://www.bjournal.co.uk/BJASS.aspx>
- [19] Paul, O. A., Abimbola, A. A., and Femi, R. T. (2017). Socio-economic and Health Implications of Urban Renewal on Internally Displaced Persons in Ogun State, South-western Nigeria. *Journal of Internal Displacement Vol.7(1)*. Pp.17-30.
- [20] Sieg, H. V., Kerry, S. H., Spencer, B., and Randy, W. (2004). "Estimating the General Equilibrium Benefits of Large Changes in Spatially Delineated Public Goods." *International Economic Review* 45(4): 1047-77. <https://doi.org/10.1111/j.0020-6598.2004.00297.x>
- [21] Smith, N. (1979). "Toward a Theory of Gentrification - A Back to the City Movement by Capital, Not People." *Journal of the American Planning Association* 45 (4): 538-48. <https://doi.org/10.1080/01944367908977002>
- [22] Smith, N. (1987). Gentrification and the Rent Gap. *Annals of the Association of American Geographers*, 77(3), 462-478. <https://doi.org/10.1111/j.1467-8306.1987.tb00171.x>
- [23] Tiebout, C. (1956). "A Pure Theory of Local Expenditures." *Journal of Political Economy*, Vol. 64: Pp.416-24. <https://doi.org/10.1086/257839>
- [24] United Nations (1992). Declaration of the United Nations Conference on Environment and Development, Principle1.

Appendix - A

Correlations 1st Hypothesis

		Number of People Displaced from Gentrified Buildings	Number of people who are socially dislocated
Number of People Displaced from Gentrified Buildings	Pearson Correlation	1	.632**
	Sig. (2-tailed)		.000
	N	30	30
Number of people who are socially dislocated	Pearson Correlation	.632**	1
	Sig. (2-tailed)	.000	
	N	30	30

** . Correlation is significant at the 0.01 level (2-tailed).

Correlations 2nd Hypothesis

		Number of People Displaced from Gentrified Buildings	Number of people forced to move into substandard housing, or homeless
Number of People Displaced from Gentrified Buildings	Pearson Correlation	1	.866**
	Sig. (2-tailed)		.000
	N	30	30
Number of people forced to move into substandard housing, or homeless	Pearson Correlation	.866**	1
	Sig. (2-tailed)	.000	
	N	30	30

** . Correlation is significant at the 0.01 level (2-tailed).

Correlations 3rd Hypothesis

		Number of People Displaced from Gentrified Buildings	Number of people that relocated to suburbs or Rural areas
Number of People Displaced from Gentrified Buildings	Pearson Correlation	1	.660**
	Sig. (2-tailed)		.000
	N	30	30
Number of people that relocated to suburbs or Rural areas	Pearson Correlation	.660**	1
	Sig. (2-tailed)	.000	
	N	30	30

Correlations 3rd Hypothesis

		Number of People Displaced from Gentrified Buildings	Number of people that relocated to suburbs or Rural areas
Number of People Displaced from Gentrified Buildings	Pearson Correlation	1	.660**
	Sig. (2-tailed)		.000
	N	30	30
Number of people that relocated to suburbs or Rural areas	Pearson Correlation	.660**	1
	Sig. (2-tailed)	.000	
	N	30	30

** . Correlation is significant at the 0.01 level (2-tailed).

Correlations 4th Hypothesis

		Number of People Displaced from Gentrified Buildings	Number of people that lost their jobs
Number of People Displaced from Gentrified Buildings	Pearson Correlation	1	.348
	Sig. (2-tailed)		.059
	N	30	30
Number of people that lost their jobs	Pearson Correlation	.348	1
	Sig. (2-tailed)	.059	
	N	30	30

The Soil-Cement Brick on Construction with Structural Masonry – An Alternative in the Fight Against Housing Deficit and Environmental Pollution in the State of Rondônia*

Carlos Augusto Maly¹, Izan Fabrício Neves Calderaro², Fabrício Moraes de Almeida³

¹Professor Adj IV of the Administration Department of the Federal University of Rondônia Foundation - UNIR and student of the Postgraduate Program in Regional Development and Environment - PGDRA / UNIR, Porto Velho (RO), Brazil. E-Mail:

²Master in Regional Development and Environment (PGDRA/UNIR). TI Analyst of Federal University of Rondônia Foundation, Porto Velho, Rondônia (Brazil). Member of GEITEC/UNIR/CNPq. Brazil. E-mail:

³PhD in Physics (UFC), with post-doctorate in Scientific Regional Development (DCR/CNPq). Researcher of the Doctoral and Master Program in Regional Development and Environment (PGDRA/UNIR). Leader of line 2 — Technological and Systemic Development, and Researcher of GEITEC — Federal University of Rondônia, Brazil.

Abstract— *The Housing Deficit in the State of Rondônia is increasing, not only due to the absence of effective public policies dedicated to the treatment of housing, but also due to the lack of study and application of new technologies in the area of civil construction, which can generate great savings and remarkable rapidity in the construction of housing units. This deficit is characterized by the lack of housing and the existence of those considered inadequate to human occupation with quality and safety, due to its operability, physical characteristics and location. However, there is a need for greater economy and productivity in the construction of housing, in order to be able to supply part of this demand, without letting the quality levels drop. In the light of Sustainable Development, it will be proposed and directed the correction of this paradigm that tends to hold more weight in the "social" dimension. The application of the Structural Masonry System with the use of the Cement Brick, popularly known as "ecological brick", is the main basis of this study, where it is intended to demonstrate that its option for housing construction can be an excellent response to the housing deficit and environmental pollution, generated by the rubbish of Civil Construction in the State of Rondônia.*

Keywords— *housing deficit, masonry structures, soil-cement, brick ecological.*

I. INTRODUCTION

Issues related to environmental preservation and sustainable development have been discussed since the last century¹.

The Amazon region, of which the State of Rondônia is a part, is one of the main poles of attention to the object of these discussions Mendes (2001).

Development, which has undergone profound transformations in the last decades, is also based on the notions of territoriality and sustainability, requiring not only the creation and reproduction of economic capital, but also human capital (knowledge, skills and competences) and social capital (trust, cooperation, organization and social participation).

This development needs to be human, social and sustainable, that is, it must be focused on promoting the quality of life for people. The Regional Development, according to Medeiros (2001), refers to the improvement of the standard of living of the population. It also points out that this factor is observed with the increase in the level of income, which must be higher or, at least, equal to the demographic growth.

We can not talk about Regional Development without considering the beacon linked directly to the Sustainability factor, which it must contain, in order to meet the criteria agreed in political development and economic growth movements that contemplate the preservation and the

Nations Conference on Environment and Development Rio (92); complemented in 2001 in Germany) and COP7 (Marrakesh / 2002).

* This article was derived from the studies and preparation of the master's thesis entitled: "STRUCTURAL ALVENARIA WITH BRICK OF CEMENT: A Technological Alternative in the Fight Against Housing Deficit and the Generation of Rubbish in Civil Construction in Rondônia", under the aegis of the author

¹ The consolidation of the discussions began with the United

environmental balance of the planet .

The housing issue is one of the constituent elements of the social dimension that forms the basis of sustainable development, as advocated by Bossel (1999), and this factor encapsulates the housing deficit, one of the recursive aspects of increasing poverty and violence in society .

This deficit has been evolving for decades, is increasing and accentuated, as evidenced in the reports of the National Household Sample Survey (PNAD) and the IBGE census, based on the results of the surveys to indicate the housing deficit, and the development of methodologies for its definition and classification, carried out by the João Pinheiro Foundation (FJP), Federal University of Minas Gerais. They point to the existence of this deficit in all the territorial units of the country, such as the State of Rondônia, where in the past and present development projects have caused intense migratory flows to this region. The main vectors for the maintenance of this deficit throughout the State are related to: constant and high population growth, either by birth rate or migration; the fall in the income level of the citizen; the absence of consistent public policies dedicated directly to the treatment of housing issues; to the current constructive methods that do not support the demand for the housing volume and, finally, the lack of research for the development and application of new technologies to combat the obsolescence of the current construction methods.

Another important factor in this scenario is the question of the environmental degradation that the construction industry has generated, according to the results of the Civil Engineering Research Foundation (CERF) 1, according to Sjöström (1966), namely:

- Civil Construction consumes 15 to 50% of the natural resources extracted and 2/3 of all wood consumed on the planet;
- The raw materials used, such as copper and zinc, have scarce mapped reserves, their current balance on the planet is critical, will sustain only another 60 years;

- This activity generates high levels of dust, CO₂ and debris (its daily volume is twice that of urban solid waste) and are highly polluting elements;
- The cement produced, to meet the demand of this area, is thousands of tons / day and each ton of clinker to process it generates 600Kg of CO₂ / day.

The housing deficit must first be qualified and classified by types of housing, occupation and social class occupant and / or without housing, in a second moment be quantified to formulate the demands that the Civil Construction and the Public Administrators must coexist in order to attenuate it.

New constructive techniques, to meet the demand for housing, with socially acceptable running costs and reduced construction time, with the lowest consumption of natural resources possible, must be identified to allow changes in the current social scenario, promoting **urbanism and the environment in harmony**.

II. HOUSING DEFICIT

The identification of the importance of the construction of adequate housing to the human needs of occupation with quality and still to promote the sustainable development in this process, comes with the understanding that the housing deficit is the most immediate and intuitive notion of the necessity of construction of new housing for the solution of social and specific housing problems detected at a certain time (FJP, 2012,2015) and stands out because it is related to the deficiency of the housing stock (which requires replacement), to which it is also added to those without conditions to be inhabited , due to the precariousness of their constructions or due to the wear and tear on their physical structure (they must be increased to the spare stock). Therefore, the housing deficit is composed of the stock replacement deficit and the inventory increase deficit. The table below presents the components that should be considered for the calculation of the housing deficit.

Frame.2.1 - Components of Housing Deficit

HOUSING DEFICIT	
Components:	Detailing:
<p>Stock Replacement Deficit</p> <ul style="list-style-type: none"> - Rustic households <p>Déficit by Inventory Increase</p> <ul style="list-style-type: none"> - Improvised households 	<ul style="list-style-type: none"> - Cálculattion for áreas: - Urban <ul style="list-style-type: none"> • Total • Rural agglomeration of urban extension - Rural

<ul style="list-style-type: none"> - Family Cohabitation - Leased and Rented Rooms - Secondary cohabitatives families intending to establish exclusive domicile - Excessive rent burden - Household with overweigh of residentes per dormitory 	<ul style="list-style-type: none"> - Subnormal clusters - Cálculacion by family income brackets in minimum wages
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

There are old buildings that, due to renovations and maintenance, only require physical repairs in their structure to remain habitable, are known as "inadequate households" and are not considered in the calculation of the deficit.

2.1 The Numbers Deficit in the State of Rondônia

The latest reports on the housing deficit (FJP, 2012 and IBGE, 2015), in addition to reviewing their theoretical conceptualization, presented statistical tables that illustrate the current scenario and the evolution of the housing issue, by type of deficit and housing, the values that comprise the North / Rondônia Region are considered.

2.1.1 Housing and Percentage Deficit of Permanent Private Households in the North Region / Rondônia - 2012/2015

HOUSING DEFICIT					PERCENTAGE OF PERMANENT PARTICULAR HOMES			
YEAR IN ANALISIS	TOTAL	URBAN	RURAL		TOTAL	URBAN	RURAL	
			TOTAL	URBAN EXTENSION			TOTAL	URBAN EXTENSION
2012	38.898	36.881	2.017	2.522	6,90	8,50	1,50	10,30
2015	48.906	44.312	4.594	3.030	6,90	8,50	1,50	10,30

Note: in the calculation of the housing deficit, the family cohabitation includes only the coexisting families who want to constitute a new domicile. **Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center**

2.1.2 Distribution of Percentage of Urban Housing Deficit (1), by Monthly Family Income Ranges, in the North Region/Rondônia – 2012/2015

MONTHLY FAMILY AVERAGE INCOME IN MINIMUM WAGES					
YEAR	Up to 3	More than 3 to 5	More than 5 to 10	Up to 10	Total (2)
2012	87,30	8,50	4,20	0,00	100
2015	81,50	10,50	6,00	2,00	100

(1) Including rural urban extension. (2) Exclusive without declaration of income.

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

2.1.3 Households Vague in Conditions to be Occupied and in Construction (1), by Residence Status, in the North Region/Rondônia – 2012/2015

HOUSEHOLDS VAGUES				PERCENTAGE OF TOTAL HOUSEHOLD		
YEAR	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL
2012	87.241	59.455	27.786	15,50	13,80	21,30
2015	65.021	44.312	20.709	12,50	11,80	19,30

(1) Does not include ruined households.

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

2.1.4 Precarious Housing and Family Cohabitation, by Residence Status in the North Region /Rondônia – 2012/2015

HOUSING PRECÁRIOS				FAMILY COHABITATION		
YEAR	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL
2012	11.103	4.252	671	10.583	9.969	614
2015	15.402	5.899	930	7.297	6.873	424

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

2.1.5 Excessive Expenses with Rent and Excessive Density in Leased Households, in the North Region /Rondônia – 2012/2015

YEAR	EXCESSIVE OVERLOOK WITH RENAL	EXCESSIVE ADHESION		
		TOTAL	URBAN	RURAL
2012	21.176	2.216	2.216	0
2015	22.966	3.241	3.241	0

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

2.1.6 Participation of Components in the Housing Deficit , by Household Situation, in the North Region/Rondônia – 2012/2015

YEAR	URBAN					RURAL			TOTAL
	PRECARIUS HOUSING	FAMILY COHABITATION	ONUS EXCESSIVE RENTAL	ADDITIONAL EXCESSIVE	TOTAL	PRECARIUS HOUSING	FAMILY COHABITATION	ADDITIONAL EXCESSIVE	
2012	26,00	22,30	40,80	10,90	100,00	69,56	30,44	0,00	100,00
2015	29,53	18,35	45,51	6,61	100,00	56,89	43,11	0,00	100,00

Nota: In the calculation of housing deficit, the family cohabitation component includes only the coexisting families that declared intention of constitute a new home.

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

2.1.7 Total Cohabitation Families and Percentage of the Considered Housing Deficit by Household Situation, in the North Region/Rondônia – 2012/2015

CONVIVING FAMILIES					PERCENTAGE OF THE CONVIVING FAMILIES CONSIDERED			
YEAR	TOTAL	URBAN	RURAL		TOTAL	URBAN	RURAL	
			TOTAL	URBAN EXT			TOTAL	URBAN EXT
2012	10.583	9.695	1.730	888	63,10	64,40	100,00	48,80
2015	13.306	12.189	2.175	1.116	63,10	64,40	100,00	48,80

Source: Housing Deficit 2012/2015. João Pinheiro Foundation/ Statistics and Information Center

Currently, the number of construction companies with works in progress and in the completion phase is significant, but most programs do not include the most

deprived classes, especially those with low family income (my home, my life - 0 to 3 SM1) . With the end of the construction of the hydroelectric plant in Santo Antonio,

there was an evasion of the migrant population, which worked there, and in this case, a balance of housing available for sale and mainly rent was obtained, which generated a certain stagnation in the growth of construction industry.

Still, low-income families, lacking housing, were not able to take advantage of this balance of available properties, depending on their financial situation. The problem of the deficit continues, despite the positive demand, meaning the existence of an absurd paradox in this factor.

O programa Minha Casa, Minha Vida vem acontecendo e até a presente data já foram entregues mais de 4.000(quatro mil moradias) apesar do esforço e políticas empregadas, este resultado ainda é muito insuficiente para atender uma demanda declarada e crescente, segundo os valores dos quadros acima, de 2012 a 2015 o déficit habitacional cresceu 32,605%. Há que se considerar que os últimos dados disponibilizados ao público pelo IBGE/FJP são de 2015, o que significa uma provável mudança neste saldo para mais, se considerarmos a demora dos atuais programas habitacionais.

III. THE IDEAL CONSTRUCTIVE TECHNIQUE

The problem is to identify constructive techniques based on the following assumptions:

- to develop affordable housing, using new materials of great quality, great durability and that do not degrade the environment;
- develop technologies that rationalize the execution time, using simple construction components with an industrial character, easy to assemble and with possibility of expansion of its original plant;
- to provide a high reduction of construction debris, lowering the levels of environmental pollution generated by this activity;
- to produce a safe and pleasant housing to the user in the aspects of appearance, conservation and cleaning, thermal and acoustic comfort and sealing, besides being ecologically correct.

According to Souza(1984), *housing is characterized as a defined product whose function is to satisfy user requirements that are understood, in the case of housing, as the level of conditions necessary to the safety and health of man, to his comfort and satisfaction of their economic concerns.*

The Project from Norma 02.136.01.001 (ABNT, 2004) - Performance of housing buildings up to 5 floors - Part 1: General Requirements establishes that under the various actions in housing, the building and its parts must meet the applicable requirements that are listed in table 1.

Table.1: User Requeriments

Security	- Structural safety - Fire safety - Safety in use and operation	
Habitability	- Sealing - Hygrothermal comfort - Acoustic comfort - Light comfort - Health, hygiene and air quality - Functionality and accessibility - Tactile and anthropodynamic comfort	NBR 9050
Sustainability	- Durability - Maintainability - Enviromental Impact	

Source: Project from Norma 02.136.01.001 (ABNT, 2004)

There are two types of construction / masonry currently used:

Conventional / common masonry, whose basic function is sealing or closing, where high volume of construction waste (debris) is generated, has a very high cost and time of execution and requires a lot of labor. In this constructive process the materials used come from the high extraction of nonrenewable resources of nature, generating much CO2 in

their manufacture, such as cement, for example.

The structural masonry, where the walls of the building are the structure of the dwelling, assimilating the two main systems of a conventional construction: the reinforced concrete structure and the masonry closures (CAMPOS, 2009).

It is a constructive process in which the walls of the house are used to resist the loads, replacing the pillars and beams

used in the systems in reinforced concrete, steel or wood (ROMAN et al., 1999). This modality results in a substantial reduction in the use of iron and wood in the

construction of a dwelling, basically it does not generate rubble, it requires very little labor and the costs and time of execution are much smaller.



Fig.1 – Conventional Construction

Source: spolx.com.br/imóveis/vendo-casa--em-construção-405639726



Fig. 2 – Construction with Structural Masonry

Fonte: www.tilego.com.br/site/?p=27

In the comparative process and considering the assumptions already presented, Structural Masonry is the most ideal to meet the economic, technical, social and ecological requirements that are encapsulated in the housing and environmental issue of the State of Rondônia.

IV. THE RAW MATERIALS EMPLOYED IN THE STRUCTURAL MASONRY

The raw material to be used in this constructive modality should consume low levels of natural resources (renewable and certified and / or recyclable), with materials without toxic components; minimize the use of industrially

produced materials and generate low costs and execution time in the construction of housing, without promoting aggression to the environment that conventional / common masonry does.

The issues to be factored are: reducing the cost of building a housing; reduction of its execution time and obtaining the least possible environmental impact, with the reuse or elimination of construction waste. In the case of Rondônia, located in the Amazon region where the tropical climate prevails, the high temperature and humidity are important issues to be observed as basic attributes of a quality construction dwelling.

The most used materials in Structural Masonry are the pre-cast blocks of structural ceramics, concrete (figures 3 and 4) and brick/block of soil-cement (figures 5).



Fig.3– Structural Ceramic Block
Source: www.blococeramico.com.br/blocos



Fig. 4-Concrete Block
Source: tuboscopel.com.br

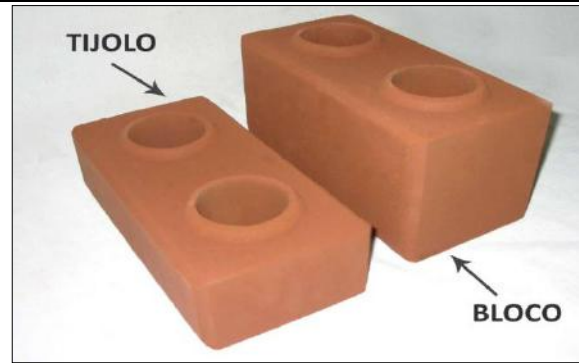


Fig. 5 – Brick and Block of Soil-Cement
Source: www.ecomaquinas.com.br

4.1 Pre-Molded Ceramic or Concrete Blocks

Structural or Concrete Ceramic Blocks use the same constructive techniques, but due to the difference of the basic materials that constitute them, do not have the same benefits.

In the cost factor, they present the highest market price and in the construction process they require a lot of cement with the application of mortar, plaster or plaster, increasing even more the execution time (waiting for the cure of the concrete / plaster) and, consequently, the final cost of housing / housing.

The thermal insulation property of these blocks is insufficient to generate the ideal occupational comfort of quality, in the region under study. To present the desired thermal property, the treatment required will further increase the cost per meter built. The Concrete Block requires a high amount of cement (80% of this material in its formulation and is a highly polluting material), as well as gravel and sand.

The Ceramic Structural Block has the same process of manufacturing the common ceramic bricks, used in the conventional construction. They are cooked in high temperature furnaces, using wood as the main fuel, causing tree extraction, which means the degradation of forests.

4.2 Soil-Cement Brick

Soil-cement is a material obtained by homogeneous mixing of soil, cement and water in suitable proportions, being compacted in hydraulic press and matured by wet curing, not needing to be cooked in high-temperature furnaces. This process, collaborates with the environment because it does not emit toxic gases (CO₂) into the atmosphere.

The soil to be used has to be sandy with a percentage of clay that should be within the range of 20% to 35%, the ideal (economical and safe) ratio of cement applied in the soil-cement formulation should be within the range of 5% to 10% of the total formula, and the percentage of water should not exceed 5%, Giuseppeponi et al (2004).

Consideration should also be given to the possibility of using construction waste, according to Souza et al (2008) and Casanova (1988), further reducing the cost and extraction of soil (soil) in its manufacture.

The ABNT Standard - NBR 10836 establishes an average value greater than or equal to 2.0 MPa at the seven days of maturation and in the calculation of the average, only one of

the individual values may have a resistance less than 2.0 MPa, provided that it is equal to or higher than 1.7 MPa and for water absorption, the mean value must be less than or equal to 20%.

In Souza et all (2006), the following values were extracted from the Soil-Brick Compression Compression Table, according to its formulation:

Table.2 – Resistance to Soil-Cement Brick Compression

FORMULATION	RESISTANCE AVERAGE(Mpa)			
	28 days	56 days	120 days	
Soil + 6% cement	1,60	3,40	4,1	4,70
Soil + 8% cement	2,31	4,20	5,03	6,63
Soil + 10% cement	2,69	5,57	7,30	7,71

Source: Study of the Use of Concrete Residues in the Manufacture of Pressed Soil-Cement Bricks (Souza et all, 2006)

In the tests of compression and water absorption, performed in Porto Velho (RO), in the Laboratory of Technological Control of Dynamics Engineering, under the responsibility of Engineer Nélio Alencar, the following results were obtained:

Table.3 – Results of Resistance and Absorption of Soil-Cement Bricks

		DINÂMICA ENGENHARIA LABORATÓRIO DE CONTROLE TECNOLÓGICO ENGº NÉLIO ALENCAR CNPJ: 34.738.559/0001-35				
ROMPIMENTO DE BLOCOS DE CONCRETO						
Empresa:	ECOTIJOLOS RONDONIA IND E COM LTDA	Tipo:	Vibrado			
Endereço:	Rua: General Osorio nº 222 - Sala 26 - Centro PVH-RO	Local:	Coleta			
Amostra:	Tijolos solo cimento	Série:	001/02			
Equipamento:	Prensa Hidráulica	Absorção:	8%			
	Zeloso	Referência:	Mod. PC 100 n: 424 Série 0580			
		Capacidade:	100.000Kg			
Dados Informados:						
Dosagem Projeto:	12 Mpa	Material:				
		Cimento:	12,5 Kg			
Tipo de Cimento:	CP II F 32	Areia:	84 Kg			
		Argila:	36 Kg			
		Água:	4 Lts			
Dados dos Blocos:						
Forma:	Retângular	Dimensões:	12,5X25X7 cm			
		Superfície:	312,50 cm ²			
Resultados Obtidos:						
Corpo de Prova	Data de Moldagem	Data de Ruptura	Idade em Dias	Carga de Ruptura (kgf)	Resistência à Compressão (Mpa)	
					Unitario	MEDIA
1	23.04.09	29.05.09	37	29.000	9,28	
2	23.04.09	29.05.09	37	28.000	8,96	8,96
3	23.04.09	29.05.09	37	27.000	8,64	
4	19.05.09	29.05.09	10	11.000	3,52	3,52

Source: Dinâmica Engenharia(2009)

Observing the table above, it is verified that the test piece 4 was not computed in the average as a function of the date of maturity of the brick and comparing this result with that of table 2, it is possible to observe the excellent degree of resistance presented, well above the parameter established by NBR 10836, characterizing the good quality of the soil of the region.

Regarding Thermal Insulation, the soil-cement brick, in relation to the other materials used in the civil construction industry, presented the following result (NETO, 2009):

Table.4: Thermal Conductivity Coefficient (K)

MATERIAL	THERMAL CONDUCT. COEFFICIENT(K)
Concrete	$2,50 \times 10^{-3}$
Bricks	$1,65 \times 10^{-3}$ a $2,40 \times 10^{-3}$
Compacted Soil-Cement	$1,83 \times 10^{-3}$
Adobe	$3,70 \times 10^{-3}$
Soil-Compressed	$2,89 \times 10^{-3}$
Bitudobe	$3,60 \times 10^{-3}$
Mortar 1:4	$1,80 \times 10^{-3}$

Source: ,Neto(2009)

The value of the conductivity coefficient is lower in compacted soil-cement, which means that thermal transmission is less efficient in this material, due to its high density physico-chemical composition, so the heat is not completely transmitted through it one environment to another.

Another factor that contributes to this low thermal conductivity are the existing holes in its structure, generating air pipes, formed by the rows that make up the wall of a building, from the base to the ceiling / ceiling. In them the convection process is formed with air that is heated and dissipated with the entrance of cold air, giving it a relative advantage over the other materials studied.

In the comparative process soil-cement brick was chosen mainly because its raw material (soil / soil) is abundant in Rondônia, and its extraction does not compromise environmental preservation.

V. STRUCTURAL MASONRY WITH SOIL-CEMENT BRICKS

Structural Masonry added to the use of the Cement Brick (Figures 6 and 7) is currently the most appropriate response to assist in combating Housing Deficit and Environmental Pollution generated by the Construction Industry and the ease of extraction of raw material, to serve it, in the State of Rondônia.



Fig. 6 – Structural Masonry with Soil-Cement Brick in execution

Source: turma1aintermachaddo.blogspot.com/2012/09/quais-os-materiais-que-precisamos-para.html



Fig. 7 – Soil Brick Housing Complete

Source: sustentoevinda.blogspot.com

Designed primarily for the construction of low-cost housing, this constructive technique has been extended to larger buildings with high quality finishes such as large luxury homes, buildings with more than four floors and commercial and / or commercial facilities. Industries. The combined use of structural masonry and soil-cement brick catalyzes some benefits / advantages that other construction techniques do not currently offer, such as:

- the final cost of building a house is 30% to 40% cheaper than conventional buildings;
- also be cheaper than constructions with concrete blocks or structural ceramics, depending on their manufacturing costs;
- the construction time has lower parameters than the other techniques in up to 1/3 of the conventional time (will depend on the architectural lines and the finish to be applied);
- the soil-cement construction process is very simple and can be quickly assimilated by unskilled labor, provided it is trained.

However, some technical care must be observed in order for these benefits to be enjoyed, namely:

- preparation of adequate training for the workforce involved in the construction process;
- the assembly of the first row must be absolutely precise, strictly obeying the template

- of the floor plan of the housing that will be built;
- the alignment of the other rows and bricks within them must be absolutely accurate, respecting the plumb and dimensions specified in the design;
- the mooring between the walls and the formation of grates (internal concrete columns) must be faithful to the techniques of this constructive process and to the project itself;
- The specifications of the bricks must be strictly in accordance with the ABNT standards.

VI. TABLES OF COSTS PROJECTED FOR THE CONSTRUCTION OF A POPULAR HOUSE OF 43M² - PROJECT MY HOUSE MY LIFE

The tables below correspond, respectively, to the Conventional Constructive Method, with the use of the traditional Brick / Bahia block and the Structural Masonry, a with the Concrete Blocks and another, with the Building Blocks (ecological brick). These tables only contemplate the steps of structure, sealing, internal and external coating, hydraulic and electrical installations were not computed because in each constructive modality these procedures are specific, the same criterion applies to the processes of installation of doors and windows.

Table.5 – Costs Construction – conventional masonry.

ELEMENTS	UNITY	AMOUNT	COST(R\$)	
			UNITY	TOTAL
Ceramic blocks / Bahian brick (14x19x29cm), 12mm joints with mixed cement mortar, hydrated lime and sand without sieving 1: 2: 8 trace. Wall thickness 14cm.	m ²	80,78	35,52	2.869,
Steel reinforcement for pillars or beam 8mm diameter. Cut and fold even.	kg	49,85	10,79	537,8
Solid wood formwork for pillars and similar structures, including assembly and dismantling.	m ²	21,60	24,26	524,02
Concrete pillar, fck = 25 mpa, with crane. Launching, densification and finishing	m ³	0,81	370,77	300,32
Masonry feature for conduits with diameters less than or equal to 40 mm	m	27,5	3,68	101,20
Linear tapping in masonry for extensions / distribution with diameters less than or equal to 40 mm.	m	33,8	7,61	257,22
Plaster applied to both pillars and concrete beams and masonry of internal walls, with trowel.	m ²	106,9	2,61	279,01
Plaster applied to both pillars and concrete beams and masonry with external walls, with trowel.	m ²	55,19	5,61	309,62
Mortar with 1: 2: 8 mortar, mechanical preparation with concrete mixer 400l, manually applied on interior walls of areas with an area less than 10m ² and spans, thickness of 20mm, with execution of slabs.	m ²	162,09	23,43	3.797,77
Plaster 1: 2 mortar (lime and sand sifted fine), thickness 0.5cm, manual preparation of mortar.	m ²	162,09	13,76	2.230,36
Manual application of acrylic sealer bottom on inner and outer walls of homes.	m ²	162,09	2,26	366,32
Manual application of paint with acrylic textured paint on exterior walls of houses, two colors.	m ²	55,19	15,48	854,34
Application and sanding of latex mass in inner walls of house, two coats.	m ²	106,9	8,66	925,75
TOTAL COST				14.390,91

Source: Author(2016)

Table.5 – Costs Construction – concrete masonry.

ELEMENTS	UNITY	AMOUNT	COST(R\$)	
			UNITY	TOTAL
Structural masonry of concrete blocks 14x19x39, (thickness 14cm), fbk = 4,5mpa, with spans, using pallet.	m ²	86,18	50,75	4.373,64
Graute for structural masonry of concrete blocks, trace 1: 2: 2,4: 1 (cement / coarse sand / gravel 0 / additive).	m ³	1,008	367,07	370,01
Vertical frame of structural masonry, diameter 10.00mm.	kg	22,4	6,16	137,98
Manual application of cast gypsum (without taliscas) in walls of environment	m ²	106,9	11,9	1.272,11

ELEMENTS	UNITY	AMOUNT	COST(R\$)	
			UNITY	TOTAL
areas between 5sqm and 10sqm, thickness of 0.5cm.				
Manual application of acrylic sealer bottom on inner and outer walls of homes.	m ²	162,09	2,26	366,32
Manual application of paint with acrylic textured paint on exterior walls of houses, two colors.	m ²	55,19	15,48	854,34
Manual application of paint with acrylic latex paint on walls, two coats.	m ²	162,09	6,12	991,99
TOTAL COST			8.366,39	

Source: Author(2016)

Table.7 – Costs Construction – soil-cement masonry.

ELEMENTS	UNITY	AMOUNT	CUST(R\$)	
			UNITY	TOTAL
Mortar 1: 1: 10 trace (cement, glue pva and medium sand), manual preparation.	m ³	0,68944	421,88	290,86
Structural masonry of soil-cement 14x15x30, (thickness 15cm), fbk = 4,5mpa, with spans.	m ²	86,18	34,89	3.006,82
Graute for structural masonry of soil, trace 1: 2: 2,4: 1 (cement / coarse sand / gravel 0 / additive).	m ³	0,32	367,07	117,63
Vertical frame of structural masonry, diameter 10.00mm.	kg	22,4	6,16	137,98
Manual application of acrylic sealer bottom on inner and outer walls of homes.	m ²	55,19	2,26	124,73
Manual application of cast gypsum (without taliscas) in walls of environment areas between 5sqm and 10sqm, thickness of 0.5cm.	m ²	106,9	11,9	1.272,11
Manual application of paint with acrylic textured paint on exterior walls of houses, two colors.	m ²	55,19	15,48	854,34
Manual application of paint with acrylic latex paint on walls, two coats.	m ²	106,9	6,12	654,23
TOTAL COST			6.458,71	

Source: Author(2016)

Comparing the total costs of the three tables above, it is evident how much the method of structural masonry with the ecological brick is cheaper and cheaper than the others, and can be classified as "The Ideal Constructive Technique" to the Housing Deficit and Environmental Pollution generated by the civil construction in Rondônia.

VII. FINAL CONSIDERATIONS

In addition to new technologies, methods and construction materials in research and some already developed, which

have been tested and applied, the use of Structural Masonry with Bricks of Cement is one of the steps to success in combating the housing deficit, pollution generated by the construction industry.

The expected results will only be achieved if other supporting measures and even protagonists are adopted, such as: adaptation and / or creation of specific Public Policies synchronized with the true reality of the scenario of its application; reviewing Housing Projects in progress, adapting them to the reality of the housing, civil, social,

economic and political problems of the region of occurrence; revision of the Housing Financing System, with the creation of Incentive Programs for Builders or Individual Builders who will use this constructive technique and / or other innovations, whether in popular housing programs or not.

It will require "political will" and courage from our rulers to take such measures. Only after this action, the constructive techniques and the adequate housing programs will begin to have the effect so desired by the Rondonian society.

REFERENCES

- [1] ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS., 1994, *ABNT. NBR 10836: Bloco vazado de solo-cimento sem função estrutural – Determinação da resistência à compressão e da absorção de água. Método de ensaio*. Rio de Janeiro, RJ, 2p.
- [2] ASSOCIAÇÃO BRASILEIRA DE CIMENTO PORTLAND – ABCP., 1985, *Solo-cimento na habitação popular*. São Paulo. 14p. ilus. 30cm.
- [3] ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS., 2004, *Projeto 02.136.01.001. Desem de edifícios habitacionais de até cinco pavimentos – Parte 1: Requisitos Gerais*. Rio de Janeiro.
- [4] ALVES, José Eustáquio Diniz; CAVENAGHI, Suzana., 2006, *Déficit Habitacional, famílias Conviventes e Condições de Moradia*. II Encontro Nacional de Produtores e Usuários de Informações Sociais, Econômicas e Territoriais. Rio de Janeiro: IBGE.
- [5] BOSSEL, Hartmut., 1999, *Indicators for sustainable development: theory, method, applications*. Winnipeg.: International Institute for Sustainable Development.
- [6] CAMPOS, Iberê M., 2009, *Procedimentos e cuidados na execução de alvenaria*. Disponível em: <<http://www.forumdaconstrucao.com.br>>. Acesso em: 09 jul.
- [7] CAMPOS, Iberê M., 2009, *O que é Alvenaria Estrutural?* Disponível em: <<http://www.forumdaconstrucao.com.br>>. Acesso em: 09 jul.
- [8] CASANOVA, Francisco José., 1988, *Tijolos Solo-cimento com resíduos de construção*. Artigo. Revista Techne .
- [9] DIAS, E C; GARCIA, F., 2008, *Um Balanço Social do crescimento da construção; – São Paulo: Conjuntura da Construção – Ano VI – nº 04*.
- [10] FUNDAÇÃO JOÃO PINHEIRO(JP)., 2014, *Déficit habitacional no Brasil 2012*. Resultados Preliminares. Belo Horizonte: FJP/CEI.
- [11] FUNDAÇÃO JOÃO PINHEIRO(FJP), 2017, *Déficit habitacional no Brasil 2015*. Resultados Preliminares. Belo Horizonte: FJP/CEI.
- [12] GIUSEPPONI, Sandro Custódio; PAULON, Vladimir Antonio., 2004, *Sistema Convencional X Sistema Alvenaria Estrutural usando Solo-cimento: Vantagens Econômicas e Construtivas*. Instituto Brasileiro do Concreto, 45º Congresso Brasileiro. Espírito Santo.
- [13] MEADOWS, Donella., 1998, *Indicators and information systems for sustainable development*. The Sustainability Institute.
- [14] MEDEIROS, Edvaldo da Silva., 2001, *Desenvolvimento Sustentável como de Proteção do Meio ambiente e Inclusão Social*. Minas Gerais: PUC/MG.
- [15] MENDES, Armando Dias; SOUZA, Ester Aguiar; BEZERRA, Lucila. *Agenda 21 Brasileira- Encontro Região Norte*. Brasília: Ministério do Meio Ambiente, 2001.
- [16] NETO, Neidyr Cury., 2009, *Solo-Cimento Aplicado em Casas Populares*. Disponível em: <<http://www.geocities.com/Athens/Styx/5303/>>. Acesso em: 15 ago.
- [17] ROMAN, H. R.; MUTTIC.,N.; ARAÚJO, H.N. de., 1999, *Construindo em Alvenaria Estrutural*. Florianópolis: Ed. UFSC.
- [18] SOUZA, R., 1984, *Avaliação de Desempenho Aplicada a Novos Componentes e Sistemas Construtivos para Habitação*. IPT. São Paulo.
- [19] SOUZA, M. I. B.; SEGANTINI, A. A. S.; PEREIRA, J. A., 2008, *Tijolos prensados de solo-cimento confeccionados com resíduos de concreto*. Revista Brasileira de Engenharia Agrícola e Ambiental, v. 12, n. 2, p. 205-212.
- [20] SJÖSTRÖM, Ch., 1996, *Durability and sustainable use of building materials*. In: Sustainable use of materials. J.W. Llewellyn & H. Davies editors. London: BRE/RILEM.
- [21] WACKERNAGEL, M.; REES, W., 1996, *Our Ecological Footprint*. Philadelphia: New Society Publishing.

Integrated Waste Management Technology with Focus on the Brazilian Amazon

Valéria Arenhardt¹, Flávio de São Pedro Filho², Waldir Schalch³, Eduardo Egídio
Vicenci Deliza⁴, Rodrigo Buss Back⁵

¹PhD in Environmental Technology from the University of Ribeirão Preto (UNAERP - Master in Business Management from the Vilhenense Association of Education and Culture, Professor of Entrepreneurship and Guidance for Research at the Federal Institute of Education Science and Technology of Rondônia IFRO. Member of GEITEC/UNIR, Brazil..

²Post-Doctor in Management and Economics from the University of Beira Interior, Covilhã, Portugal. PhD in Business Administration from the University of São Paulo, Brazil. PhD in Business Management from the Autonomous University of Asunción, Paraguay. Professor and Researcher at the Federal University of Rondônia, where he is Coordinator of the Management of Innovation and Technology Research Group (GEITEC/UNIR/CNPq), Brazil.

³PhD in Hydraulic Engineering and Sanitation from the University of São Paulo, Master's Degree in Hydraulic Engineering and Sanitation from the University of São Paulo, Graduation in Chemical Engineering from the Superior School of Chemistry Oswaldo Cruz, Coordinator of NEPER – Study and Research Center on Solid Waste. Works on technologies for the integrated management and environmentally appropriate disposal of solid waste, Visiting Professor at the University of Nebraska, Lincoln-USA (1999-2000), Professor USP/UNAERP, Brazil

⁴Specialist in Occupational Safety Engineering from Amazônia College (FAMA), Graduated in Mechanical Engineering from the Federal University of Technology, Paraná (UTFPR). Professor of Electromechanics at the Federal Institute of Education, Science and Technology of Rondônia (IFRO). Member of GEITEC/UNIR, Brazil. E-mail:

⁵Specialist in Management of Works from the Cuiabano Institute of Education (ICE), Graduate in Architecture and Urbanism from the State University of Mato Grosso (UNEMAT), Professor of Architecture and Urbanism at the Federal Institute of Rondônia (IFRO). Member of GEITEC/UNIR, Brazil.

Abstract— *This study deals with the management of the specific residues of tires, electro-electronics and batteries in a city in the Brazilian Amazon. The goal is to propose sustainable actions for the residues under study and, using SWOT analysis, to build a prognosis capable of contributing to environmental, economic and social sustainability. The specific objectives are: (1) Characterization of the hazardousness of the waste under study and the responsibility for its management; (2) identification of actions and goals in the management of specific solid waste; (3) use of the SWOT matrix to identify the positives and negatives in the waste management under study; (4) propose actions and goals to combat the problems encountered. The choice of sample was purposely directed to the public managers directly involved in implementing the plan with a focus on the residues under study. It is an exploratory descriptive study, mixed I character and with qualitative results. The result points to problems that demand immediate and urgent solution suggestions are made for actions and aims with immediate effect. These actions would enable entrepreneurs to optimize sustainable social and economic development in the Amazon. This study may benefit business owners, governments and other institutions interested in specific waste-related issues.*

Keywords— *Amazon. SWOT Analysis. Specific Waste. Sustainability.*

I. INTRODUCTION

One of the main challenges for Brazilian municipalities is the management of urban solid waste. It should be recognized that enough reusable waste is disposed of each year in the world to have a major environmental impact, for example on the pollution of water, soil, or air or the endangering of the planet through the contamination of plants. Planning actions to minimize the amount of waste disposed of on land or in the sea will ensure a more sustainable planet for future generations.

To strategically plan for an environmentally efficient and effective management is the intention of the present study; it does so by analyzing the plan of aims and actions for specific solid waste in the Municipality of Vilhena located in the region of the Brazilian Amazon. The main income of the Municipality, which according to IBGE (2017), has an estimated population of 95,630, comes from commercial and service activities, but industry, agriculture and horticulture are gaining greater prominence in its economic growth. Research shows that the collection of municipal solid waste is carried out by the city council in trucks that, since May 2014, have taken

their loads to a place where the waste is sorted and the tailings sent to be stored in a prepared landfill site. Before 2014, the city, like many other Brazilian cities, had an open dump. The municipality has not yet implemented selective household collection.

II. OBJECTIVES

This work proposes sustainable actions for the waste under study using a SWOT analysis to identify positive and negative points in the management of specific waste. It seeks to propose a plan capable of contributing to the pillars of environmental, economic and social sustainability in a municipality in the Amazon region of Brazil. Its specific objectives are: (1) classification of the hazardousness of the waste under study and responsibility for its management; (2) identification of actions and goals in the management of specific solid waste; (3) use of the SWOT matrix to identify the positives and negatives in the waste management under study; and (4) proposing actions and goals to combat any problems encountered. The sample was purposely restricted to the municipal managers directly involved in the execution of the plan, focusing on the waste under study. This is an exploratory descriptive study, of mixed character and with qualitative results. The question to be addressed is: What actions are possible for a municipality anxious to send the waste under study to the most suitable destination? The result points to problems that require urgent solutions and suggests actions and targets for waste that can be implemented at once. The actions indicated would enable entrepreneurs to optimize sustainable social and economic development in the Amazon. This work may benefit business owners, governments and other institutions interested in specific waste-related issues.

III. LITERATURE REVIEW

According to Luiz *et al.* (2015), there is an environmental crisis due to the inefficient execution of public policies for disposing adequately of specific waste. In a study, the same authors point out that the State of Rondônia, in the Brazilian Amazon, presents sad statistics of concentrations of solid waste in open dumps in several municipalities. This shows the fragility of the country's social structure with reference to solid waste management. Such a scenario demands immediate solutions in the municipalities of the region to the problem of the best destination of specific waste, for example, tires, electronic devices and batteries. Brazil's inadequate management of specific solid waste suggests national and not only local consequences, which allows us, by means of epistemological studies, to suggest actions that might alleviate its current predicament.

3.1 Characterization and hazardousness of the waste under study and reuse technologies

The Brazilian Association of Technical Standards – ABNT, through the NBR 10.004/2004, classifies residues on the basis of their potential risk to the environment and public health, indicating which must have more strictly controlled handling and disposal.

a) Waste of disposed tires

According to a study by Bertollo, Fernandes and Schalch (2002), tires are classified as Class II A – non inert – because of the levels of metals they contain (zinc and manganese) in their solubilized extracts, which are higher than the standards established by NBR 10.004/2004. Abandoned or inadequately disposed of unserviceable tires constitute an environmental liability, which results in a serious risk to the environment and public health. For this reason, even before the approval of the PNRS, tire manufacturers and importers have been since 2009 required to implement reuse technologies; they must collect and dispose of waste tires in compliance with CONAMA Resolution No. 416 of 2009.

b) Electronic waste

The classification of WEEE-Electrical and Electronic Waste recalls a norm established in the NBR 10.004 of 2004 of the Brazilian Association of Technical Standards – ABNT, in which Annexes G and H classify as non-hazardous such residues as polymerized plastic, scrap non-ferrous metal (brass etc.) and rubber waste. Given these stipulations, electronics may be said to fall into the non-hazardous category, although according to Pnuma (2010), electronic waste includes plastics, metals and other elements, which require specific technologies and suggest that electronics may be hazardous.

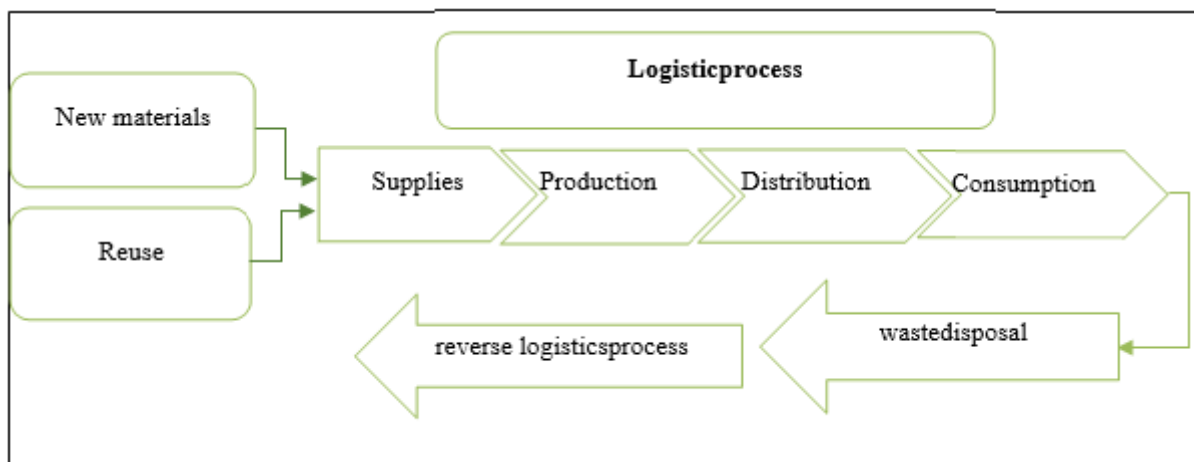
c) Spent batteries

The CONAMA Resolution 401/2008 insists that establishments selling batteries must contain adequate discarding points and promote reverse logistics for spent batteries, establishing the toxic limits contained in batteries and also the criteria for their commercialization in any country. Machado (2013) states that batteries can contain toxic metals which in the long term can be very harmful to the environment. He emphasizes that there are alternatives for their disposal, such as the recycling of parts or materials in cells and batteries. According to Mesquita *et al.* (2015), the risk with batteries is their endurance in the environment, especially in soils and groundwater; they have great potential for environmental destruction and do not degrade over time but remain in the ecosystem where they are deposited.

3.2 Shared responsibility for the management of specific solid waste

The Brazilian legal norms for solid waste are found in the National Solid Waste Policy – PNRS, which prioritizes the non-production, reduction, reuse, recycling, treatment and adequate final disposal of waste. The same rules establish a series of obligations for generators and public authorities to enforce the management of waste produced in a company. These obligations include the preparation of Municipal Plans, a compulsory condition, imposed on municipalities under penalty of non-access to federal resources of the Union (PNRS/BRASIL, 2010). Soares *et al.* (2016) point out that, despite the imposition of

restrictions, only 41% of the 5569 municipalities had drafted their municipal solid waste plans by the end of 2015. Manufacturers, importers, distributors and traders of the waste under study are also obliged to take all necessary measures to ensure the implementation and operation of the reverse logistics system (the model is represented in Figure 1), involving the return of waste generated by consumers, the purchase of used packaging, the provision of waste discarding points and working in partnership with cooperatives and associations of collectors to enable this waste to be sent to the most suitable destination.



Picture.1: Reverse logistics

Source: Authors' Construction

The reverse logistics process requires procedures and investments capable of effecting actions from the manufacturing of goods to the consumption and return of the waste generated for reuse in the manufacturing process or even in appropriate disposal, observing the composition of the residue. Table 2 describes the procedures in the trajectory to effect reverse logistics.

Table.1: Manufacturing process, reverse logistics and reuse of materials

Logistic process	The process of returning the materials, after the use of specific residues, that must receive treatment by the manufacturer, due to their composition. These can be reused with their own technologies.
New Materials	Those produced by manufacturers who know the composition and technologies used.
Supplies	Place where the materials and technologies are located that will be part of the manufacturing process
Production	The process of transforming the materials with private technologies
Distribution	After the transformation, the product is ready to be distributed to the dealers, to reach consumers
Consumption	The consumer uses the material/product until it no longer has a use.
Discard	Process for the disposal of waste materials
Reverse logistic process	Pickup process to send to the manufacturer who will forward it to the correct destination
Reuse	Process of reuse by the manufacturer, where the waste enters the productive process again, obviating the use of new natural resources.

Source: Authors' Construction

3.3 SWOT Matrix Concepts

Strategic planning is the process of defining strategy, direction and decision making for the allocation of resources, including capital and people. SWOT Analysis is a strategic diagnostic tool integrated into the process of continuous improvement that facilitates the evaluation of a particular area. It reflects a global perspective on the situation of a given organization, allowing improvements to be identified, and helping strategy to be defined (UNEP, 2009). According to Silva (2009), the SWOT Analysis

tool, divided essentially into Internal Environment Analysis and Analysis of the External Environment, proposes that, from the mapping of Internal Strengths and Weaknesses and also from External Opportunities and Threats, those responsible for creating strategies will gain have the necessary resources to take full advantage of Opportunities and Strengths, minimizing or even eliminating the Weaknesses and Threats that impede the advent of solutions to the problems identified (see Figure 2).

Internal (Organization)	Forces	Weaknesses
	They are advantages that the company has in relation to competitors	These are the competencies that are under the organization's influence, but somehow disrupt or do not generate competitive advantage
External (Environment)	Opportunities	Threats
	The forces that positively influence the organization, but over which it has no control.	These forces do not exert influence, but they weigh negatively on a company. They can be considered as a challenge imposed that can reduce its ability to generate wealth.

Picture.2: SWOT Matrix Model

Source- Adapted SILVA, 2009

IV. METHODOLOGY EMPLOYED IN THE RESEARCH

The present work was developed on the basis of the Municipal Integrated Solid Waste Management Plan of Vilhena (PLAMRESOLV), which provides for the management of urban solid waste in a city in the Brazilian Amazon. Exploratory qualitative research on the legal norms was carried out in a bibliographical study of the action plan and the targets, diagnosis and prognosis for waste tires, electrical and electronic equipment and batteries; and a field survey for a case study to identify the actions implemented and the goals reached from 2014 to October 2017. The SWOT matrix was used to identify the internal strengths and weaknesses, external opportunities and threats to the waste under study. The instruments used were questionnaires answered by the public agents responsible for implementing the plan and those who coordinated the activities related to such waste. The landfill was visited by the agents who segregate the waste. Data were collected in October 2017 and the respondents in the sample were selected specifically

because they are directly involved with the actions and the residues under study and represent the local municipality.

V. RESULTS OF THE RESEARCH

The results of the research bring a diagnosis of the actions and goals foreseen in the Municipal Plan of Integrated Management of Solid Waste of Vilhena, the municipality under study, as well as a SWOT analysis of the specific residues of tires, electric, electronics and batteries. The study ends by suggesting actions which might contribute to the social, economic and environmental sustainability of the Amazon region of Brazil.

5.1 Diagnosis of the actions and goals in the management of specific municipal solid waste in the period from 2014 to 2017

Table 2 presents information for analyzing the goals and action plan. No plan compares the deadlines established by the municipality with the evidence contributed by the municipal managers.

Table.2: Actions and targets for waste under study and search result

	Actions and deadlines foreseen in the municipal plan. Waste from Reverse Logistics (Tires, Electronics, and Batteries) Year 2014	Evidence from questionnaires Month of October 2017
Action 1	Creation, reproduction and distribution of informationsheets	The municipality claims to have published information sheets but there were distortions in the population's understanding, and so they were immediately reorganized.
Goal	Disclose clearly and objectively to consumers the procedures for disposing of such waste and also inform and guide entrepreneurs about the regulations and procedures for collection, transportation and final destination of reverse logistics waste.	
Deadline	02 YEARS	
Action 2	Create a register of establishments involved in reverse logistics.	No information was obtained on this action.
Goal	All establishments whose waste can be treated by reverse logistics must register with the Municipal Environment Department, indicating, when necessary, the name of the technically qualified person responsible for waste management.	
Deadline	05 years	
Action 3	Creation and implementation of municipal law dealing with waste from reverse logistics.	Up to the present, no law has been passed regulating reverse logistics in the municipality.
Goal	Create the Municipal Law based on Federal Law 12,305/2010 regulating reverse logistics in the municipality.	
Deadline	02 years	
Action 4	Regulate the reverse logistics system	No information was obtained on how supervision works. According to the evidence, the partnerships for shared responsibility are informal only and have not been formalized.
Goal	Regulate and supervise reverse logistics, in order to organize the enterprises that are included in this system, defining the procedures for collecting such waste and establish shared responsibility, including procedures in environmental licensing.	
Deadline	05 years	
Action 5	Establish Sector Agreements.	-The municipality with the Public Prosecutor's Office "charges" the entrepreneurs' actions based on the National Policy. -According to information, the Municipality formalized some agreements for sending some waste products, such as tires, to the correct destination.
Goal	Seek cooperation between the Municipal Public Power with the business sector and other segments of society, through clarifications on the structuring and implementation of the issues involved and through material and technical support to put the legal provisions into effect.	
Deadline	05 years	

Action 6	Establish VDP-Voluntary Delivery Points	<p>-There was an initiative to send electronic devices to delivery points, mobile "carts" that took them to a deposit in the City Hall for some future destination.</p> <p>-For batteries, there are two privately runeco-points</p> <p>-For tires a local (municipal) deposit was created to receive such waste from the generators.</p>
Goal	In partnership with merchants,create, voluntary delivery points (VDP) for the temporary accumulation of special waste, since the law obliges retailers to make servicesfor receiving such waste available to consumers.	
Deadline	05 years	
Action 7	Discipline and intensify supervision of enterprises	<p>The plan now in progress will be reformulated and the activities of generators, transporters and waste receivers will be disciplined.</p>
Goal	Discipline the activities of generators, transporters and waste receivers, requiring management plans as appropriate, inspecting the establishments within the Reverse Logistics System, issuing declaration of compliance with the National Policy on Solid Waste	
Deadline	Not determined. Continuous program as of the 2nd half of 2015.	
Action 8	Conduct educational campaigns.	<p>Work is being done with schools, companies and entities; this should be expanded.</p>
Goal	Hold encounters and meetings with bodies representing the sectors in the reverse logistics chain to discuss, clarify, debate, find solutions and campaign in partnership with the companies to collect the waste that can be sent to a final destination.	
Deadline	Not determined. Continuous program as of the 2nd half of 2015.	
Action 9	Restructure tire shed.	<p>This action is foreseen, but not yet performed due to lack of financial resources. Note that the site still supports the demand.</p>
Goal	To carry out the necessary maintenance as well as improvements of the existing structures for the good operation of the shed holding waste tiresfor collection, since it is not in the best state of conservation.	
Deadline	06 years	

Source: PLAMRESOLV (2014) and Authors of this research (2017)

5.2 SWOT analysis of the waste under study

The SWOT analysis points out positive opportunities and strengths as well as negative threats and weaknesses in an internal and external balance, taking into account the Municipal Plan for the Integrated Management of Solid Waste of Vilhena- PLAMRESOLV. The National Solid Waste Policy establishes that the waste under study

requires reverse logistics through sectoral agreements between public entities, manufacturers and traders. Table 3 identifies the internal and external positive points – strengths and weaknesses – as well as the external opportunities and threats found after the bibliographical and field research with the municipality on the actions and targets for waste tires, electronics and batteries.

Based on this analysis, some strategies were proposed to minimize the weaknesses. maximize the strengths and opportunities while

Table.3: SWOT Analysis for Tires, Electronics and Batteries waste

	Positive	Negatives
Internal	<p>Strength (S)</p> <p><u>Common to all waste under study</u></p> <ul style="list-style-type: none"> -The waste is foreseen in the municipal plan and plan of actions and goals - There are initiatives to install the VDP- Voluntary Delivery Points for some waste. - The creation of a segregation cooperative in the landfill is encouraged. <p><u>Tire Waste</u></p> <ul style="list-style-type: none"> -There is a public space (shed) to hold the waste. -There is a partnership for the disposal and incineration of waste. - There are human resources and materials for receiving it. - The cost of the transportation company contracted for incineration was assumed. <p><u>Electrical and Electronic Equipment waste</u></p> <ul style="list-style-type: none"> - The VDP (Voluntary Delivery Point) and collection with simple mobile vehicles are in use. -The definition of conditions and public space (Shed) for the disposal of waste electrical and electronic is in process. -The disposal of electronic waste is being studied. <p><u>Battery Waste</u></p> <ul style="list-style-type: none"> - There are initiatives to install PEV-Points of Voluntary Delivery. 	<p>Fragility (W)</p> <p><u>Common to all waste under study</u></p> <ul style="list-style-type: none"> - There is no planning or publicity of the actions goals, responsibilities, dangers, initiatives and sanctions for the agents who must be involved in the collection and destination process. -Lack of policies to encourage and educate the population in waste disposal, with clear aims for generator/consumer attitudes and behaviour -Lack of a Reverse Logistics municipal law -Selective household collection is not effectively implemented - The sectoral agreements are informal. - There is no comprehensive environmental education plan or action plan for the general population. -There are too few partnerships and training incentives for the use of waste andfor entrepreneurial reuse projects. <p><u>Tire Waste</u></p> <ul style="list-style-type: none"> -The location of a delivery point/collectionis not appropriate -There is no collection for small generators - Too little initiative has been shownin the transportation for small enterprises. <p><u>Waste Electrical and Electronic Equipment</u></p> <ul style="list-style-type: none"> - It is not predicted in actions and goalshow and when this waste will be reused, inertize and/or recycled. - Electronic devices are not separated from other residues in people's homes. - Waste is collected by simple mobile vehicles in public spaces, but it has no destination. <p><u>Spent Batteries</u></p> <ul style="list-style-type: none"> - These are not separated from other kinds of waste in people's homes. - There are only two collection points for them. - Despite legislation, resellers do not feel obliged to collect after use. - There is no definite destination for this waste.
	External	<p>Opportunities (O)</p> <p><u>Common to all the waste under study</u></p> <ul style="list-style-type: none"> - Develop a positive and sustainable image by means of advertising. -Create clear information targeted at the population

	<p>encouraging positive action</p> <ul style="list-style-type: none"> -Create a municipal law for reverse logistics. -Involve dealers and manufacturers -Create legal norms guiding the actions of the population in separating and treating waste correctly and sending it to the right place. -Introduce domestic selective collection -Make an environmental education plan with actions and goals that can reach the entire population -Create legal norms to inform the amount of waste generated in the municipality. - Formalize partnerships and sectoral agreements. -Propose partnerships with neighboring cities for effective actions. - Encourage the implementation of small enterprises. Generating employment and income through the implementation of reuse. 	<ul style="list-style-type: none"> -Actions with damaging results due to lack of information -Sending waste to locations that are not suitable for generators -Difficulty in identifying the VDP (Voluntary Delivery Points). -Difficulty of separating waste in people's homes and segregating waste in the landfill, owing to contamination.
--	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Source: Prepared by the authors

The result of the SWOT analysis points to viable actions contributing to social, economic and environmental sustainability that should be carried out immediately. Actions should have feasible goals summarized as legal norms, involving the people who are part of the waste generation process; the legal norms and disclosure should underline the rules so as to reinforce the commitment to sending waste to the most suitable destination.

The positive actions of the municipality should be highlighted, for example, the initiative in the partnerships arranged for the creation of the Voluntary Delivery Points-VDP, as well as the creation of cooperatives for the segregation and correct destination of waste.

The weaknesses found are lack of planning, of public policies for reverse logistics, and of publicity with clear and objective information, together with the improper disposal of waste, the need for selective collection; they should all be interpreted as opportunities to involve the powerful and the generators of waste to commit themselves to its disposal.

The opportunities found are to act through an environmental education program to create means to control the generation of waste, formalize partnerships with neighboring municipalities to minimize the costs of destination, with SENAI and SENAC to propose training courses for the reuse and recycling of this waste and with SEBRAE for business plans and economically profitable management.

External threats are the contamination of drinking water and the sources of soil and air. The study points to threats such as inadequate pipelines from generators that dispose of electronic devices on the street, at roadsides and in rivers, tires that are buried and burned, batteries that are included in household waste without proper separation: these are all totally inappropriate ways of dealing with waste. Another threat is that the PVDs, are not identified which makes it difficult to locate where specific kinds of waste are received. It should be emphasized that failure to separate residues in households and businesses in landfills often contaminates them beyond use.

5.3 Actions and goals proposed for these waste products to combat present problems

The above SWOT analysis identified that the municipality did not assess the gravimetric composition for obtaining the type and quantity of waste generated in the municipality. According to the survey, no study has been made of the amount of waste generated in the municipality, which leads to difficulties in proposing actions and targets for subsequent years. With this in mind, taking theoretical studies into account, actions and goals have been proposed to minimize the threats and weaknesses found in both the plan and the local research. Table 6 presents suggestions for actions and targets for this municipality's waste derived from the SWOT analysis and the findings about the municipal plan.

Table.4: Targets and actions for waste under study

Waste in this Municipality – Actions	
Actions and technologies to reduce the internal fragilities found	
Internal	<ul style="list-style-type: none"> -Create a municipal law for reverse logistics and partnerships to allocate funding for the accommodation and transportation of waste and sufficient staff. -Institute legal norms to regulate the behaviour of the generators, traders and consumers involved in the process, with clear definitions of each group’s responsibilities. -Introduce selective collection of waste in people’s homes. -Include in the Plan more concrete actions and targets for the reuse, recycling and disposal of waste using existing technologies and as practiced in other municipalities. -Study means of direct communication with the population that can guide, raise awareness and inform about the importance of sending residues to the correct destination and of the implications for health of the contamination of water, soil and air, breaking down current paradigms and compromising to take innovative action. -Define the correct destination of waste, in particular, batteries and electronic devices by means of partnerships and the removal of such waste to places where its components can be used. - Encourage SEBRAE/SENAI/SENAC partnerships and commitment to a business plan, training in dismantling and separation and thus the emergence of new enterprises capable of generating employment and income through the use and reuse of waste by means of available technologies. -Create control and survey systems for consumption by the municipality through links on the city's website where manufacturers and resellers can periodically post the quantity of sales made. -Identify and expand local Voluntary Delivery Points and/or provide transportation to collect waste in the peripheries, especially in small enterprises/generators.
Goal	Immediate Initiative
Actions and Technologies to Reduce External Threats Found	
External	<ul style="list-style-type: none"> - Prepare the population for inspection, to eradicate the inadequate disposal of waste. - Disseminate, inform and raise people’s awareness about the danger to human health and negative impact of waste electrical and electronic devices when they are improperly disposed of, highlighting the pollution of soil, water and air. - Control the sale of products so that the quantity of waste generated can be identified, making possible the monitoring and inspection of its destinations. -Create legal rules with fines for those who dispose of waste improperly.
Goal	Immediate Initiative

Source: Prepared by the authors

With the actions and goals proposed for the waste under study, it is suggested, the impact on the environment by inadequate disposal will be minimized and all those involved will be able to consciously participate in consolidating the national policy for solid waste and thus promote economic, social and environmental sustainability. It must not be forgotten that the greater part of the residues under study are not bio-degradable and that inadequate disposal can irreparably damage the environment.

VI. CONCLUSION

All the methodology of diagnosis and analysis employed here makes it clear that the management of solid waste in an important region of the Brazilian Amazon is a great challenge. The importance given to the waste under study should nonetheless be sensitive to the people who

produce it there, while matching the flows and demands in accordance with national standards. This task is even more difficult for a region that is far from the big productive centers, often hindering reverse logistics because of the high cost of transportation and other relevant factors. Any technical alternative proposed for the system must respect the integration between the cities of the region and a more intense participation of the three levels of government.

The initial suggestion in answering the research question is to implement selective collection in the municipality, which leads to people’s commitment to sending different kinds of waste to the correct destination by separating them at home or in the workplace. The installing of more collection points for batteries and the effective collection of tires and electronics would consolidate the reverse logistics proposed in the National Policy. It can be stated

that the present deficiencies are also related to the current need for more effective communication with the population, by retailing products which carry orientation strategies for their adequate disposal after use, and information on the impact of improper disposal on soil, water and air, which directly affects the health of the population.

The local analysis reveals that the municipality was concerned with the destination of the specific waste in that it requires reverse logistics but is still at fault for not meeting the general demands, for not expanding collection and destination actions, and for neglecting awareness programs for the breaking of paradigm through education. Finally, the present study recommends the formalization of local and sectoral partnerships, and the study and formulation of legal norms to define the responsibility of the municipality, the entrepreneur, and the population, including rules of conduct and punishment for inappropriate actions.

REFERENCES

- [1] Bertollo, S. M., Fernandes J., J. L. & Schalch, V. (2002). *Benefits of incorporating rubber tires into asphalt pavements*. In: Inter-American Congress of Sanitary and Environmental Engineering Cancun, Mexico, October 29, 30 and 31, 2002. Available at <http://waste.com.br/textos/Reciclagem%20de%20neus.pdf> Accessed in 27/11/2017
- [2] Brazil. *Federal Law n°. 12.305 of August 2, 2010* (2010). Institutes the national solid waste policy. August 2010.
- [3] Brazil. *Decree n°. 7.404, dated December 23, 2010* (2010). Regulates Law n°. 12.305, of August 2, 2010, which establishes the National Solid Waste Policy, creates the Interministerial Committee of the National Solid Waste Policy and the Steering Committee for the Implementation of Reverse Logistics Systems.
- [4] Brazil. Brazilian Association of Technical Standards ABNT. *NBR 10.004/2004* (2004). Solid Waste: Classification. Available at: <http://www.unaerp.br/documentos/2234-abnt-nbr-10004/file> Accessed on November 27, 2017.
- [5] Brazil, Conama-National Council for the Environment. *Resolution 401/2008* (2008). Establishes the maximum limits of lead, cadmium and mercury for batteries and batteries sold in the national territory and the criteria and standards for its environmentally sound management, and other measures. Disponível em: <http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=589> Accessed on November 27, 2017
- [6] Brazil, Conama-National Council for the Environment, *Resolution 416/2009* (2009). Provides for the prevention of environmental degradation caused by waste tires and their environmentally appropriate disposal and provides other measures. Available at: <http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=616> Accessed on November 27, 2017.
- [7] Ibge-Brazilian Institute of Geography and Statistics. *Demographic Census: Cities* (2017). Available at: <http://cidades.ibge.gov.br/xtras/perfil.php?lang=&odmun=110030> Accessed: March 05, 2017.
- [8] Machado, G. B. (2013) (Offenbach-Germany). *Recycling Tires*. Portal of Solid Waste. (2013). Available at: <http://www.portalresiduossolidos.com/reciclagem-de-pneus/>. Accessed on November 23, 2017.
- [9] Mesquita, G. M.; Souza, M. A. P. de; Silva, A. C. da & Rabelo, A. (2015). *Solid waste and battery management plan for a company in the telephony business*. DOI: 105902/2236117016937 Electronic Report on Environmental Management, Education and Technology Santa Maria, v. 19, n. 2, mai. Aug 2015, p. 534-542 Journal of the Center for Natural and Exact Sciences - UFSM ISSN: 22361170. Available at: https://periodicos.ufsm.br/reget/article/viewFile/16937/pdf_1 Accessed on November 23, 2017.
- [10] Municipal Administration of Vilhena – PMV, Autonomous Water and Sewage Service of Vilhena – SAAE & Municipal Law n. 4,125 of May 15, 2015 (2015). *Approves the Municipal Goals of Integrated Management of Solid Waste - PLAMRESOLV*
- [11] Pnuma, Recycling (2015). *From e-waste to resources*. United Nations Environment Program. 2010. Available at: http://www.unep.org.br/admin/publicacoes/texto/E_Waste_final.pdf. Accessed on: 10/19/2017
- [12] Silva, L. L. (2009). SWOT Analysis. Available at: <http://agenda-digital.blogspot.com/2009/07/matriz-de-analise-de-swot.html>. Accessed on November 27, 2017.
- [13] Soares, D., Marques, H., Chaves, O. & Zago, V. (2016). *Diagnosis for the optimization of the solid waste management system in the Center-South Region of the Municipality of Belo Horizonte: an analysis of strengths and weaknesses, opportunities and threats*. GOT, Journal of Geography and Spatial Planning. Online Version ISSN 2182-1267. n°10 Porto ten. 2016. <http://dx.doi.org/10.17127/got/2016.10.015>. Available at: <http://www.portaldeperiodicos.unisul.br/index.php/g>

[estao_ambiental/article/view/2704](#)> Accessed on November 27, 2017.

- [14] United Nations Environmental Programme (UNEP) (2009). *Developing Integrated Solid Waste Management Plan: Training Manual*. 1^a ed. v. 4, Osaka/Shiga: International Environmental Technology Centre. 2009.
- [15] Luiz, E. L. C.; Pedro Filho.F. de S. & Silva, I. C. (2015) *Strategies for the Management of Solid Residual Domiciliary in Porto Velho, Brazilian Western Amazon*. See, *Environmentally Sustainable*. July-December, 2015, year X, vol.II, number 20, pp. 1591-1602. ISSN: 2386-4362 Available at:<
http://revistas.udc.es/index.php/RAS/article/view/1687/pdf_94> Accessed on November 11, 2017

Analysis of the effectiveness of sanitizers for a low moisture footwear sanitization unit

Abeywickrema S., Navaratne S.B.

Department of Food Science and Technology, University of Sri Jayewardenepura, Sri Lanka

Abstract— Footwear sanitization is critically considered in food industries as control of the cross contamination of pathogens for the safety and quality of the production. Since poor maintenance of footbaths type of footwear sanitization systems can further enhance cross contaminations, importance of low moisture systems in footwear sanitization is acclaimed. This study examines the efficacy of the decontamination of *E. coli*, with IPA/ethanol, QAC/ethanol, IPA/QAC/ethanol, IPA/QAC/water chemical treatments for boots and slippers. Cleaned footwears were treated with *E. coli* sample and sanitizer was treated by spraying. Swab tests were done before and after applying treatments. Using dilution series, CFU was counted after incubating the selected diluent on the petri plates. Log value of the reduction of *E. coli* was graphically represented, and further statistical analysis was done by Tukey's test with a post hoc test. Results revealed that IPA/QAC/water treatment was the best as it significantly contribute (Tukey's test, $P \leq 0.05$) in log reduction/CFUs of microorganism. Overall study depicts IPA/QAC/water combination is efficient and effective as sanitizer combination for a low moisture footwear sanitization system.

Keywords—*E. coli*, Footwear sanitization, IPA, Low moisture systems, QAC.

I. INTRODUCTION

Safety of food is a vital issue in most of the food manufacturing industries to prevent the ingress and spread of the pathogens. It is often considered into Good manufacturing Practices (GMPs) in food processing environments. Frequently, Cross contamination from external sources as footwear has considered as a decisive factor in hygienic control. Even in HACCP¹ footwear sanitization has considered as a critical point (CP) to manage.

Foot baths are commonly used to decontaminate footwear soles to enhance the hygienic environment, which required high capital investment, chemicals and human resource for maintenance. Some studies depicts that

footbaths are responsible for the enhancing of environmental microbial load, if not maintained properly [1] [2]. Even such systems can lead to microbial spread and boost the safety risk by introducing water and increasing humidity of the thoroughly dry areas of a plant [3]. Increased humidity level can severely affect the quality of low moisture food products and enhances the safety issues mostly related with foodborne pathogens.

Foodborne diseases are common, as millions of cases were reported worldwide for a year [4]. Among number of pathogens, *Listeria monocytogenes*, *Campylobacter spp.*, *Staphylococcus aureus* and *Escherichia coli* (*E. coli*) are frequently causing food borne illnesses and food spoilage. Specially, *E. coli* is extremely associated with the food safety factor as it's a facultative anaerobic microorganism which found in warm blooded animals intestine [5].

Since low moisture systems for footwear sanitization is an imperative, this study proposes the use of sanitizers in different combinations for a footwear sanitization unit on the affectivity in decontamination of *E. coli* for two different footwears as boots and slippers.

Despite of footbaths, vaporizable proper sanitizer combination can be used for a low moisture footwear sanitization system. Sanitizers are the chemicals those were not effect to the quality of the product and even the safety but used for reducing microorganisms which considered as critical to human health [6]. Hypochlorite, Quaternary ammonium compounds (QACs), Chlorine dioxides, Iodophors, Peroxyacetyl acids (PAAs), Isopropyl alcohols (IPAs) and *etc.* are examples for sanitizing agents. Therefore, overall study was based on the effectiveness of QAC and IPA chemical combinations on the decontamination of *E. coli* on footwears; boots and slippers.

II. MATERIALS AND METHODS

2.1 Footwear

Two different types of footwear were used in the study as work boots and slippers. Comparatively boots were having wide treads than slippers which are having narrow treads more shallow with closer together (Fig. 1). Six identical unused pairs of footwears (Slippers and boots separately) were used in the study.

¹ HACCP - Hazard Analysis Critical Control Point

In each trial, footwear was cleaned and disinfected thoroughly on, before used and after used. Cleaning and disinfection was carried out by; rinsing with 600ppm chlorinated water for 5 minutes and dried with clean

paper tissues. Then, 98% ethanol was sprayed and allowed to dry. The effectiveness of the disinfection procedure was analyzed by a Swab test before processing the trials.



Fig.1: (A) work boots, (B) tread pattern of work boot, (C) work slippers, (D) tread pattern of slippers

2.2 Preparation of *E. coli* sample

A 200mL previously prepared *E. coli* sample was taken for the study. 25mL of the sample was absorbed into a sponge (30cm*30cm*3cm) before each trial.

2.3 Preparation of sanitizers

Study was carried out by using two chemical sanitizers in different composition while ethanol or water using as base solvent as shown in the table 1.

Table.1: Sanitizer combination

Chemical	Ratio	Contact time
IPA/Ethanol	10:1	1 min
QAC/Ethanol	10:1	1 min
IPA/QAC/Ethanol	10:10:1	1 min
IPA/QAC/Water	10:10:1	1 min

Prepared sanitizers were transferred into a sprayer (capacity 100mL) which can spray approximately 0.20 mL per stroke as measured at the beginning of the study.

2.4 Task and Procedure

Clean footwear was pressed on the *E. coli* treated sponge for 1 minute. Three locations of each footwear from the top to bottom was sprayed using one stroke, holding nozzle of it 5±1 cm away from the footwear. Footwear was held its downside up for the easiness of further tests.

All the tests were conducted as triplicates for slippers and boots discretely.

2.5 Microbiological sampling and analysis

To enumerate the initial *E. coli* content a swab test was performed before applying the sanitizers. After 1 min of a contact time, again a Swab test was done for each footwear. The suspension in each swab test bottle was serially diluted and plated on petri plates. Plates were incubated at 35°C for 48 hours.

2.6 Statistical analysis

Colony forming units (CFU) were counted for both types of footwear and recorded after converted them into log values. And also mean value for CFU in triplicate of each treatment and controls were calculated. The difference of the defined log value of the initial and the post treatment for separate footwears were noted as the log reduction value. A Tukey comparison test was conducted using Minitab 17 by means of analyzing the variance. Finally, one way ANOVA was conducted as a post hoc test for the tukey's test, to determine the significantly different treatment.

III. RESULTS AND DISCUSSION

CFU in terms of average log value for each treatment are depicting in fig. 2. According to the results, slippers type

footwear having high *E. coli* load than in work boots. This might be due to the tread line pattern of the foot wears (fig. 1). Slippers are having narrow and shallower as well as closely aligned treads which provide a big

surface for microorganisms than the wide tread pattern in a boot. According to previous studies; it confirms that wide tread patterns on footwear combines with less count of pathogens compared with narrow tread pattern [3].

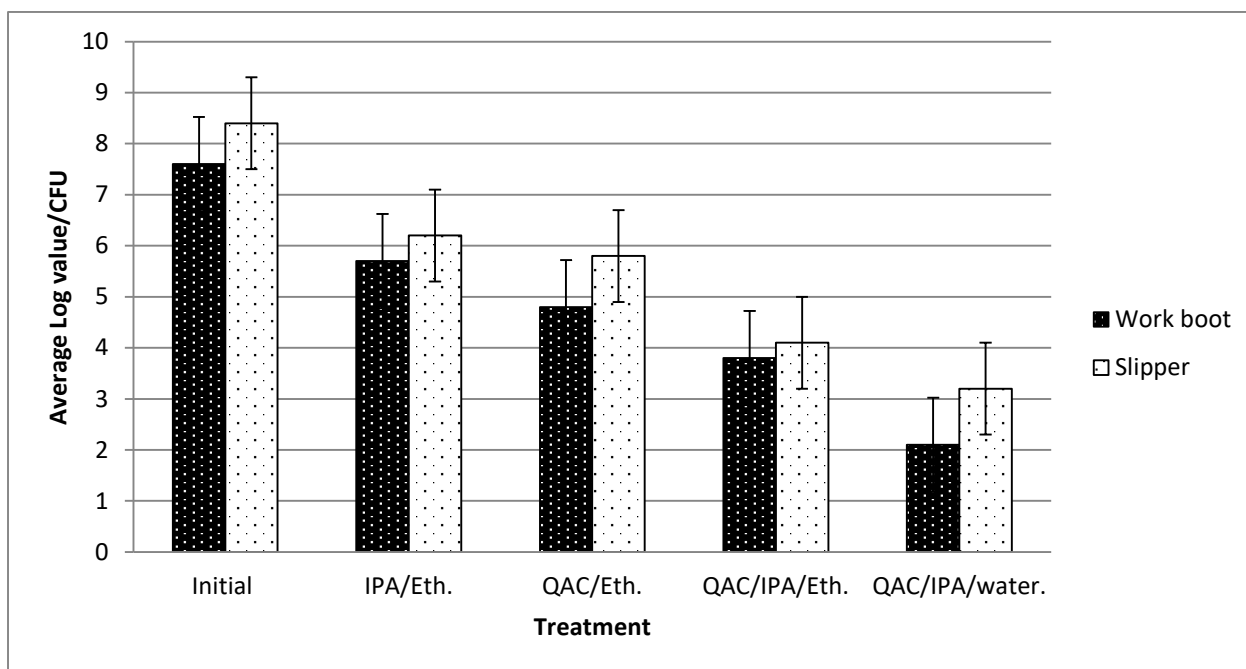


Fig.2: Average log values of CFU of *E. coli* after sanitization

According to the fig. 2, reduction of log CFU for QAC/ethanol was higher than for the IPA/ethanol. QAC is mostly active than IPA, since IPA is a secondary alcohol, but; QAC is a complex chemical which is having a positively charged cation that can easily bind with phospholipids of the microbial cell wall. This supports to destroy the microbial load to an extent [7]. Gram negative, *E. coli* like microorganisms effected by QAC most.

Results impart, combination of QAC/IPA/ethanol indicates higher log reduction than for QAC/ethanol and IPA/ethanol. This resulted by the total action of QAC and IPA together towards the *E. coli*. According to previous studies, QAC and IPA are most effective towards pathogens in decontamination of footwear soles [3].

But QAC/IPA/water shows an uppermost log reduction compared to all other treatments. And also it depicts a difference with the treatment of QAC/IPA/ethanol. Therefore, the variation was caused by the base “water” because it has enhanced the sanitization power of QAC/IPA. Thus dry QAC is not active towards pathogens since it needed at least some moisture to activate against the target microorganism [3].

Overall study found that there was a less difference in sanitization between slipper and work boots except in the initial microorganism load. Both footwears revealed similar variation pattern of sanitization within the study.

The degree of decontamination is depends on the type of the footwear, microorganism load in the footwear sole and the type of the sanitizer. Similar variation pattern for sanitization of two footwear, boot and slipper can be occurred due to the similarity of the treatments.

Study extends to the efficacy of the sanitization on the basis of log reduction, and it was analyzed according to tukey’s test, using Minitab 17 statistical software. Results pertaining to the log reduction in *E. coli* populations on the work boot and slipper footwears with respect to the four treatments were significantly different (Tukey’s test, $P \leq 0.05$) to each other. Post hoc analysis for the Tukey’s test, one way ANOVA was also found that, all four treatments are significantly different from each other.

This finding tends the variation between each treatment on footwears; boot and slipper. Figure 2 describes such a variation as per QAC/IPA/water shows the highest log/CFU reduction for *E. coli* decontamination while QAC and IPA alone show a lower log reduction. A research conducted on the *Salmonella* population has shown similar results for the combination of QAC and IPA as >3.9 log reduction, but for aqueous QAC 1.3 log reduction [8]. Therefore, a remarkable biocidal activity is presented in the combination of the sanitizers QAC/IPA.

On facts, the study found that all four chemical treatments for boots and slippers were capable in reducing *E. coli* content to an extent, but the uppermost 99.99% *E. coli*

reduction was examined in work boots and slippers for QAC/IPA/water. But in practical conditions this depends on the bactericidal activity of the microorganism as the longer contact times can enhance it [9], except other factors such as maintenance practices.

IV. CONCLUSION

Inclusive study suggested IPA/QAC/water, the best sanitizer combination in reducing *E. coli* population on footwear. Thus, IPA/QAC/water is most suitable for low moisture footwear sanitization system as QAC/IPA/water combination was the best for log reduction of *E. coli* population (99.99%) since water activated function of QAC towards pathogens.

The effect of water (<5%) in the QAC/IPA/water having minimum influence compared to water based footbaths containing aqueous QAC, since IPA and QAC are readily vaporizable [3]. This supports to reduce the risks of cross contaminations and suitable for dry environments where humidity of the plant is a critical factor (i.e. biscuits manufacturing).

REFERENCES

- [1] Langrud, S. T. Moretro, and G. Sundheim. 2003. Characterization of *Serratiamarcescens* surviving in disinfecting footbaths. *J. Appl. Microbiol.* 95:186–195.
- [2] Langsrud, S., L. Seifert, and T. Moretro. 2006. Characterization of the microbial flora in disinfecting footbaths with hypochlorite. *J. Food Prot.* 69:2193–2198.
- [3] Burnett, S.L., S.J. Eglund, P.J. Mckelvey and F.K. Cook. 2013. Chemical decontamination of footwear soles to limit microbial transfer in a dry environment. *Food Prot Trends* 33(2):74-81
- [4] Martinović T., Andjelković U., Šrajer Gajdošik M., Rešetar D., Josić D. 2016. Foodborne pathogens and their toxins. *J. Proteomics* 146, 226-235.
- [5] Maria Schirone, Pierina Visciano, Rosanna Tofalo and Giovanna Suzzi. 2016. Biological hazards in food. *Front Microbiol.* 2016; 7:2154.
- [6] Code of Federal Regulations, Title 21, Sec. 110.3
- [7] McBain, A.J., R.G. Ledder, L.E. Moore, C.E. Catrenich and P. Gilbert. 2004. Effects of quaternary-ammonium-based formulations on bacterial community dynamics and antimicrobial susceptibility. *Appl Environ Microbiol.* 70(6):3449–3456.
- [8] Du, W., M. D. Danyluk, and L. J. Harris. 2009. Efficacy of aqueous and alcohol-based quaternary ammonium sanitizers for reducing *Salmonella* in dusts generated in almond hulling and shelling facilities. *J. Food Sci.* 75:M7–M13.

Amaranth Starch Isolation, Oxidation, Heat-Moisture Treatment and Application in Edible Film Formation

Ritu Sindhu, Bhupendar Singh Khatkar

Department of Food Technology, GJUS&T, Hisar, India

Abstract— Starch was isolated from amaranth grains and subjected to modification treatments. Oxidation of isolated starch was done using sodium hypochlorite and heat-moisture treatment was done at 85°C for 6hr keeping the moisture content 30% during treatment. Native and modified starches of amaranth were used for preparation of edible films and different characteristics of films were evaluated. Both the modification treatments increased tensile strength of amaranth starch films. Heat moisture treatment increased water vapour permeability while oxidation had contrary effects on amaranth starch films. Water solubility of films of amaranth starches was reduced by modification treatments of starches. Heat moisture treatments increased yellowness of starch films.

Keywords— amaranth, edible films, heat-moisture treatment, oxidation, starch.

I. INTRODUCTION

Environmental awareness has renewed the interest in edible and biodegradable films in last few decades. Researchers are focused on developing edible films and coating based on biopolymers such as protein, starch, lipids and polysaccharides due to their environment-friendly nature, good keeping quality and safety records for food products. Among these natural polymers, starch is the important biopolymer used as thickener, emulsifier and stabilisers. Major aspects producing starch as a potential material for edible film formation are its edibility, large availability, cost effective isolation, nutritional importance, biodegradability, biocompatibility and diverse functional properties (Dang and Yoksan, 2015; Reis et al., 2015). It was concluded from different studies that edible films prepared from starch are odourless, neutral in taste, colourless, toxic free, and semi-permeable to moisture, carbon dioxide, oxygen, and lipid as well as flavour components (Shah et al., 2016). However, native starch from each source is unique in nature and have some shortcomings such as hydrophilic nature, poor mechanical strength, paste inconsistency during cooking or processing, and low freeze-thaw stability (Xie et al., 2013; Dang and Yoksan, 2015;

Sabetzadeh et al., 2015). Starches are modified by different treatments to overcome the shortcomings of native starch and to enhance the suitability for specific application. Various modification techniques such as physical, chemical, enzymatic, and genetic, or a combination of treatments have been developed to alter the properties of starches. Alteration of properties including functional, mechanical and organoleptic characteristics of starch films is possible by addition of certain amounts of various chemicals in Filmogenic solution (Mali et al., 2004), however, it is not desirable to mix chemicals to starch film for the reason that they are edible. Therefore, to improve the quality of starch films, modification of starch itself is preferable. developed oxidised and heat-moisture treated potato starch Studies conducted on development of edible films using native and modified starches of different sources revealed significant changes in various properties of films (Zavareze et al., 2012; Fonseca et al., 2015; Biduski et al., 2017). Amaranth (*Amaranthus spp.*) is a dicotyledonous plant comes under the category of pseudocereals and grown in Himalayan area and few states of India. It is well-known for good nutritional quality of its leaves and grains. Amaranth can serve as excellent source of starch due to high starch content in grains. Extremely small size of granules with diameter ranging from 1.05 to 1.78µm amaranth starch has gained attention for applications (Sindhu and Khatkar, 2016). No previous studies have been reported on the production of edible film prepared from amaranth starches modified physically and/or chemically. Therefore, present investigation was aimed on development of edible films from amaranth starch and evaluation of effects of modification treatments including heat moisture treatment and oxidation of starch on film properties.

II. MATERIALS AND METHODS

2.1 Materials

Grains of amaranth (*Amaranthus hypocondriacus*) used in this study were procured from National Bureau of Plant Genetic Resources Regional Station, Shimla, India. The

grains were screened to remove foreign matter and stored in sealed container at room temperature. The flour was prepared by grinding seeds on laboratory mill and stored in polyethylene bags at 10° C.

2.2 Starch Isolation

Starch was isolated from amaranth grains according to the alkaline steeping method (Choi et al., 2000). Grains were steeped in 0.25% aqueous NaOH solution for 18 hr at room temperature and stirred three times during this period. After steeping, the grains were washed with distilled water and ground in a blender at full speed for 2 min, and slurry was filtered step wise through 100 mesh (150µm), 270 mesh (53µm) and 400 mesh (38 µm) sieves. The starch was isolated from the filtrate by centrifugation at 25,000g for 20 min. The supernatant was discarded, and the top yellowish layer of protein was removed. This step was repeated to obtain a white starch layer. The starch layer was re-suspended in distilled water, shaken and centrifuged as described above. Thereafter, the isolated starch was dried in hot air oven at below 40°C for 8 to 10 hr and stored at room temperature in sealed container.

2.3 Heat Moisture Treatment of Starch

The heat moisture treatment of amaranth starch was carried out according to the method of Franco et al. (1995) with minor modifications. The moisture level of starch was adjusted to 30% by adding appropriate volume of distilled water (the moisture level of native starch was predetermined). The addition of distilled water was done slowly and simultaneously mixed for uniform distribution of water in starch powder. Sample was sealed in polyethylene pouch and equilibrated at 10°C overnight. After the incubation, starch was filled in air tight glass container and heated for 6 hr at 85°C. The container was shaken occasionally for uniform distribution of heat. The sample was cooled to room temperature and dried at 40° C for 6 to 8 hr and equilibrated at room temperature for 4hr. The dried starch powder was sealed in polyethylene bag, labelled and stored at room temperature for further analysis.

2.4 Oxidation of Starch

Oxidation of isolated starch was done by following the method of Forsell et al. (1995). Starch sample was weighed 100g (db) and dispersed in 500ml distilled water. The pH of the suspension was adjusted to 9.5 with 2.0M NaOH. Sodium hypochlorite solution (4% active chlorine available) of volume 25ml was slowly added to the starch slurry over a period of 30min with constant stirring while maintaining the pH in the range from 9.0 to 9.5 with 1M H₂SO₄. The reaction was allowed for 10min after all the sodium hypochlorite has been added. The pH of slurry was adjusted to 7 with 1M H₂SO₄ and centrifuged at 4000rpm for 10 min. The starch cake obtained was

washed 4 to 5 times with distilled water and dried at 40°C in hot air oven. The dried oxidized starch was ground and passed through 75µm sieve, packed in polyethylene bags, labelled and stored at room temperature for further analysis.

2.4.1 Carboxyl content of starch

The carboxyl content of the oxidized starch was determined by following the method described by Smith (1967) and employed by Parovuori et al. (1995). In 500 mg starch (db) sample, 30 ml of 0.1 M HCl was mixed at room temperature to acidifying the carboxyl groups of the samples and maintained under the magnetic stirring for 30 min. Subsequent to this, the starch was exhaustively washed and recovered by centrifugation (2,000g) until the pH raised to neutrality. This procedure was named de-mineralization by Smith (1967). The starch was dispersed in 300 ml of distilled water and heated at 98°C for 30 min under agitation for complete starch gelatinization. While still hot, the samples were titrated with 0.002 M NaOH solution until pH 8.3, using the phenolphthalein as indicator. Complete experiment was performed with native starch instead of oxidised starch and treated as blank. The carboxyl content was calculated using the following equation:

$$\text{COOH (\%)} = \frac{(V_s - V_b) \times M \times 0.045 \times 100}{\text{wt. of sample (g)}}$$

Where V_s is the volume of NaOH used for the sample (ml); V_b is the volume of NaOH used for the blank (ml); M is the molarity of NaOH.

2.5 Preparation of Starch Films

Starch films using native and modified starches of amaranth were prepared by following the method described by Chandla et al. (2017) with minor modifications. Filmogenic solutions were prepared by dispersion of 5g starch in 100 ml distilled water with continuous stirring at magnetic stirrer for 15min. Glycerol at rate of 3g/100g starch was added as plasticizer and mixed thoroughly. The solution was magnetically stirred for 15min at 85°C. The resulting solution was cooled at room temperature to avoid air bubbles during pouring. Casting technique was used to prepare films. The prepared solution was poured onto the polypropylene round trays of diameter 12.5cm and dried at 40°C for 16hr in hot air oven with circulating air in chamber.

2.6 Analysis of Films

2.6.1 Thickness

The thickness of starch films was determined using Digital micrometer with an accuracy of ±0.001mm. The average value of 10 thickness measurement at different locations on each film was used in all calculations.

2.6.2 Moisture Content

Moisture content of starch films was determined by drying the pre-weighed pieces of films at 110°C for 6 to

8hr or till the weight comes constant. Moisture content was measured as loss in weight of film sample during heating.

2.6.3 Water Solubility

Water solubility of starch films was determined by following the method of Gontard et al. (1994). Pre-weight piece of starch film was immersed in water at room temperature for 24hr. The immersed film piece was removed from water and dried in oven at 110°C for 4 to 5 hr, cooled and weighed. The water solubility of starch film was measured as the difference in weight of dried piece of film before and after immersion in water.

2.6.4 Color Parameters

Color of native and modified starch films was measured using CR-300 Chroma meter (Minolta, Japan). The system determines the L*, a* and b* values, where L* represents lightness and darkness; a* represents the opposition between green and red color ranging from positive (red) to negative (green) values; and b* is the yellow/blue opposition ranging from positive (yellow) to negative (blue) values. The average value of three measurements were calculated and used.

2.6.5 Water vapour permeability

Water vapour permeability of starch films was determined by following the E96-95 ASTM standard method (ASTM, 1995). Each film sample was sealed over the circular opening of a permeation cell containing anhydrous CaCl₂ (0% RH) and weighed. These cells were placed on desiccators with a saturated NaCl solution (75% RH) at 25°C. The weight of each permeation cell was recorded after 24hr and water vapour permeability of films was calculated using following formula-

$$WVP = \frac{\Delta W \times X}{t \times A \times \Delta P}$$

Where WAP is the water vapour permeability (g.mm/m².day.kPa); ΔW is the weight gain by desiccant (g); X is the film thickness (mm); t is the incubation period (days); A is the area of the exposed film surface (m²); and ΔP is the difference of partial pressure (kPa).

2.6.6 Tensile Strength

Tensile strength of films was determined by a tensile test based on ASTM D-882-91 method (ASTM, 1996) using texture analyser (TA-XT 2i Stable Micro Systems, UK). The films were cut in strips (20mm × 50mm) and thickness of strips was measured at eight points. The strip was gripped from both the edges of width on 'tensile grip' probe and initial grip separation was set at 30mm. The force and distance were recorded during extension of strips at 0.8mm/s up to break. The tensile strength of films was calculated using following formula-

$$TS = \frac{F}{A}$$

Where TS is the tensile strength (MPa); F is the maximum force (N); A is the area of film cross-section (thickness × width; m²).

2.7 Statistical Analysis

Analytical determinations were done in triplicate, and Duncan test was conducted to examine significant differences among experimental mean values. The statistical significance was observed at p < 0.05. Data were analyzed using Statistical Analysis System SAS, version 8.2 and SPSS software version 16.0 (SPSS Inc).

III. RESULTS AND DISCUSSION

Oxidized starch showed 0.099% carboxyl content which was higher than that of 0.052% reported by Fonseca et al. (2015) in potato starch. Oxidation of starch depends on various factors such as reaction conditions (time, pH, and temperature), concentration of active chlorine and starch properties.

3.1 Thickness, Tensile Strength, Solubility and Water Vapour Permeability of Films

The film produced from the native and modified starches of amaranth were continuous and easily peelable. All film samples were visually transparent. The results of moisture content, thickness, water solubility, water vapour permeability and tensile strength of films are presented in Table 1. The moisture content of films ranged from 13.21 to 15.60% with the maximum value of oxidized starch film samples. comparatively higher range of moisture content (16 to 20.50%) was recorded by Chandla et al. (2017) for starch films of amaranth of different cultivars. Various factors including the drying temperature, relative humidity of drying chamber, starch characteristics and thickness of films affect the moisture of starch films. Higher values of moisture content of modified amaranth starch films were noticed as compared to native amaranth starch films. Increment in moisture content of heat-moisture treated starch films might be due to the increased hydrophilicity of treated starch (lower retrogradation in waxy starch) and more thickness of modified starch films than native starch film. The thickness of film is an important parameter as it influences the film properties like transparency and water vapour permeation rate. Consistency in film thickness is prerequisite for good and consistent mechanical strength attainment. Thickness of films made from native and modified starches of amaranth varied from 0.157 to 0.161mm. These thickness values were comparable with the findings of Zavareze et al. (2012) reported that the thickness of films prepared from oxidized and hydrothermally modified potato starches ranged from 0.10 to 0.16mm. Higher values of thickness were noticed by Chandla et al. (2017) for the films of amaranth starches from different cultivars. Water solubility of

edible film is the key factor in determining its applicability. High water solubility of film results in partial or complete dissolution of film rapidly while low water solubility slows the degradation of film. Heat moisture treated and oxidised starch films were intact after immersion in water for 24hr, while native amaranth starch film samples were partially dissolved. The water solubility of amaranth starch films ranged from 32.89 to 48.11% and significantly lower solubility of films was noticed in case of modified starches as compared with native starch of amaranth. Chandla et al. (2017) reported lower values of water solubility (33.64 to 37.56%) of films made from starches of amaranth from different cultivars as compared to solubility of native starch film of amaranth. Zavareze et al. (2012) observed decreased solubility of starch film made up of oxidised and hydrothermally modified starches of potato relative to solubility of native potato starch films. Fonseca et al. (2015) developed potato starch film and noticed lower water solubility of film prepared from starches oxidised with different levels of sodium hypochlorite as compared with films made from native starch of potato using similar concentration of starch. The reduced water solubility of the hydrothermally modified and oxidised amaranth starch films might be attributed to the increased interactions between amylose-amylose, amylose-amylopectin chains and strengthened intermolecular bonds promoted during modification treatments.

The tensile strength indicates the force applied at the break point of film. Considerably increased values of tensile strength were noticed for films of oxidized and heat-moisture treated amaranth starches as compared to films of native starch. The value of tensile strength of films made from native starch was 0.734MPa indicating

lower strength of films as compared with findings of Chandla et al. (2017) reported tensile strength ranged from 2.30 to 2.61MPa for films of amaranth starches of different cultivars. The discrepancy in mechanical strength of films prepared from amaranth starch in present study and previous reports might be due to the differences in concentration of starch used for film formation, thickness, film formation conditions like heating temperature and drying rate. Oxidised starch showed tensile strength value of 1.42MPa which was higher than that of native starch film samples. Hydrothermally modified starch showed the highest value (2.51MPa) of tensile strength of film among tested samples. It has been reported by Zavareze et al. (2012) that oxidation and heat moisture treatment of potato starch increased the tensile strength of the films from 3.53 to 5.25MPa and 3.53 to 6.07MPa, respectively. Increment in tensile strength of film following oxidation of potato starch with 1.0% active chlorine while decrement in the value of tensile strength of films was noticed for potato starches oxidised with 0.5 and 1.5% active chlorine (Fonseca et al., 2015). The mechanical properties of the starch films depend on various factors such as polymeric chain arrangement, molecular chain interactions, film thickness, quantity and type of the plasticizer, and relative humidity of the environment. Additional interaction among amylose and amylopectin molecules resulted from heat-moisture treatments could be the reason for increment of tensile strength of films. Zhang et al. (2009) suggested that carbonyl and carboxyl groups present in oxidised starch can form hydrogen bonds with amylose and amylopectin chains, and these bonds offer larger structural integrity in the polymer matrix, thus causing increased tensile strength of film.

Table.1: Moisture content, thickness, solubility, water vapour permeability and tensile strength of films of native and modified starches of amaranth

Treatments	Moisture content (%)	Thickness (mm)	Solubility (%)	WVPR (g.mm/m ² .day.kPa)	Tensile strength (MPa)
NS	13.21±0.10 ^a	0.158±0.00 ^a	48.11 ±0.34 ^a	6.88±0.03 ^a	0.734±0.00 ^a
Oxi-S	14.77±0.32 ^b	0.157±0.00 ^a	38.38±0.06 ^b	5.72±0.01 ^b	1.42±0.00 ^b
HMT (at 85°C)	15.60±0.17 ^c	0.161±0.00 ^b	32.89±0.56 ^c	7.20±0.03 ^c	2.51±0.00 ^c

All values are mean of triplicate determinations ± standard deviation mean. Values within same column with different letters are significantly different ($p \leq 0.05$). NS: native starch; HMTS: heat moisture treated starch; Oxi-S: oxidized starch; mm: millimetres; kPa: kilopascal; MPa: megapascal

Water vapour permeability evaluates of easiness with which moisture can permeate through the film. The water vapour permeability of film is required low to provide a barrier for the transfer of moisture between the food and

the surrounding atmosphere. Native and modified starches showed significantly different values of water vapour permeability of films. Heat-moistur treated starch showed higher water vapour permeability of film while oxidised starch showed lower values with respect to native starch of amaranth. Similar trend of increased water vapour permeability of hydrothermally modified starches and decreased values for oxidized starches was reported by Zavareze et al. (2012) for the potato starch films. Higher barrier property for moisture were recorded by Fonseca et

al. (2015) for oxidised potato starch films than that of native starch films, and increasing level of oxidation resulted in raising water barrier capacity of film during oxidation. On further oxidation, these carbonyl groups were transformed to carboxyl groups (hydrophilic) and hydrophilicity of oxidized starch increased significantly. Therefore, lower water vapour permeability of oxidized starch films in the present investigation could be attributed to the higher carbonyl groups (hydrophobic) in oxidized starch than native starch. In heat-moisture treatment, retrogradation in starch gel takes place due to interaction in amorphous region at initial stage followed by interaction in crystalline domains. As amaranth starch is waxy type, heat moisture treatment increased stiffness in the starch granules and caused lesser retrogradation (due to absence of amylose) resulted in loose packing of gelatinised granules offering space for mobility of water molecules, consequently more hydrophilic films formed with more water vapour permeability and stiffness. Thickness of film is an another important factor affecting

water vapour permeability and higher thickness of films in case of heat moisture treated starches might be the reason for more water vapour permeability than native starch film. Linearly increasing water vapour permeability with increasing thickness and hydrophilicity of starch films was recorded for different starches in literature (Cuq et al., 1996; Mali et al., 2004; Zavareze et al., 2012).

3.2 Color Parameters of Films

Color of the film is key factor influencing the appearance of product on which it is applied. Table 2 depicts the color parameters of films native and modified starch films of amaranth. Modification treatments of amaranth starch changed color of starch, consequently altered color (L^* , a^* and b^* parameter) of produced starch films. No significant difference was noticed in lightness of native and modified starch films indicated by statistically similar L^* values. Slight greenish shade was noticed in all film indicated by negative values of a^* ranging from -0.25 to -0.40 with the highest value exhibited by oxidised starch film.

Table.2: Color properties of films of native and modified starches of amaranth

Treatments	L^*	a^*	b^*
NS	83.48±0.02 ^a	-0.25±0.01 ^a	3.26±0.04 ^a
Oxi-S	83.55±0.23 ^a	-0.40±0.02 ^c	2.80±0.03 ^c
HMT (at 85°C)	83.61±0.28 ^a	-0.26±0.01 ^a	3.32±0.02 ^a

All values are mean of triplicate determinations ± standard deviation mean. Values within same column with different letters are significantly different ($p \leq 0.05$). NS: native starch; HMTS: heat moisture treated starch; Oxi-S: oxidized starch; L^* : black to white; a^* : green to red; b^* : blue to yellow

Yellowness in starch films represented by positive b^* values ranged from 2.8 to 3.32 with the highest value observed for hydrothermally modified starch films, however, it was not statistically dissimilar to the value of native starch film. Change in color of heat moisture treated starch films could be attributed to the occurrence of Millard reaction during modification treatment of starch. Improved lightness of oxidised starch films might be attributed to the increased whiteness of starch by bleaching action of chlorine during oxidation. Fonseca et al. (2015) reported comparatively higher L^* values ranging from 87.6 to 89.7 for starch films prepared from native and oxidised starches of potato.

IV. CONCLUSION

Amaranth starch was found interesting material for film formation. Native and modified starches of amaranth produced biodegradable films with different characteristics. Both the modification treatments resulted in increased tensile strength of films. Water vapour

permeability of films increased in heat moisture treated while decreased in oxidised starch film samples. Overall, amaranth starch films were transparent, continuous and had good tensile strength.

REFERENCES

- [1] ASTM E 96-95. (1995). Standard test method for water vapour transmission of materials in sheet form Annual book of astm standards. Philadelphia, PA: Amer. Soc. for Testing and Materials.
- [2] ASTM E 96-95. (1996). Standard test method for tensile properties of thin plastic sheeting of materials. Annual book of astm standards. Philadelphia, PA: Amer. Soc. for Testing and Materials.
- [3] Biduski, B., Silva, D. F. T., Silva, D. W. M., Halal, E. I. S. L. M., Pinto, V. Z., Dias, A. R. G., and Zavareze, D. R. E. (2017). Impact of acid and oxidative modifications, single or dual, of sorghum starch on biodegradable films. Food chemistry, 214, 53-60.
- [4] Chandla, N. K., Saxena, D. C., and Singh, S. (2017). Amaranth (*amaranthus* spp.) starch isolation, characterization, and utilization in development of clear edible films. Journal of Food Processing and Preservation. 41(6), e13217.

- [5] Choi, C. R., Choi, H. J., Kim, S. R., Lee, J. H., and Shin, M. S. (2000). Comparisons of characteristics of amaranth starches isolated from five cultivars grown in Korea. *Korean Journal of Food Science and Technology*, 32(2), 252-257.
- [6] Dang, K. M., and Yoksan, R. (2015). Development of thermoplastic starch blown film by incorporating plasticized chitosan. *Carbohydrate polymers*, 115, 575-581.
- [7] Cuq, B., Gontard, N., Cuq, J. L., and Guilbert, S. (1996). Functional properties of myofibrillar protein-based biopackaging as affected by film thickness. *Journal of food science*, 61(3), 580-584.
- [8] Fonseca, L. M., Gonçalves, J. R., Halal, E. I. S. L. M., Pinto, V. Z., Dias, A. R. G., Jacques, A. C., and Zavareze, D. R. E. (2015). Oxidation of potato starch with different sodium hypochlorite concentrations and its effect on biodegradable films. *LWT-Food Science and Technology*, 60(2), 714-720.
- [9] Forsell, P., Hamunen, A., Autio, K., Suortti, P., and Poutanen, K. (1995). Hypochlorite oxidation of barley and potato starch. *Starch-Stärke*, 47(10), 371-377.
- [10] Franco, C. M., Ciacco, C. F., and Tavares, D. Q. (1995). Effect of the heat-moisture treatment on the enzymatic susceptibility of corn starch granules. *Starch-Stärke*, 47(6), 223-228.
- [11] Gontard, N., Duchez, C., Cuq, J. L., and Guilbert, S. (1994). Edible composite films of wheat gluten and lipids: Water vapour permeability and other physical properties. *International journal of food science and technology*, 29(1), 39-50.
- [12] Mali, S., Grossmann, M. V. E., García, M. A., Martino, M. N., and Zaritzky, N. E. (2004). Barrier, mechanical and optical properties of plasticized yam starch films. *Carbohydrate Polymers*, 56(2), 129-135.
- [13] Parovuori, P., Hamunen, A., Forsell, P., Autio, K., and Poutanen, K. (1995). Oxidation of potato starch by hydrogen peroxide. *Starch-Stärke*, 47(1), 19-23.
- [14] Reis, L. C. B., Souza, D. C. O., da Silva, J. B. A., Martins, A. C., Nunes, I. L., and Druzian, J. I. (2015). Active biocomposites of cassava starch: The effect of yerba mate extract and mango pulp as antioxidant additives on the properties and the stability of a packaged product. *Food and Bioproducts Processing*, 94, 382-391.
- [15] Sabetzadeh, M., Bagheri, R., and Masoomi, M. (2015). Study on ternary low density polyethylene/linear low density polyethylene/thermoplastic starch blend films. *Carbohydrate polymers*, 119, 126-133.
- [16] Shah, U., Naqash, F., Gani, A., and Masoodi, F. (2016). Art and science behind modified starch edible films and coatings: A review. *Comprehensive Reviews in Food Science and Food Safety*, 15(3), 568-580.
- [17] Smith, R. J. (1967). Characterization and analysis of starches. *Starch: chemistry and technology*. In: Whistler, R.L.; Paschall, E. F. (Eds.), 2, New York: Academic Press. 569-635.
- [18] Sindhu, R. and Khatkar, B. S. (2016,a). Thermal, microstructural and pasting properties of starch and flour of grain amaranthus. *Annals of Biology*, 32(2), 269-273.
- [19] Xie, F., Pollet, E., Halley, P. J., and Avérous, L. (2013). Starch-based nano-biocomposites. *Progress in Polymer Science*, 38(10), 1590-1628.
- [20] Zavareze, D. R. E., Pinto, V. Z., Klein, B., Halal, E. I. S. L. M., Elias, M. C., Prentice-Hernández, C., and Dias, A. R. G. (2012). Development of oxidised and heat-moisture treated potato starch film. *Food chemistry*, 132(1), 344-350.
- [21] Zhang, S. D., Zhang, Y. R., Wang, X. L., and Wang, Y. Z. (2009). High carbonyl content oxidized starch prepared by hydrogen peroxide and its thermoplastic application. *Starch-Stärke*, 61(11), 646-655.

Green Purchases and Sustainability in Amazon's Coffee Management

Saiane Barros de Souza¹, Flávio de São Pedro Filho², Cleice de Pontes Bernardo³,
Rwrsilany Silva⁴, José Moreira da Silva Neto⁵

¹Master student in the Program Business Administration Graduate Studies in the Federal University of Rondônia, Brazil. Teacher at Instituto Federal de Educação de Rondônia (IFRO), Campus Cacoal, Brasil. Member of the research group in Management and Technological Innovation, Brazil.

Email: saiane.souza@ifro.edu.br

²Post-Doctor in Management and Economic by University of Beira Interior, Covilhã, Portugal. PhD in Administration from the University of São Paulo, Brazil; PhD in Business Management from the Universidad Autónoma de Asunción, Paraguay. Coordinator of the Research Group on Management of Innovation and Technology, desveloping research in innovation and sustainability in the Amazon. Professor Socio-Environmental Management in the Program Master's in Administration at the Federal University of Rondônia, Brazil.

Email: flavio1954@gmail.com

³Master student in the Program Business Administration Graduate Studies in the Federal University of Rondônia, Brazil. MBA in Project Management and Human Resources. Graduation in Law. Civil Servant at Tribunal de Contas do Estado de Rondônia (TCE-RO), Brazil.

E-mail: cleicepontes@gmail.com

⁴Master student in the Program Business Administration Graduate Studies in the Federal University of Rondônia, Brazil. Specialization in Methodology of Higher Education. Graduation in Accounting. Teacher at the Instituto Federal de Educação de Rondônia (IFRO), Campus Zone North in Porto Velho city, Brazil. Member of the Group of Studies and Research in Innovation and Sustainability of the Amazon - GEPISA.

E-mail: rwrsilany@hotmail.com

⁵PhD in Production Engineering from the Federal University of Santa Catarina (2004). Teacher in the Graduate Program (Master's) in Administration at Federal University of Rondônia, Brazil.

E-mail: msilva@unir.br

Abstract— This study was conceived in the cradle of the Brazilian Amazon region, on managerial and cognitive knowledge of the perspectives of sustainable management in coffee cultivation. The objective is to study the green purchasing process and sustainability in coffee management; (1), to map the factors that interfere in the green purchasing processes and sustainability in the researched scenario (2), propose the innovation required with participative management in the face of sustainability with green purchasing (3). With a base on Contingency theories of adaptive nature and emerging demands, Ecodevelopment interprets and performs compatible actions for sustainable local development, the U Theory confronts the problems and transforms them with innovative solutions. The Method of Study adopted is the Case study, of a qualitative nature, such as bibliographic survey procedures, data collection by semi-structured interviews with social actors of the coffee system, data analysis through triangulation and criticism with the theoretical framework and construction of the innovation sustainable development proposal. The result shows the lack of knowledge about green purchasing and the

sustainability aspect of the practices used in the Global Coffee Platform. The quality work of the coffee farmers was evidenced in an individual form, but in order to meet the quantitative demands of the market, it is required the structural and leadership development for the construction of APL or agricultural cooperative. The mental design configured at the base of the productive chain needs to break paradigms that interfere in the sustainable posture, to understand the needs of the consumers and to emphasize their participation on the responsibility with the Amazon and the beneficiary society as a whole. We presented suggestions of innovation discussed from the gaps detected by the mapping of factors.

Keywords— Coffee. Sustainability. Management. Amazon.

I. INTRODUCTION

Since the Industrial Revolution, competition has been the sustaining point of capitalism. Its mark is accelerated consumerism and with it the devastation of the natural resources that maintains this merely economic cycle. In contemporary society, the concepts of sustainability and

local management emerge, redirecting the role of managers and their responsibilities, in order to try to achieve convergence in this scenario. The Green Purchase can be considered a measure of the new dimensional look of the practices that converge the competitive advantage with the innovative character of the commitments between the environmentally responsible organizations and the productive chain in which it is a part.

In the context of the Brazilian Western Amazon, there is the sensitive biome under the planetary expectation. There, the wealth revealed by the unusual biodiversity, glimpses interests and also threats. Therefore, it is opportune to deepen the knowledge of the environment surrounding this relationship, which imposes, strictly speaking, preservation and conservation as factors aligned with integrated and sustainable local development. It motivates the emergence of studies such as this that focuses on the traditional work of coffee producers in the Amazon.

II. OBJECTIVES

This is the design to answer the following: How are green purchases and sustainability in the scenario investigated? To answer this question this research is presented with the general objective of studying the process of green procurement and sustainability in coffee management; and as specific objectives to characterize the local coffee production arrangement in the Brazilian Western Amazon (1), map the factors that interfere in the green purchasing processes and sustainability in the researched scenario (2), propose the required innovation and participative management in the face of sustainability with the green purchases (3). This work is made up of topics and sub-topics, bringing a theoretical-conceptual review, the methodological tracing of the preparation, the results treated in accordance with the proposed objectives, the conclusion and the references.

III. THEORETICAL AND CONCEPTUAL REVISION

The basis of this study is the Contingency Theory, with the contribution of the Theory of Ecodevelopment and the U Theory, in order to lead the interpretation of the socio-technical scenario investigated. Bibliographical survey in Barbosa (2017) refers to the Contingency Theory, about its approach, which focuses on contingency situations; this implies that, in administrative management, nothing is done with an exclusive method, but it is related to the structures dependent on the context; In this way, a manager's position is required to interpret the set of operant facts in the organizational structure, such as the control over the economic, technological and environmental systems to be considered in a research like this. It implies a cognitive interrelation with the environment and the

activities of the environment; it's done in a flexible way, focused on intervening or necessary adaptations, in which the factors are confluent to the internal or external environment of the structure, where the actions are operated, which is a great way to avoid the loss of performance.

Oliveira and Monteiro (2015) argue that the Theory of Ecodevelopment studies the potentialities and the growth of a certain geographic region. Their approach involves interpretations of the social needs of a population. It preaches a study of the inextricable economic aspects of quality of life, through conservatism with environmental responsibility. These authors unite the essential strand for sustainable development since it brings together an ethical, knowledge-based as well as an economic, social, environmental and institutional development, all indissociable from the political and cultural aspects of the beneficiaries of the actions. These are attitudinal orientations that converge to continuous solutions of an integrated participatory nature, fully satisfactory to the progress of a particular locality or region, and therefore sustainable.

A reading in Tinti (2014) indicates that the U Theory is the conglomerate of theories, tools and auxiliary practices in support of entrepreneurial leaders, organizations and communities. It is usual in the confrontation of contemporary problems, bringing together abstract ideas essential for the outcome of innovative and conscious actions, through learning and changes in society. This theory could be a fundamental tool for the organization aid involved in behavioural and structural changes, with effects in the management of innovation, allowing a differentiated work in the competitive path.

3.1 Concepts on Green Purchasing and the Global Coffee Platform

The theme of this study focuses on sustainability. It is important to bring to this subtopic the theoretical and conceptual elements on Green Purchases and the Global Coffee Platform. This provision allows us to deal with the premises in their similarities and in the differences, through the crossing of the peculiar information and intervening factors that, in some way lead to a sustainable relationship. This survey allows the construction of an empirical concept of Green Purchases. A study in Monzoni Neto et al. (2012) indicates that green procurement refers to a concept generated at the World Summit on Sustainable Development in Johannesburg and reflects the promotion of acquisition policies that favour the development and diffusion of environmentally friendly goods and services, factors that positively influence sustainability.

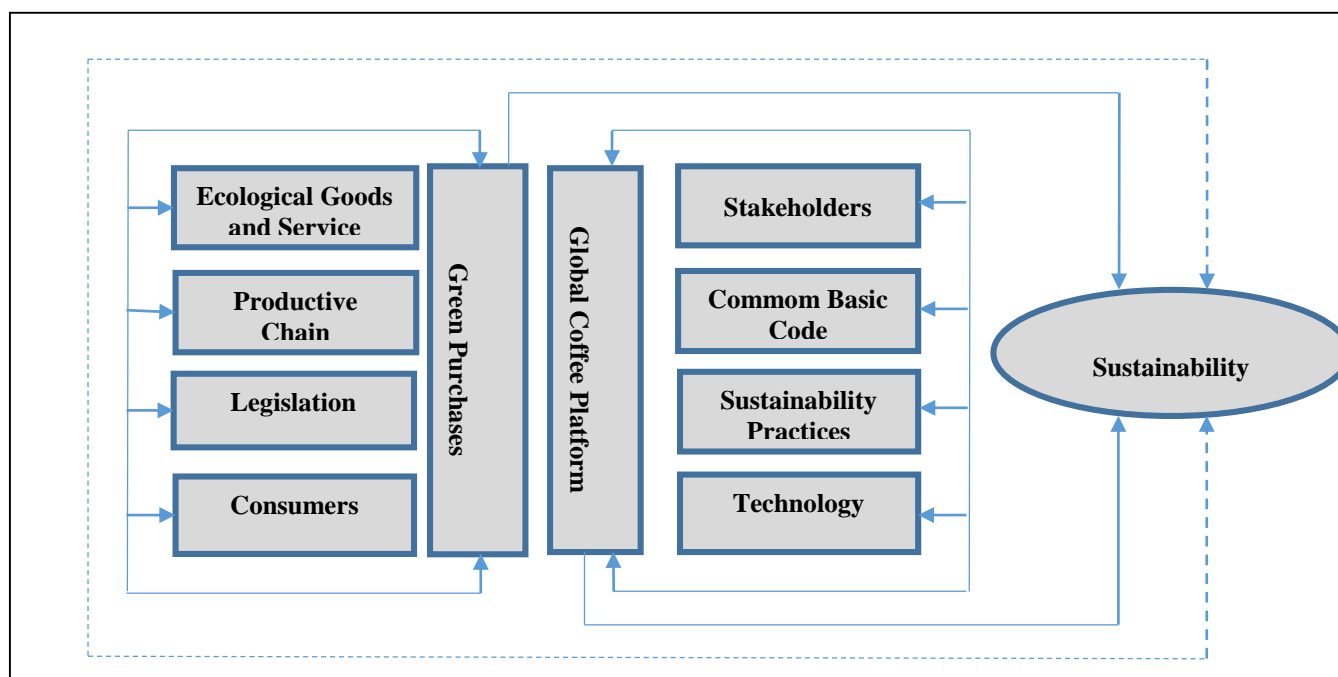
A survey in Silva, Bohnke, & Silva (2016), provides us with a definition about the practice of green shopping when

prescribing its modelling; for this author, such performance represents a global significance, as regards the aspect of sustainable guarantee of the products acquired by the consumer. It is characterized by how cycles of purchases of goods and services; analyzes the production chain in its phases. The author points out the challenges of modifying an organizational structure in which situations involving this level of complexity, since, as consumers improve their critical sense, institutions will never abandon the commitment proposed in the scenario where they are installed.

The Global Coffee Platform (2016) is an international association that involves multiple stakeholders, all of

whom are engaged in the development of the Common Basic Code. This code is a representative language on practices, which establishes the activities of prohibitions, priorities and with recommended compatibility for the strengthening of sustainable interests in a coffee production chain. It is an innovative approach since it comes to stablish sustainable practices in the routine of coffee growers, in a configuration that meets the emerging demands. Figure 1 and Table 1 show the fundamental elements related to green purchasing and their inference with the Platform under study.

Fig.1: Operational diagram of Sustainability in Green Purchases and in the Global Coffee Platform.



Source: Prepared by the authors.

Table.1: Specification of the Green Purchasing Diagram in the face of the Global Coffee Platform.

Elements	Conceptual specification
Green Purchases	It is the contracting of suppliers of goods and services that act in favor of sustainability.
Ecological Goods and Service	It's the product of organisations' work.
Productive Chain	It is the set of consecutive steps on transforming things into goods or services.
Legislation	The laws that regulate the country over certain content.
Consumers	The people who buy goods and services.
Global Coffee Platform	It's an international association responsible to evaluate sustainable coffee practices.
Stakeholders	The strategic public that has interests in the production of coffee.
Common Basic Code	The universal language accessible to coffee growers.
Sustainability Practices	Actions aimed at coffee sustainability.
Technology	It is the systematic operating mechanism that facilitates life in the field.
Sustainability	It is the key point of the connection between Green Purchasing and the Global Coffee Platform, which infer on human actions to prospect the environment.

Source: Prepared by the authors.

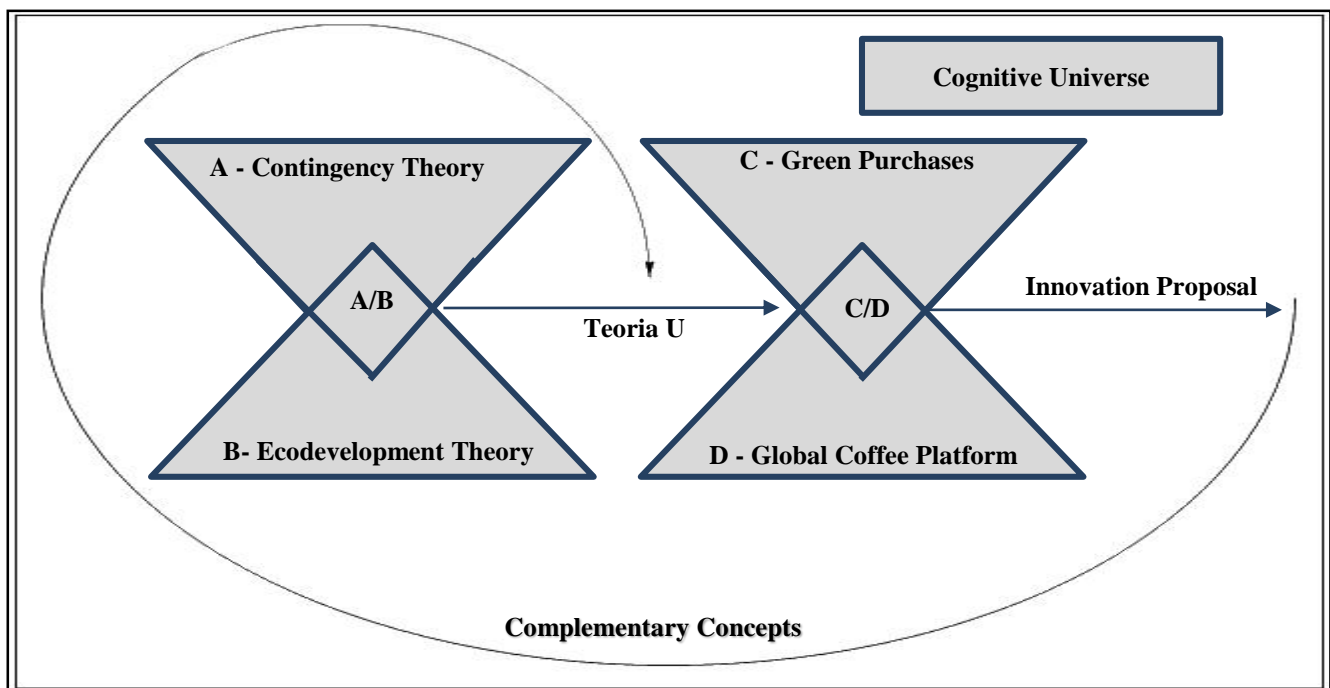
3.2 Concept of participatory management and sustainability

Participatory management refers to effective ways of governing, represented by superior gains in the structural and emerging context. Silveira (2010) conceptualizes participatory management as the contemporary paradigm required in the face of the future challenges. This management has as a guide the circumstances of the socio-environmental dynamics allied to the human factor; but adds the dynamism of the market to economic, social, environmental and institutional variables. Thus, stakeholders have a globalized vision and knowledge of the activities of this type of management and, in general, feel

as an integral part of the strategic process of the organizations that practice such management, as long as it is led by a leadership free of authoritarianism.

Cenci, Zanini, Callegaro, Pinto and Hertzberg (2016) portrays sustainability as a highly representative subject, but not yet familiar with its true depth of knowledge, necessary for the prosperity of people and society, because it is directly linked to development, requiring an awareness of changes in behavior, in the way man interacts with the world, to achieve improvement in quality of life and local development. Figure 2 shows the interconnection of the elements treated herein, and Table 2 shows the descriptive elements.

Fig.1: Diagram of the conceptual theoretical body applied in this research.



Source: Prepared by the authors.

Table.2: Descriptive elements on the arrangement of the theoretical foundation of Figure 1.

Elements	Description
Cognitive Universe	Mental process that influence the behavior of the individual.
A - Contingency Theory	Ability of interpretation, relationship and adaptation in the structures of their context.
B -Ecodevelopment Theory	It seeks to recognize the regional potentialities and problems, to apply continuous solutions.
A/B	Union of elements of emergency interpretation for the development of local solutions.
U Theory	Cognitive mechanisms conducive to innovation management.
C - Green Purchases	It involves the purchase of goods and services on the supply chain and production, from the beginning to final disposal.
D – Global Coffee Platform	Common Basic Code of good practices in the coffee sector, to strengthen sustainability in the production cycle.
C/D	Intersection of the study base evaluating the sustainable factors guiding the system.

Innovation Proposal	Discovering gaps in sustainability processes characterized by green procurement and the global coffee platform.
Complementary Concepts	Auxiliary knowledge on the mapping of the factors that infer in the green purchasing processes in the researched scenario.

Source: Prepared by the authors.

3.3 Concepts about local productive arrangement (LPA) and coffee consumer market in the Western Amazon

The Local Productive Arrangement (LPA) has been taking proportions, based on interventionist measures of public policies, that operate with development programs directed to sectoral economics. Regarding this contextualization, Anes, Deponti and Arend (2016) conceptualizes that LAP is conceived from the integration of small and medium companies that work in the same field of activity and have physical proximity. These elements become facilitators when the similarities of social, cultural, logistic, governmental and cooperation experiences are studied, based on organizational guidelines, which have repercussions on the situational strategic planning.

Considering these pieces of information, the LAP of agribusiness structure survives on selling to the consumer market, which according to Tejon (2017), this stage reaches the fourth link of agribusiness, Beyond the farm doors, it emphasizes that the future of agribusiness will be chained by the vision of the broader context of people's consumer relations, which comes from sensory analysis and certification, social responsibility standards throughout the production process and valorization of origination, all of this is embedded in a society that seeks to enjoy natural products that are accessible to all social classes, this means changing habits and behaviors in order to obtain health, food security and nutrition, admitting that this is considered a privilege of the few today, due to the high cost of daily consumption.

IV. METHODOLOGY

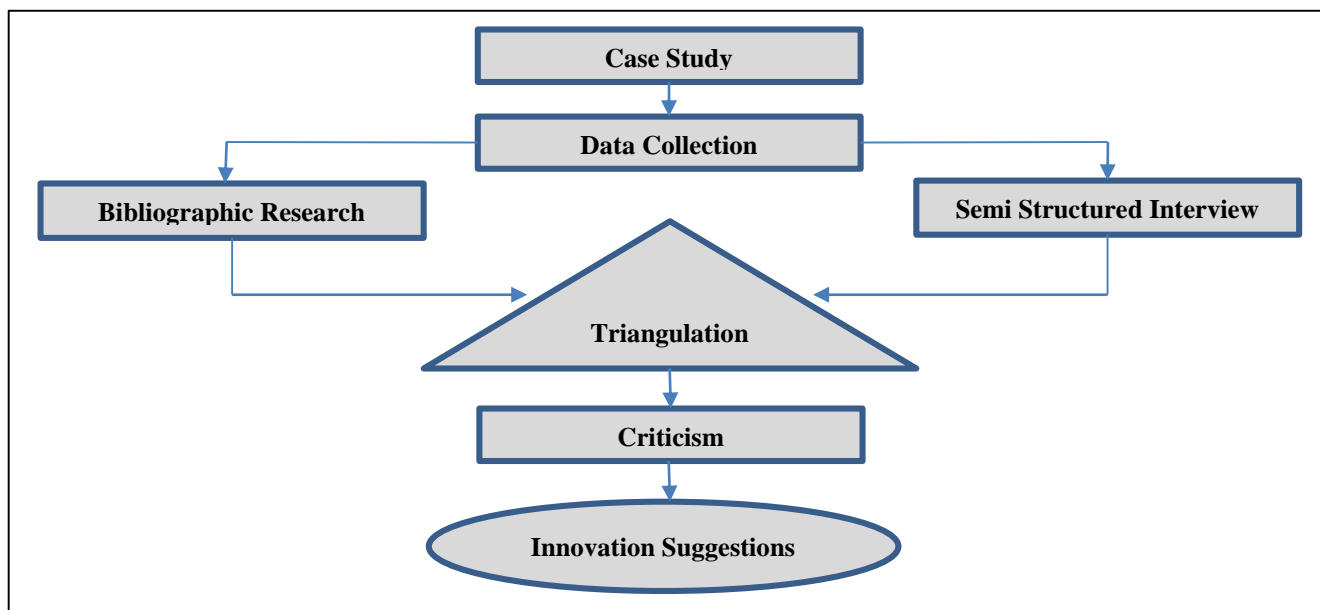
The method adopted in preparation for this task is the Case Study, qualitative nature, according to André (2013)

contributes to the research with the provenance of multiple methods, rationalized in their dynamics to understand and deepen the facts that are not controllable, in order to guarantee that the approach is appropriate to the nature of the question and the research objectives. Thus, we sought to select the main stakeholders of the coffee production sector, having different forms of performance in this cycle; and to know the explanations of the common phenomenon found in each case.

As procedures are elements of support to the practice of the research, as addressed by Siena (2011), the procedure is related to the techniques of data collection, processing and analysis. It serves as a database to guide the results of the research, the retrieval procedure, the use of a bibliographic survey, as well as an application of semi-structured interviews with stakeholders, codification and critical examination of information.

Data processing involves the confrontation of the reports collected from the respondents, verifying the lines of convergence and divergence of investigation, taking into account the criteria of validity; This is a program that aims to put in evidence aspects that get in the way of green purchasing, sustainability, consumer market, Amazon and participatory management, based on the theoretical framework. This practice is effective in identifying gaps in the productive arrangement, making possible the construction of innovative proposals in this segment. Figure 3 shows the methodological functional diagram, included in the case study method, as well as stages of data collection, interpretation and treatment, analysis and proposal of innovation. And Table 3 below contains the diagrams and their respective description.

Fig.2: Methodological diagram now applied



Source: Prepared by the authors.

Table.2: Specification of the Methodological Diagram considered in this research.

Elements	Description
Case Study	Social Sciences based method of approach involving multiple procedures.
Data Collection	Search for information correlated to the theme.
Bibliographic Research	Procedure to gather concepts addressed by authors that will serve as a basis for research.
Semi Structured Interview	Semi Structured questions with involved key research actors for fact narration.
Triangulation	Confrontation of the responses of social actors based on the theoretical conceptual framework.
Criticism	Detailed evaluation of the intervening elements of the research.
Innovation Suggestions	Check the gaps detected in the system and propose innovation to solve problems.

Source: Prepared by the authors.

V. STUDY OF THE PROCESS OF GREEN PURCHASES AND SUSTAINABILITY IN COFFEE MANAGEMENT

The study of the green purchasing process in this research involves as the central element the Amazonia coffee, considered as the black gold of the region; which lead to the recognition of social actors about the significance of this product for local and regional progress and development. This concept surpasses the Amazonian geographical environment and reaches an international dimension when the concept of Amazon Coffee arises, which reveals the competitive differential and the triumph reached by immigrants from the Brazilian states of Paraná, Minas Gerais and Espírito Santo; they brought this culture and turned it into an alternative solution that is now part of the reality and living conditions of the families involved in this monoculture.

Investigations like take into consideration the regional peculiarities and the interest of the society in context. Among these complexities, the characterization of the productive arrangement that supports the coffee platform under study, the mapping of factors that somehow interfere with this activity and other issues that make it possible to innovate the scenario with sustainability.

5.1 Characterization of the Productive Arrangement of the local coffee

The research was developed in the Western Amazon, in the State of Rondônia, according to Empresa Brasileira de Pesquisa Agropecuária [Embrapa] (2015), the State is responsible for the production of approximately 90% of the coffee in the Amazon. The scientific name of coffee is *Coffea Canephora*, and Arabic variations, Conilon and Robust. Ranked as the fifth largest coffee producer in Brazil, first in the Robusta variety, second in the Conilon

variety, and in the International Coffee Week of 2017, it received the National Quality Award in the second and third places. The area of spatial concentration of coffee production is located in the central and northern regions, which include the Municipalities of Cacoal, Alta Floresta d' Oeste, São Miguel do Guaporé, Machadinho d' Oeste, Ministro Andreazza and Nova Brasilândia D' Oeste.

A survey by Embrapa (2015) points to challenges that reflect the characteristics and geographical conditions of the Amazon; high rainfall rates that cause water stress, and consequently affects pest formation and other diseases, which affect coffee production. According to Embrapa (2017), the incipient revolution in coffee production in Rondônia is a direct reflection of two changes in global coffee consumption: the increase in global demand for robust coffee and the valorization of products with higher quality and differentiation at the end of the chain.

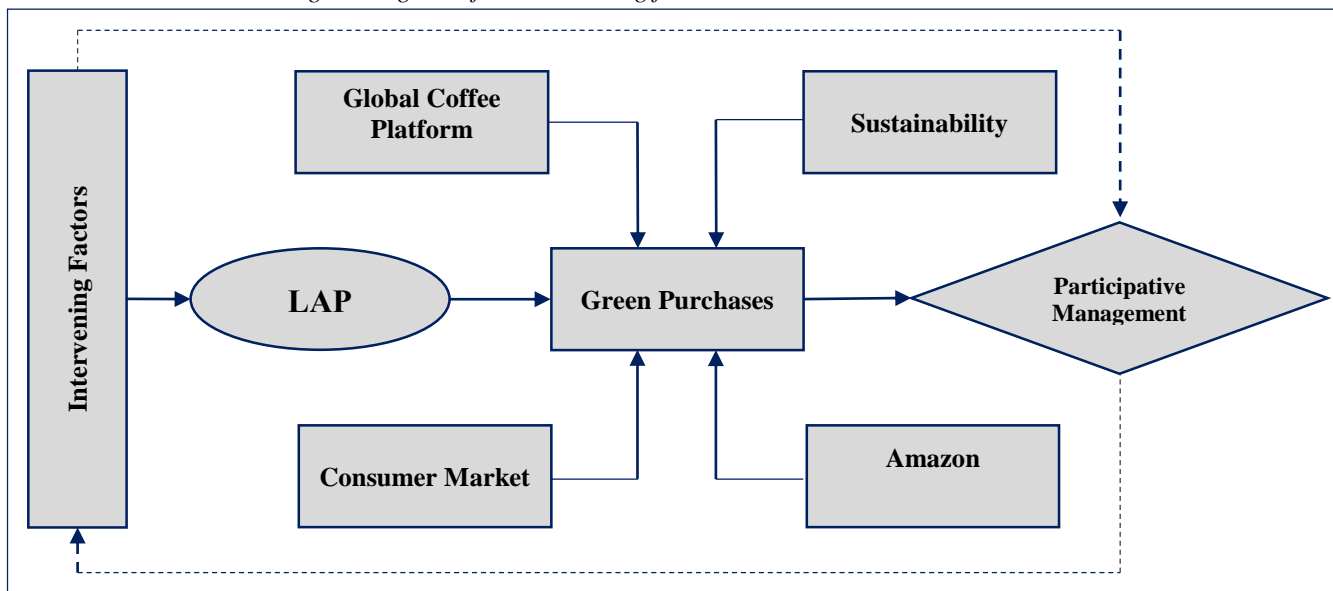
The site investigated is located in the Municipality of Cacoal, in the State of Rondônia, in the Brazilian Western Amazon. According to Instituto Brasileiro de Geografia e Estatística [IBGE] (2017), the municipality has an estimated population of 88,507 inhabitants, in a territorial unit of 3,792,948 km². A survey by Embrapa (2015) says that the area that harbours the coffee harvest in 2014 was one of 11,356 hectares. As a result of the acceptance of the soil to grow crops, the immigrants brought seeds of coffee, and there they established themselves transforming the city

into the Coffee Capital. Embrapa's ongoing productive characterization research (2015) predominates the traditional model, with a low technological standard, where pruning, sowing, pest and disease control, soil repair and fertilization are little used. The irrigation system is characterized by the intensive use of inputs and high productivity.

5.2 Mapping of the intervening factors presented by the social actors on coffee management in the Amazon

The search for the results of this research required an interaction with the social actors and a direct interview with the coffee grower winner of the CONCAFÉ award in the 2017 Sustainability Modality. Another measure involved talking to the current President of the Coffee Sector Chamber and an interview with the rural extension technician based on the state, responsible for the technical assistance and rural extension activities in the rural properties of Rondônia. In fact, this activity was considered as a state standout, and then national, in the coffee segment in the years 2016 and 2017 consecutively. The concepts of the green purchasing activity and the Global Coffee Platform, the relationship of sustainability, consumer market performance, the reflection in the Amazon and the participative management remained to be clarified. Figure 4 below and the subsequent Table 4 represent the mapping of this task.

Fig.4: Diagram of the intervening factors to be criticized in the research.



Source: Prepared by the authors.

Table.4: Specification of the Research Intervening Factors Diagram.

Elements	Description
Intervening Factors	LAP, green purchasing, Global Coffee Platform, consumer market, participatory management and Amazon.
LAP	Integration of the social agents for the development of the branch of activity in common.

Green Purchases	Rigor in the acquisition of products and services from institutions that prove sustainable application.
Global Coffee Platform	It establishes the unification of language and practical actions for the sustainable strengthening in the coffee farms.
Sustainability	Attitudes that consecrate the beneficial relationship between coffee grower and environment.
Consumer Market	Acknowledgment of the desires customers expect from coffee.
Amazon	Investigated scenario.
Participative Management	Form of organization of the social actors in the coffee reality.

Source: Prepared by the authors.

A) Local Productive Arrangement - LAP

The critique begins here with the knowledge of the factors mapped above, revealing the absence of - LAP, which implies productive barriers to achieve management competence. In the conception of Anes (2016) LAP is the union of equal or similar activities of spatial proximity that provide competitive advantages with strategic planning, such as productive links, interaction, cooperation and learning.

B) Green Purchases

In order to present the data of the interview with the stakeholders, it's brought to light the understanding of the Green Purchases concept. The trio confirmed the ignorance on the Green Shopping theme. This fact contradicts the indications of Monzoni Neto (2012) and Silva et al. (2017) that use of procurement management criteria with suppliers that recognize the origin of the production chain for sustainable guarantee throughout the cycle. This demonstrates that there is no selectivity in the contracting of goods and services from trustworthy organizations, which compromises the sustainability of the chain of production before the farm doors. This contextualization, inferred from the contingent perspective in a bibliographic survey of Barbosa (2017), portrays the role of the leader in the understanding of the internal and external context, for the application of various methods in the intervening or necessary adaptive capacity.

C) Sustainability

The research brings results on the perception of those involved in the characterization of sustainability. Social actors are aware of the relevance of changing attitudes towards sustainable practices and the beneficiary society as a whole, but it is still considered in the initial phase. They admit that in the past the concept of sustainability was used in a negative way, allied exclusively to the environment, for example, the prohibition of agrochemicals, deforestation, among others, generating erroneous interpretations that at this point make complicated to break this paradigm. They believe that the role of the State was fundamental to the development of specific policies to support the sustainability initiative, which today is a concern of those involved; they say that before the CONCAFÉ competition, they were unaware of the subject

and that there is a long way to go for achieving excellence, but it's a good starting point; This vision of sustainability, in line with the approach of Cenci et al (2016), refers to the significance of the theme, however, there is a need to deepen this concept, to validate human actions committed to socio-environmental aspects and local development. This premise values the conceptualization of the Theory of Eco-development by Oliveira and Monteiro (2015) advocates for sustainable development, through conservationism with environmental responsibility, based on ethical human behaviour and the consequential local growth.

D) Global Coffee Platform

The research turns to the interpretation of the study in Global Coffee Platform (2016) which offers support to the appropriate treatment of the topic under study; this platform indicates the Common Basic Code, where prohibited, priority and recommended operations for sustainability in coffee farms are designated. In the consensus of the interviewed farmers, the initiative of the state government with the support of the Global Coffee Platform instrument, provided learning and knowledge on how to know what is right and wrong, with joint valorization and responsibility, made in a language simple and accessible; they believe that these actions prevail in the development of a new identity for the State of Rondônia. In addition, the social agents are favorable to the concept of Oliveira and Monteiro (2015), when bringing the Theory of Eco-development he proposes the study of the potentialities and the development of a geographic region, through compromising attitudes in favour of sustainability, based on the integrated participatory nature.

E) Consumer Market

The key point of this topic is to consult the respondents with their position on the coffee consumer market perspective. Understanding makes it clear that consumers view coffee as a special food that is part of their daily lives, but there are several types of consumers, ranging from the ones who seek special products such as organic, gourmet and exotic, as well as the traditional bakery coffee; it's important to state that the consumer knows the difference of the product not only in the monetary value but also the added value with the quality certifications, considering the

requirements that regulatory agencies determine for excellence in this segment. Another demand that has an impact on the value added by the client are the health issues, that is why the concern to know the origin of what is consumed, having the coffee grower as an essential factor at the beginning of this productive chain. According to Tejon (2017), the consumption relations are complex, since they involve sensorial processes, responsibility, appreciation of origination, standards, health, food security and nutrition.

In the evaluation of the rural extensionist, with the advent of globalization and the critical sense of the demands, communicative attributes are used to expose opinions in a positive or negative way, without barriers; taking advantage of this situation, the industries that provide innovation, charge high prices to meet these requirements. Although there are still several coffee producers who still work in the same way since 1980; others are already in the process of evolution, looking over for market trends and believing in prosperity with the combination of the involvement of young people and women, but the difficulty is in how to enter this market, due to lack of experience, leadership and disunion of the group. The repercussion of this situation emerges by treatments in the Contingency Theory, addressed by Barbosa (2017), that portrays the indispensable role of the leader on this scenario and proposes actions for the development of the cognitive interrelationship with the environment for the achievement of performance.

F) Amazon

The results obtained with the stakeholders in relation to what the locus in which they are inserted in the Amazon represents shows that there is a unanimity about the responsibility that this nomenclature infers about, and with coffee it's no different, the planetary concern of how Brazilians are disposing of the natural resources that exist here, and how far are conservation and preservation initiatives. At the 2017 International Coffee Week event held in the city of Belo Horizonte, state of Minas Gerais, the questioning evidenced by potential international buyers, focused on deforestation for coffee planting, making clear the cancellation of purchases should this occur. In the report of some coffee grower, they confirmed that before participating in the event, they were unaware that the State of Rondônia belonged to the Amazon region, which portrays the position of the group of coffee producers.

The President of the Coffee Sector Chamber added an issue to be discussed as a matter of urgency on the subject of water control, used from springs, in the irrigation system of rural properties, especially in periods of drought, a climatic feature of that region, although we are privileged by the abundance of water in the Amazon region,

alternative drip and sprinkler mechanisms should be used to save water, avoiding that in the future such problems as those faced in the States of Espírito Santo and Minas Gerais will occur. In summary, the Ecodesign Development Theory that compromises the systematization of Amazonian development, as approached by Oliveira and Monteiro (2015), involves a diagnosis of the potentialities and difficulties of a region, bringing together participants' attitudes towards the sustainable environment, jointly.

G) Participative Management

Significant management factors can lead the organization to success through competence development. This study allows us to bring an essential factor that is participative management, corroborating with Silveira (2010). Regarding this theme, there were disagreements in the positions of social actors and the role of each one.

According to the President of the Sectorial Chamber, the organization of the group occurs with the union of the components of the productive chain, coffee growers, public and private agencies, where problems and potential for decision-making, language and consensual actions are discussed. This model of performance was responsible for the revitalization of coffee and achieved representativeness for the State, the National Coffee Awards being a proof of it. This leads us to believe that even with the replacement of governments, the structure and understanding of those involved is consolidated for future confrontations. These facts confirm the concept of participative management of Silveira (2010) from the perspective to select assertions with the group.

In the conception of the coffee growers, there is no participative management process for this class, being this deficiency that prevents the development of the system to meet the quantitative and qualitative demands for the world, which would add negotiation power, portfolio disclosure, among other advantages; the reality that prevails is individualism, the need for organization, lack of awareness of the benefits that collective attitudes bring. The validation of this view contradicts Silveira (2010) prescription that incorporates as a challenge for the human element the responsibility for the dynamism of managing the economic, social, environmental and institutional variables, this requires an informal leadership capable of arguing the information to be decided by the group.

In the modeling applied by the public body, they present some methods that have positive effects on the forms of learning together, the modality is called Indirect Technical Assistance ", where a prominent producer is chosen, one that has productive performance, easy absorption of technical orientation and search for knowledge, so two types of treatment are implemented: Observation Unit and Demonstrative Unit. Observation Unit uses the

experimentation of new techniques for the crop under analysis, where after the implementation is observed the development and its data will be used later as an example to the other producers. Demonstration Unit is about concrete actions that have worked and become a way of mirroring other producers, and as a form of incentive is now being shown to the general public in the form and visits, field days and excursions. The participatory approach is also supported by the Hanns R. Neumann Stiftung Group method, which is present in 18 countries, a non-profit institute for the training of smallholders, through collective technical assistance with sustainable development; has the support of youth for the purpose of planetary challenge, reproducing strong ties of cooperation with governmental organisms; develop tools and promotional resources for knowledge exchange, which significantly optimizes the systemic performance of the initiative. The actions promoted to help the practice in the property, use the premise of the participative management of Silveira (2014) under the character interface of the globalized vision of the stakeholders and the knowledge of the work activities, of comprehensiveness as an integral part of the strategic process there. The approach that fits the thoughts of social actors is the Contingency Theory presented by Barbosa (2017) requires

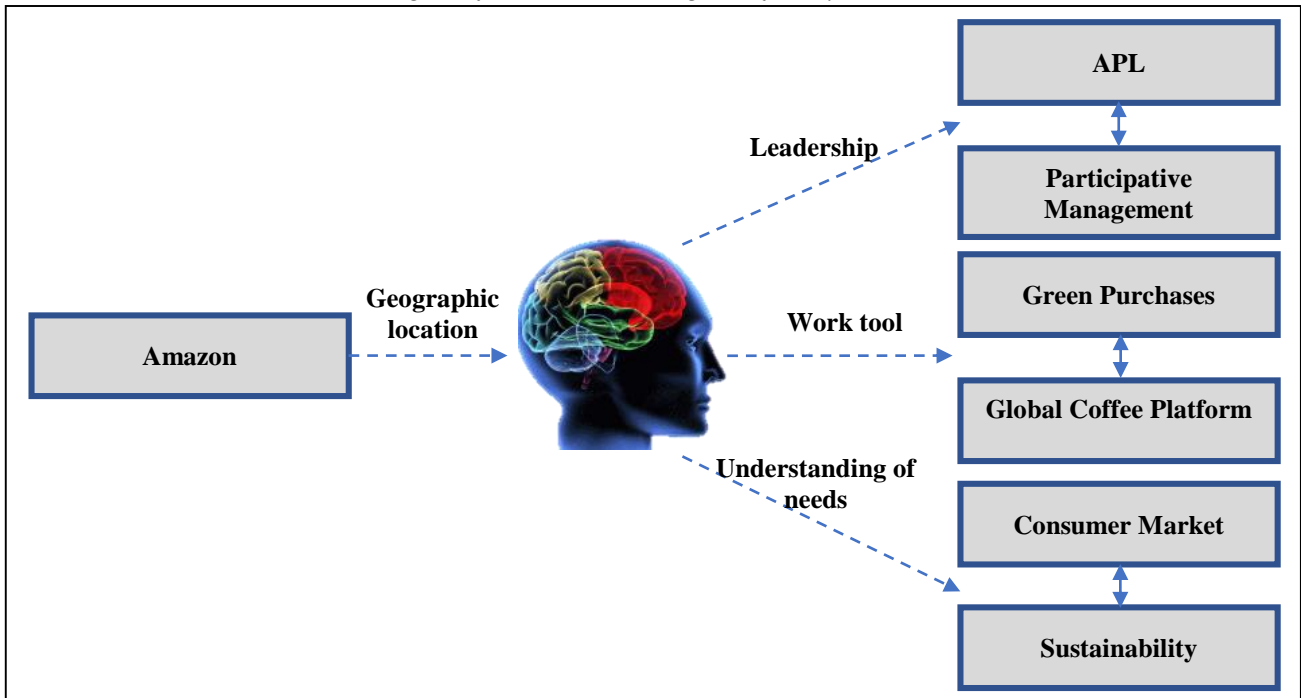
the recognition of the scenario, as well as the physical and cognitive dependent structures to focus on the adaptive or necessary adaptations in favor of performance organizational structure.

5.3 Proposal for the innovations required in the face of sustainability with green purchases

In this subtopic the challenge related to the presentation of innovations for green purchases and sustainability in coffee management, with the contribution of the Theory, addressed by Tinti (2014), referring to the gathering of abstract ideas supported by the use of theories, instruments and actions that support leadership in solving contemporary problems in the innovative competitive path through learning and behavioral changes.

It is possible to identify gaps in the mapping of factors, which in some way interfere in the evolutionary process of the sustainable coffee production chain, evidenced by the social actors who lead the work routine in the Brazilian Amazon region. This implies a significant change in the situation, bringing real advantages to this conjecture. Continuing the sustainable construct, it became important the representation in Figure 5 and in Table 5 that continue suggesting actions of innovative interventions using the results of this research.

Fig.5: Inferences and the cognitive flow system.



Source: Prepared by the authors.

Table.5: Suggestions for interventions for the scenario investigated.

Intervening Factors	Problems Detected	Suggested Intervention
Green Purchases	1. Lack of knowledge about Green Purchases.	1. Insert public policies for the acquisition of goods and services linked to institutions that act with sustainability in the agribusiness environment. 1. Implement in the CONCAFÉ Contest, the premise of responsibility for the raw material purchased for planting.
Sustainability	1. Amplitude about the concept of sustainability.	1. Carry out publicity campaigns demonstrating practices on sustainability, to root the conception, values and beliefs.
Global Coffee Platform	1. Avoid the discontinuity of the evaluation instrument.	1. Carry out partnerships and training of public and private professionals working in the coffee business, students of technical and higher education courses segmented in rural activities, as guiding and supervising the evaluative criteria of the Platform.
Consumer Market	1. Break paradigm over coffee as poison; 2. Being unaware of consumer trends and needs; 3. Not knowing how to advertise their products to the consumer market;	1. Presenting the coffee as a special food and show its benefits; 2. Present information on news, complaints and requests that the industries receive in their communicative channels in lectures, events, among others; 3. Hire a company specialized in marketing, to reproduce the history, daily practices with the sustainability, responsibility, unique special flavor of the Amazon biome, will be the key to the success and appreciation of the local coffee grower.
Amazon	1. Contextualization on the Amazon locus; 2. Relevance of care with the Amazon;	1. Emphasize and disseminate the geographical location of Rondônia in the Western Amazon for the understanding of the mass; 2. To raise awareness and responsibility for the Amazon.
Participative Management	1. Individualism of coffee growers; 2. Need for leadership;	1. Raise awareness of the urgency of the need for group work to strengthen the productive chain and to integrate young people and women into decision-making. 2. Present candidates with a leadership profile, capable of promoting the creation of an agricultural cooperative with coffee growers, to work together, establishing standards of quality, organization and profitability;

Source: Prepared by the authors.

VI. CONCLUSION

This study provides essential information for strengthening the productive sector, the academic area, local

management, government, consumers and the Amazon region from the perspective of coffee production. The result answers the research question when it brings knowledge that allows us to affirm the inexistence of the green purchasing process in the municipality of the Brazilian Amazon, but even though the knowledge of sustainable practices is recent, the Global Coffee Platform tool is used in a way that allows a significant socio-environmental contribution.

Given the breadth of qualitative recognition of this coffee worldwide, it is possible to affirm that there are divergences of conceptions or lack of information mainly for the coffee grower who initiates the productive chain, this sector needs special attention because it is rooted in backward beliefs, values and attitudes, suffering influences even from the geographical location where it is inserted, which implies compromising the achieved. Another factor that infers in the local development, is existent individualist concept in that organism, that requires works with conscientization to change this cognitive structure, to obtain opportunity and competitive advantage. Finally, it stands out in this research when producing innovative suggestions that can be used by the leaders and of the segment.

REFERENCES

- [1] André, M. (2013). *O que é um estudo de caso qualitativo em educação?* Universidade do Estado da Bahia – Salvador – Bahia. Revista da FAEEBA – Educação e Contemporaneidade.,22 (40), 95-103. DOI: 10.21879/faeaba2358-0194.v22. n.40.753.
- [2] Anes, C. E. R., Deponti, C. M., & Arend, S. C. (2016). O desenvolvimento de arranjos produtivos locais no Rio Grande do Sul: planejamento e diretrizes. Universidade de Santa Cruz do Sul – Unisc – Santa Cruz do Sul – Rio Grande do Sul – Brasil. *Revista Ágora*, 17(02), 117-126. DOI: 10.17058/agora.v18i2.8107.
- [3] Barbosa, K. A. (2017). *Cooperativas de crédito: mapeamento das características demográficas, gerenciais e financeiras na região nordeste do Brasil*. Paper of Conclusion of Course in Accounting Sciences Universidade Federal da Paraíba, João Pessoa/PB. Retrieved from <http://rei.biblioteca.ufpb.br:8080/jspui/handle/123456789/1989>.
- [4] Cenci, D. R., Zanini, D., Callegaro, R. S., Pinto, R. C. F., & Herbertz, M. H. (2016). A sustentabilidade e estratégias do desenvolvimento local. *Revista Científica Faculdade de Balsas*, 7 (1), 45-65.
- [5] Empresa Brasileira de Pesquisa Agropecuária. (2017, September). Cafés de Rondônia. *Revista Cafés de Rondônia sabor e qualidade quem vem da Amazônia*. Annual / Year 2.
- [6] Empresa Brasileira de Pesquisa Agropecuária. (2015). Cafés de Rondônia. *Revista Cafés de Rondônia sabor e qualidade quem vem da Amazônia*. Brasília-DF.
- [7] Instituto Brasileiro de Geografia e Estatística. (2017). *População de Cacoal*. Retrieved October, 07, 2017, from <https://cidades.ibge.gov.br/xtras/temas.php?codmun=110004&idtema=130>.
- [8] Monzoni Neto, M. P., Betiol, L. S., Laloë, F. K., Appugliese, G. A, Adeodato, S., & Ramos, L. (2012). *Compra sustentável: a força do consumo público e empresarial para uma economia verde e inclusiva*. São Paulo: Editora FGV.
- [9] Oliveira, D. F. O., & Monteiro, L. V. G. (2015). Ecodesenvolvimento: uma abordagem sob o contributo de Ignacy Sachs. *Revista de Direito, Economia e Desenvolvimento Sustentável*. *Revista de Direito, Economia e Desenvolvimento Sustentável*. Minas Gerais, 1 (2), 29-48. DOI: 10.21902/2526-0057/2015.v1.939.
- [10] *Manual of implementation of the fundamental items of the Coffee Sustainability Curriculum*. Global Coffee Platform. (2017). Retrieved, October, 17, 2017, from <http://www.globalcoffeeplatform.org/assets/files/Resources/Manual-de-Implementa%C3%A7%C3%A3o-dos-Itens-Fundamentais.PDF>
- [11] Siena, O. (2011). *Metodologia da pesquisa científica: Elementos para Elaboração e Apresentação de Trabalhos Acadêmicos*. ISBN 978-85-7764-023-2. Porto Velho –RO.
- [12] Silva, A. K., Bohnke, H. S., & Silva, K. D. N. S. (2016). Considerações acerca do processo de compras verdes aplicadas às empresas públicas e privadas. *Revista FATEC Zona Sul*, 2(2), 21-41.
- [13] Silveira, V. S. (2010, February). Gestão participativa: uma nova realidade. *Boletim de Informações Gerenciais da Justiça Federal*, IV (4).
- [14] Tejon, J. L. M. (2017). *Dez tendências do marketing no agronegócio do futuro*. Retrieved, October, 17, 2017, from <http://tejon.com.br/NoticiaInterno.aspx?Id=439>.
- [15] Tinti, D. L. (2014). Teoria U e programação neolinguística: acessando o poder de presenciar. In: *Revista Global Manager*, 14(1), 93-109. Rio Grande do Sul.

Preservation and storage of Lemon (*Citrus Limon*) Juice

Ritu Sindhu, Bhupendar Singh Khatkar

Department of Food Technology, GJUS&T, Hisar, India

Abstract— Lemon fruits were sorted and washed before extraction of juice. Extracted juice of lemon fruits was treated with potassium metabisulphite, sodium benzoate and thermal processing. Treated and untreated samples of juice were stored at room and refrigeration temperature for 90 days and analyzed for chemical properties at 15 days of interval during storage. Total sugars, reducing sugars and browning of juice increased during storage. On the contrary, tannin content of juice decreased during storage. Storage at refrigeration temperature was found better effective in preservation and keeping quality of juice showing lesser changes in chemical properties of juice during storage than at room temperature. Results suggested that lemon juice after chemical and pasteurisation treatments can be stored safely at room and refrigeration temperature for 90 days.

Keywords— chemical preservatives, lemon juice, sugar content, tannin, thermal processing.

I. INTRODUCTION

Lemon (*Citrus limon* Burm. f.) is the medicinally important plant and belongs to the family Rutaceae. Lemon is the third most important citrus fruit following orange and mandarin (Perez-Perez et al., 2005). Alkaloids in crude extracts of different parts of lemon plant such as stem, root, leaves and flower have been reported by Kawaii et al. (2000). Fruits of lemon plants are appreciated for their high content of flavonoids, vitamin C, citric acid and minerals. Many consumers around the world prefer lemons as fruit due to exceptional flavour and acidity, and also potential applications of lemons in value-added food products. Lemon juice in the form of beverage is enjoyed by people of all age groups including children and elders due to their refreshing taste and medicinal benefits (Mishra et al., 2015). Depending on the climatic conditions, different varieties of lemons are grown around the world. Baramasi variety of lemon is commonly grown in various agro-climatic zones including sub mountainous tract of Punjab. Winter crop of Baramasi lemon is harvested in the cooler part of the year, in that period consumption of lemon fruits is low. Sensitive of lemon fruits to chilling injury makes it hard to store in the commercial cold stores (Kaur et al., 2014). So, due to sensitive to chilling injury and limited shelf-

life of lemon fruit, it becomes important to process it in the form of juice to reduce the surplus in the market in its peak season of production. Preservation of fruit in the form of juices has turned out to be the business activity of great significance and countries with rich fruit resources with short harvesting season are emphasizing more for established storage to keep up quality of fruits, enhance shelf life and preserve fruit juices for availability in off-season (Franke et al., 2005). Fruit juices are preserved by various methods such as freezing, irradiation, heat processing and addition of chemical preservatives, however it is a well known fact that nutritional and sensory quality of juice changes during extraction, preservation treatment and storage. Rabia et al. (2014) and Holeman et al. (2002) reported that thermal processing of citrus juice lowers the ascorbic acid content. Sulfur dioxide acts as an antimicrobial agent and also stabilizes ascorbic acid and it is added in fruit juices in the form of sulfites and metabisulfites of sodium or potassium. Shahnawaz et al. (2013) investigated the effect of sodium-benzoate with different concentrations on orange juice packed in various popular packing materials for different time intervals of storage and found that orange juice with sodium benzoate without the additions of sugar could be useable up to 30 days. The action of sulphur dioxide as an antimicrobial agent as well as a stabilizer of ascorbic acid depends on the pH of the food (El-Ashwah et al., 1981). It is, therefore, significant to assess its effectiveness in a high acid juice such as orange and lemon juice. Keeping all these factors in view, present investigation was carried out to preserve lemon juice by chemical preservatives and heat processing and to study the effects of different preservation treatments and storage temperature on properties of lemon juice during storage.

II. MATERIALS AND METHODS

2.1 Preparation of fruits and juice extraction

Fully matured lemon fruits of Baramasi variety were procured from central fruit farm, Hisar. Lemon fruits were washed thoroughly with water to remove dirt and waste, manually graded for size and shape, only sound fruits were taken for extracting juice. Fruits were cut into halves and juice was extracted by pressing the fruit pieces in manually operated citrus juice machine. The expressed

juice was passed through single layer of muslin cloth to remove the solids and pulp materials. The filtered juice was filled in sterilized glass bottles with head space 2cm.

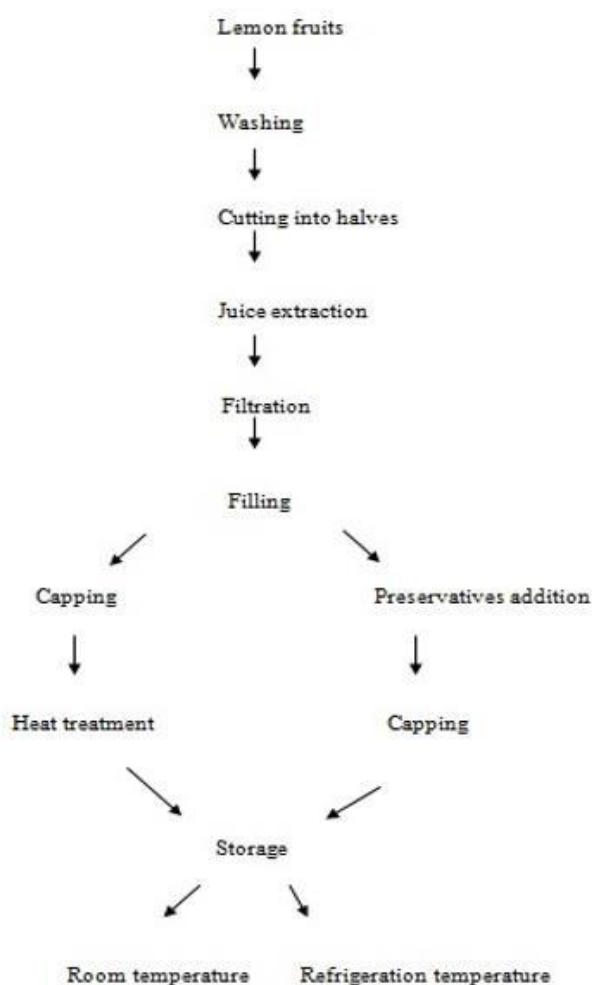


Fig.1: Schematic diagram showing the process of extraction and preservation of juice

2.2 Preservation and storage of juice

Preservation of juice was done by two methods using chemical preservatives and pasteurization as shown in Fig 1. In filtered juice chemical preservatives namely potassium metabisulphite (@ 0.1%) and sodium benzoate (@ 0.1%) were added. Juice in sealed bottles was heat processed for 15 minutes at 80°C in hot water bath and then cooled under running tap water. Untreated juice was taken as control sample. Processed and control juice samples were labelled and stored at two different

temperatures (room temperature and refrigeration temperature) for 90 days.

2.3 Chemical analysis

Stored samples of lemon juice were analysed at 15 days interval during storage. Tannin content was determined according to AOAC (1984) method. Non-enzymatic browning was determined using method described by Ranganna (1986). Total sugars and reducing sugars were estimated according to method describe by Hulme and Narain (1931). The data obtained in present investigation was subjected to statistical analysis of variance (ANOVA) techniques using two factorial completely randomized designs (CRD). All the tests were made in triplicate. Chemicals used in the study were of analytical reagent grade obtained from Sigma Chemicals, U.K.

III. RESULTS AND DISCUSSION

Total and reducing sugar contents of control and treated lemon juice samples during storage at room and refrigeration temperatures are presented in Table 1. Total sugars escalated from 1.456g to 1.956g per 100ml during storage. Total sugars were maximum (1.783g per 100ml of juice) in pasteurized juice stored at room temperature and minimum (1.623g per 100ml of juice) in sodium benzoate treated sample stored at refrigeration temperature. The rise in total sugars could be due to hydrolysis of starch to sugars in juice during storage. Such results have already been observed in earlier studies (Shahnawaz, 2013; Barwal and Shrera, 2009) reporting increase in total sugars in lemon juice and orange juice respectively during storage. Reducing sugar increased substantially from 0.587g to 1.002g per 100ml juice in all juice samples during storage period. The escalation in reducing sugars in juice could be due to the gradual inversion of non-reducing sugars during storage. The average reducing sugars content was observed maximum (0.816g per 100ml) in potassium metabisulphite treated samples stored at room temperature and minimum (0.753g per 100ml) was found in sodium benzoate treated samples stored at room temperature. The results were consistent with the findings of other studies (Akhtar et al., 2013) in which a significant increase was noticed in reducing sugars in pomegranate juice during ambient temperature storage.

Table.1: Effects of different treatments and storage on total sugars (g/100ml) and reducing sugars (g/100ml) of lemon juice

Treatment		Storage period (days)							Mean
		0	15	30	45	60	75	90	
Total sugars	C + RT	1.410	1.380	*	*	*	*	*	
	KMS+ RT	1.480	1.535	1.650	1.720	1.820	1.920	1.960	1.726 ^b

	SB + RT	1.450	1.500	1.550	1.635	1.750	1.835	1.920	1.663 ^d
	P + RT	1.450	1.550	1.705	1.790	1.905	2.020	2.060	1.783 ^a
	C + RFT	1.430	1.520	1.650	1.620	1.790	1.890	2.040	1.706 ^c
	KMS + RFT	1.480	1.500	1.550	1.650	1.690	1.820	1.905	1.656 ^d
	SB + RFT	1.450	1.480	1.520	1.565	1.690	1.805	1.850	1.623 ^e
	P + RFT	1.450	1.520	1.580	1.690	1.820	1.940	2.020	1.717 ^b
	Mean	1.456 ^g	1.515 ^f	1.601 ^e	1.667 ^d	1.781 ^c	1.890 ^b	1.965 ^a	
Reducing sugars	C + RT	0.570	0.500	*	*	*	*	*	
	KMS+ RT	0.570	0.655	0.770	0.825	0.870	0.980	1.040	0.816 ^a
	SB + RT	0.600	0.640	0.700	0.770	0.810	0.890	0.940	0.764 ^d
	P + RT	0.600	0.640	0.720	0.770	0.840	0.960	1.010	0.791 ^b
	C + RFT	0.570	0.670	0.700	0.770	0.810	0.855	1.040	0.774 ^c
	KMS + RFT	0.570	0.670	0.740	0.790	0.840	0.910	1.010	0.790 ^b
	SB + RFT	0.600	0.640	0.685	0.740	0.770	0.855	0.980	0.753 ^e
	P + RFT	0.600	0.640	0.720	0.740	0.770	0.870	0.995	0.762 ^d
	Mean	0.587 ^g	0.651 ^f	0.719 ^e	0.772 ^d	0.816 ^c	0.903 ^b	1.002 ^a	

C = Control; KMS = Potassium metabisulphite; SB = Sodium benzoate; P = Pasteurized; RT = Room temperature; RFT = Refrigeration. Means with the same superscript are not significantly different. * Not recorded due to fermentation

The values of tannin content and optical density of lemon juices during storage are given in Table 2. Tannin content showed a noticeable downtrend from 51.035mg to 31.652mg/100 ml juice during storage. The maximum tannin content (45.305mg/100 ml juice) was noticed in potassium metabisulphite treated juice stored at refrigeration and minimum tannin content (38.179 mg/100 ml juice) was observed in sodium benzoate treated juice stored at room temperature. The reduction in tannins in juice could be attributed to their condensation into brown pigments during storage. These results were in conformity with the finding of Ranote et al. (1992) who reported decrease in tannin content in kinnow-RTS stored at room temperature for 24 weeks. It was perceived from data (Table 2) that the mean optical density value of

lemon juice increased from 0.022 to 0.036 during storage. The samples stored at room temperature showed significantly higher mean browning value than the samples stored at refrigeration temperature. Maximum browning (0.042 OD) was noticed in pasteurized sample stored at room temperature while minimum browning (0.022OD) was observed in potassium metabisulphite treated sample stored at refrigeration temperature. Intensification in browning in juice may be attributed to the accumulation of degradation products of sugars, ascorbic acids and proteins during storage. These results are in agreement with earlier studies (Alex et al., 2004) for litchi juice, kinnow natural juice, sweetened juice and squash stored at room and refrigeration temperature.

Table.2: Effects of different treatments and storage on tannin content (mg/100ml) and browning (OD) of lemon juice

Treatment		Storage period (days)							Mean
		0	15	30	45	60	75	90	
Tannin content	C + RT	49.670	45.285	*	*	*	*	*	
	KMS+ RT	51.305	50.120	47.485	45.865	33.565	32.515	30.570	41.632 ^c
	SB + RT	49.960	46.975	42.020	36.800	33.175	30.385	27.935	38.179 ^e
	P + RT	50.795	49.025	46.395	44.445	37.435	32.005	30.880	41.569 ^c
	C + RFT	51.105	49.365	48.205	46.525	39.710	36.080	33.290	43.469 ^b
	KMS + RFT	52.145	50.985	51.135	49.580	39.545	38.065	35.680	45.305 ^a
	SB + RFT	50.460	48.675	43.115	40.075	35.575	31.470	28.480	39.693 ^d
	P + RFT	51.475	49.755	47.850	46.185	38.125	35.615	34.730	43.391 ^b
Mean	51.035 ^a	49.271 ^b	46.601 ^c	44.211 ^d	36.733 ^e	33.734 ^f	31.652 ^g		
Non enzymatic	C + RT	0.022	0.034	*	*	*	*	*	
	KMS+ RT	0.022	0.022	0.024	0.036	0.038	0.039	0.041	0.032 ^c

browning	SB + RT	0.022	0.022	0.024	0.040	0.043	0.045	0.046	0.035 ^b
	P + RT	0.022	0.025	0.028	0.049	0.057	0.057	0.057	0.042 ^a
	C + RFT	0.022	0.022	0.022	0.024	0.026	0.027	0.027	0.024 ^f
	KMS + RFT	0.022	0.022	0.022	0.022	0.022	0.022	0.023	0.022 ^g
	SB + RFT	0.022	0.022	0.023	0.026	0.028	0.029	0.029	0.026 ^e
	P + RFT	0.022	0.022	0.023	0.028	0.029	0.030	0.030	0.026 ^d
	Mean	0.022 ^g	0.022 ^f	0.024 ^e	0.032 ^d	0.035 ^c	0.036 ^b	0.036 ^a	

C = Control; KMS = Potassium metabisulphite; SB = Sodium benzoate; P = Pasteurized; RT = Room temperature; RFT = Refrigeration. Means with the same superscript are not significantly different. * Not recorded due to fermentation.

IV. CONCLUSION

In the present study, it was noticed that chemical properties of lemon juice were affected by different preservation treatments, storage temperature and storage period. Retention of tannin content in juice was the highest in samples preserved with potassium metabisulphite during storage. Sodium benzoate treated samples showed least increase in total and reducing sugars during storage. Visual quality of juice was greatly affected by pasteurization which resulted in highest increase in non-enzymatic browning in juice. Substantial changes in all chemical properties of juice were noticed at room temperature than at refrigeration temperature in all treatments during storage. Tannins and browning of juice in all samples were highly affected by storage temperature showing noticeable changes at room temperature storage as compared to refrigeration temperature storage. Comparatively little effect of storage temperature was observed on total sugars and reducing sugars of juice in all samples. The findings of present investigation suggest that untreated lemon juice cannot be stored for more than a week at room temperature but it can be stored for 90 days at refrigeration temperature. Refrigeration temperature was better than room temperature for storage of untreated and processed lemon juice.

REFERENCES

- [1] Akhtar, S., Ali, J., Javed, B. and Khan, F. A. (2013) Studies on the preparation and storage stability of pomegranate juice based drink. Middle-East Journal of Scientific Research 16 (2), 191-195.
- [2] Alex, L., Suresh, C. P., Kabir, J. and Dhua, R.S. (2004) Litchi juice processing and preservation. Indian Food Packer 58, 48-53.
- [3] AOAC. (1984) Official Methods of Analysis. 14th edition. Washington DC: Association of Official Analytical chemists.
- [4] Barwal, V. S. and Shreya, S. K. (2009) Standardization of extraction methods and preservation techniques of hill lemon juice. Journal of Scientific and Industrial Research 68, 608-610.
- [5] El-Ashwah, E. T., Tawfik, M. A., El-Hashimy, F. S., Rouf, M. S. and Sarhan, M. A. (1981) Chemical and Physical Studies on Preserved 'Benzahir' Lime Juice. Sudan Journal of Food Science and Technology 1: 64-68.
- [6] Franke, A. A., Cooney, R. V., Henning, S. M. and Custer, L. J. (2005) Bioavailability and antioxidant effects of orange juice components in humans. Journal of Agriculture and Food Chemistry 53 (13), 5170-5178.
- [7] Holeman, J. (2002) Nutrition professor says concentrated juice offers high volume of vitamin C. News & Information, ASU.
- [8] Hulme, A. C. and Narain, R. (1931) The ferricyanide method for determination of reducing sugars. A modification of Hage dorn-Jensen Hanes technique. Biochem Journal 25, 1051.
- [9] Kaur, S., Jawandha, S. K. and Singh, H. (2014) Response of baramasi lemon to various post-harvest treatments International Journal of Agriculture, Environment & Biotechnology 7(4).
- [10] Kawaii S, Yasuhiko T, Eriko K, Kazunori O, Masamichi Y, Meisaku K and Hiroshi F. (2000) Quantitative study of flavonoids in leaves of Citrus plants. J Agric Food Chem 48, 3865-3871.
- [11] Mishra, P., Rai, G. K., and Mahatana, C. L. (2015) Process of standardization for development of spray-dried lemon juice powder and optimization of amla-lemon based RTS (Ready-to-serve) drink using response surface methodology. Journal of Food Processing and Preservation 39, 1216-1228.
- [12] Perez-Perez, J. G., Porrás Castillo, I., García-Lidon, A., Botia, P. and García-Sánchez, F. (2005) Fino lemon clones compared with the lemon varieties Eureka and Lisbon on two rootstocks in Murcia (Spain). Scientia Horticulturae 106, 530-538.
- [13] Rabie, M. A, Soliman, A. Z., Diaconeasa, Z. A. S. and Constantin, B. (2014) Effect of pasteurization and shelf life on the physicochemical properties of Physalis (Physalis peruviana L.) juice. Journal of Food Processing and Preservation 39(6), 1051-1060.
- [14] Ranganna, S. (1986) Handbook of Analysis & Quality Control for Fruit & Vegetable Products. 2nd Edition. New Delhi: Tata McGraw Hill publishing Co. Ltd.

- [15] Ranote, P. S., Bawa, A. S. and Saini, S. P. S. (1992)
Thermal process for kinnow-RTS. *Indian Food Packer* 46: 16-20.
- [16] Shahnawaz, M., Sheikh, S. A. and Minhas, S. (2013)
Role of sodium benzoate as a chemical preservative in extending the shelf life of orange juice. *Global Advanced Research Journal of Food Science and Technology* 2 (1), 7-18.

Jumping Spiders (Araneae: Salticidae) of Satlasana Taluka

B. M. Parmar*, K. B. Patel

Department of Zoology, Sheth M.N.Science College, Patan, India

Abstract— Family Salticidae is most species rich group of order Araneae. Jumping spiders are taxonomically diverse, present everywhere in huge abundance and diurnal. As their names simply, jumping spiders are also quick and agile jumpers, and will do so both to escape potential predators and to capture small prey and regulating arthropod population. Spiders have important role in ecosystems but they have been largely ignored in conservational studies. This might be one of the reasons of poor knowledge on jumping spider of this area. The study on jumping spiders made in different habitats from Satlasna Taluka during October 2014 to December 2017. Specimen collections were conducted using visual search, litter sampling, sweep netting and hand picking methods from all the sites. One hundred eighty four specimens belong to 28 species and 17 genera were recorded. For the period of this study certain new genera documented for Gujarat such as *Carrhotus sannio*; *Menemerus brachygnathus*; *M. fulvus*; *phintella alboterminus*; *Siler semiglaucus* and *Thiania sp.*

Keywords— Salticidae, diversity, spider, Satlasana.

I. INTRODUCTION

Jumping spiders are relatively small spiders which belong to one of the largest and most diverse groups of true spiders found in world. Jumping spiders (Salticidae) contain 632 recognized and described genera, and over 6953 species, represent the most diverse spider family in the World spiders (World Spider Catalog 2018). Numerically 207 species and 73 genera recorded from India (Keswani *et. al.*, 2012). Total 43 species belong to 25 genera are recorded from Gujarat (Yadav *et. al.*, 2017). The aim of present study was to document and provide base line information of Salticidae spider fauna.

II. STUDY AREA

Satlasna taluka has 308.38 km² areas with 73 villages, situated 23.540 N latitude and 72.380 E longitudes. The study area is surrounded on the north by Banaskantha district, west-south by Kheralu taluka and on the eastern part of Sabarmati River. The forest of Satlasna is unclassified reserved forest (under section-IV). The weather condition of the Satlasna is irregular rainfall and

experiences a prolonged dry season which experiences a high variation in temperature with minimum going down 10° C in winter and maximum 44° C in summer, annual average rainfall is about 600 mm to 700 mm, approximately.

Table.1: Sites geographic location:

Sr. No	Sites	Geographic location	Habitats
1.	Taranga Hills	23°58'19.28"N 72°45'42.50"E	Forest
		23°57'51.34"N 72°45'13.57"E	Hilly Area
2.	Timba Village	23°59'24.63"N 72°45'27.06"E	Agriculture
		23°59'06.24"N 72°45'36.56"E	Waste land
3.	Dharoi Dam	24°00'38.87"N 72°50'37.30"E	Area near by Water body
4.	Satlasana Village	24°01'20.34"N 72°47'46.42"E	Residential Area

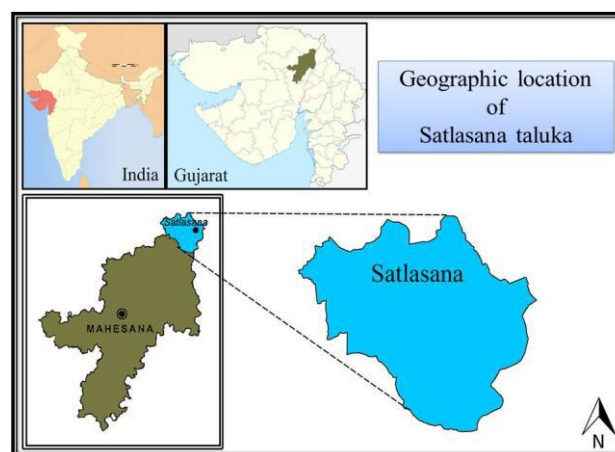


Fig.1: Map of Satlasana Taluka

III. METHODOLOGY

The Specimens collection was done in different selected sites, using various methods like visual search, litter sampling, sweep netting and hand picking. The sample collection was done during was mainly three time in day

with morning at 7am to 10am, in afternoon 1pm to 3pm and in evening at 4pm to 6pm from different parts of the habitats. All collected samples transferred in screw cap vials which contain 75% ethyl alcohol for preservation purpose. For the detailed study of morphological characters of collected samples, stereo zoom microscope was used. Specimens were identified up to family, genus and species level when possible with help of taxonomic keys and relevant taxonomic literatures.

IV. RESULTS

Total recorded 17 genera and 28species from Satlasana.

FAMILY SALTICIDAE Blackwall, 1841

a. Genus *Carrhotus* Thorell, 1891

1. *sannio* Thorell, 1877

Material Examined: Dharoi village. Near Dam, 2♀, 19.09.2015, collected under shrub vegetation

Distribution: Réunion, India to Indonesia

2. *carrhotus* sp.

Material Examined: Timba village, near agriculture farms, 1♀ (Immature), 19.07.2015, collected from farms.

Distribution: Satlasana

b. Genus *Chrysilla* Thorell, 1887

3. *lauta* Thorell, 1887

Material Examined: Taranga, near Tapovan, 4♀, 01.07.2015, Timba village, 4♀, 25.11.2015, Dharoi village, near dam, 3♀, 28.10.2015, collected from vegetation and ground of park.

Distribution: Myanmar to China, Vietnam, India

c. Genus *Epeus* Peckham & Peckham, 1886

4. *indicus* Prószyński, 1992

Material Examined: Taranga, near Temple, 1♀, 25.06.2016, Timba village, 2♀, 28.08.2016, collected from leave of shrubs.

Distribution: India, Nepal

d. Genus *Epocilla* Thorell, 1887

5. *aurantiaca* Simon, 1885

Material Examined: Timba village, near agriculture farms, 4♀, 20.07.2015, Dharoi village, near dam, 1♀, 20.07.2015, collected from vegetation.

Distribution: India to Malaysia

e. Genus *Hasarius* Simon, 1871

6. *adansoni* Audouin, 1826

Material Examined: Taranga forest, 1♀, 08.06.2015, Timba village, 4♀, 02.08.2016, Dharoi village, near dam, 1♀, 02.10.2014, collected from collected from leave of shrubs.

Distribution: Africa. Introduced to both Americas, Europe, India, Laos, Vietnam, China, Japan

f. Genus *Hyllus* C. L. Koch, 1846

7. *semicupreus* Simon, 1885

Material Examined: Taranga forest, 1♀, 03.08.2016, Timba village, 4♀, 20.11.2014, Dharoi village, near dam, 1♀, 20.11.2014, collected from shrubs vegetation.

Distribution: India, Sri Lanka

g. Genus *Menemerus* Simon, 1868

8. *bivittatus* Dufour, 1831

Material Examined: Taranga forest, 10♀, 20-25.05.2016, Timba village, 9♀, 23.05.2016, Satlasana village, 5♀, 28.10.2015, collected from barks of trees and houses.

Distribution: Africa. Introduced to North, Central and South America, southern Europe, India, China, Japan, Australia, Pacific Is.

9. *brachygnathus* Thorell, 1887

Material Examined: Timba village, 8♀, 25.10.2016, Satlasana village, 1♀1 ♂, 25.10.2016, collected from houses.

Distribution: India to Japan

10. *fulvus* L. Koch, 1878

Material Examined: Taranga temple, 3♀2♂, 20.02.2015, Timba village, 6♀3♂, 20.02.2015, Satlasana village, 7♀, 20.08.2016, collected from barks of trees.

Distribution: India to Japan

h. Genus *Myrmarachne* MacLeay, 1839

11. *plataleoides* O. P.-Cambridge, 1869

Material Examined: Taranga temple, 6♀, 28-30.07.2016, Timba village, 3♀, 27.07.2016, Dharoi village, near dam, 1♀, 02.10.2014, collected from farm crop.

Distribution: India, Sri Lanka, China, Southeast Asia

12. *tristis* Simon, 1882

Material Examined: Timba village, 2♀, 28.07.2016, Dharoi village, near dam, 1♀, 02.10.2014, collected from vegetation.

Distribution: Libya to India

13. *Myrmarachne* sp. 1

Material Examined: Taranga temple, 2♀ (Immature), 20.03.2016, collected from collected from vegetation.

Distribution: Satlasana

14. *Myrmarachne* sp. 2

Material Examined: Timba village, 1♀ (Immature), 25.04.2016, collected from collected from farm vegetation.

Distribution: Satlasana

i. Genus *Phintella* Strand, in Bösenberg & Strand, 1906

15. *vittata* C. L. Koch, 1846

Material Examined: Taranga forest, 4♀, 25.02.2015, Timba village, 2♀, 28.02.2015, Dharoi village. Near dam, 1♀, 28.02.2015, collected from ground and vegetation.

Distribution: India to Philippines

16. *alboterminus* John T. D. Caleb, 2014

Material Examined: Timba village, 1♀, 28.09.2016, collected from houses.

Distribution: India, Satlasana

j. Genus *Phlegra* Simon, 1876

17. *dhakuriensis* Tikader, 1974

Material Examined: Taranga temple, 2♀, 05.07.2016, Timba village, 1♀, 10.08.2016, Dharoi village, near dam, 1♀, 02.10.2014, collected from shrub leaves.

Distribution: Pakistan, India

k. Genus *Plexippus* C. L. Koch, 1846

18. *paykulli* Audouin, 1826

Material Examined: Taranga forest, 6♀3♂, 25.06.2015, Timba village, 3♀, 25.07.2015, Dharoi village, near dam, 2♀, 28.09.2016, collected from shrubs vegetation and houses.

Distribution: Africa. Introduced to both Americas, Europe, India, China, Japan, Korea, Philippines, Papua New Guinea, Australia, Pacific islands

l. Genus *Ptocasius* Simon, 1885

19. *Ptocasius* sp.

Material Examined: Timba village, 1♀ (Immature), 23.02.2015, collected from shrubs vegetation around farms.

Distribution: Satlasana

m. Genus *Siler* Simon, 1889

20. *semiglaucus* Simon, 1901

Material Examined: Timba village, 10♀, 29.04.2016, Satlasana village. 2♀, 25.06.2016, collected from shrubs vegetation

Distribution: India to Philippines

21. *Siler* sp.

Material Examined: Timba village, 1♀ (Immature), 07.02.2015, collected from road side vegetation

Distribution: Satlasana

n. Genus *Stenaclurillus* Simon, 1886

22. *lesserti* Reimoser, 1934

Material Examined: Taranga forest, 12♀, 29-31.07.2015, Timba village, 5♀, 25.08.2015, Dharoi village, near dam, 1♀, 24.09.2015, collected from ground vegetation.

Distribution: India, Sri Lanka

23. *Stenaclurillus* sp. 1

Material Examined: Timba village, 2♀ (Immature), 25.09.2016, Dharoi village, near dam, 1♀ (Immature), 25.09.2016, collected from ground vegetation.

Distribution: Satlasana

24. *Stenaclurillus* sp. 2

Material Examined: Timba village, 1♀ (Immature), 21.09.2016, Dharoi village, near dam, 1♀, 12.09.2016, collected from ground vegetation.

Distribution: Satlasana

25. *Stenaclurillus* sp. 3

Material Examined: Timba village, 1♀ (Immature), 01.09.2016, collected from ground vegetation.

Distribution: Satlasana

o. Genus *Telamonia* Thorell, 1887

26. *dimidiata* Simon, 1899

Material Examined: Taranga forest, 4♀3♂, 11.03.2016, Timba village, 3♀2♂, 25.05.2016, Dharoi village, near dam, 2♀, 28.09.2016, collected from shrubs vegetation.

Distribution: India, Bhutan, Malaysia, Indonesia (Sumatra)

p. Genus *Thiania* C. L. Koch, 1846

27. *Thiania* sp.

Material Examined: Timba village, 1♀ (Immature), 26.07.2016, Satlasana village, 1♀ (Immature), 26.07.2016, collected from Vegetation.

Distribution: Satlasana

q. Genus *Thyene* Simon, 1885

28. *imperialis* Rossi, 1846

Material Examined: Taranga forest, 2♀, 20.05.2015, Timba village, 1♀, 20.06.2015, Satlasana village, 1♀, 28.2.2016, collected from leaves of trees.

Distribution: Southern Europe, North and East Africa, Near East to Central Asia and China, India, Indonesia

Comments

Present study, total 28 species and 17 genera of the family Salticidae is recorded from Satlasana Taluka. Moreover, new generic records of jumping spiders have been given for the species found in study area, which were *Carrhotus sannio*; *Menemerus brachygnathus*; *M. fulvus*; *phintella alboterminus*; *Siler semiglaucus* and *Thiania* sp. In the collection of spiders, most collective and abundant spiders were *Hyllus semicupreus*, *Menemerus bivittatus*, *Phintella vittata*, *Plexippus paykulli*, *Stenaclurillus lesserti* and *Telamonia dimidiata*. Out of total species collected, four genera and five species recorded new to Gujarat. Further study is required for understand the complete salticid fauna of study area as well estimate species identity of immature spiders collected during study.

REFERENCES

- [1] Biswas, B. and K. Biswas. 1992. Araneae: Spiders. State Fauna Series 3: *Fauna of West Bengal 3. Zool. Surv. India*, 357500.
- [2] Coddington, J.A, Line L. Sorensens, and Nikolaj S., 2002. Inventorying and Estimating Subcanopy Spider Diversity Using Semi quantitative Sampling Methods in an Afromontane Forest Environment. *Entomology*. 31(2): 319-330.
- [3] Keswani, S., P. Hadole and A. Rajoria, 2012. Check list of Spiders (Arachnida: Araneae) from India, *Indian Journal of Arachnology* 1 (1) 1-129.
- [4] Metzner, H. (2018): Jumping spiders (Arachnida: Araneae: Salticidae) of the world. Accessed 10 March 2018. Online at <https://www.jumping-spiders.com>
- [5] Prószyński, J. 2015. Salticidae (Araneae) of the world, online at: <http://www.peckhamia.com/salticidae/>

- [6] Sebastian, P.A. and Peter, K.V. 2009. Spiders of India, First edition, Universities Press, Hyderabad.
- [7] Tikader, B.K. 1987. Handbook of Indian Spiders. Calcutta, Zoological Survey of India, 251pp.
- [8] World Spider Catalog (2017). World Spider Catalog. Natural History Museum Bern, online at <http://wsc.nmbe.ch>, version 18.5, accessed on {date of access}. doi: 10.24436/2
- [9] Yadav, A., R. Solanki, M. Siliwal & D. Kumar (2017). Spiders of Gujarat: a preliminary checklist. *Journal of Threatened Taxa* 9(9): 10697-10716.

The Analysis of Creative and Innovative Thinking Skills of the 21st Century Students in Solving the Problems of “Locating Dominating Set” in Research Based Learning

Firma Yudha, Dafik, Nanik Yuliati

Mathematics Education Department, University of Jember, Jember, Indonesia
CGANT Research Group, University of Jember, Jember, Indonesia

Abstract—In the 21st century, creative and innovative thinking skill is greatly required. According to the P21 platform (Partnership for 21st century learning), someone will survive in the 21st century if they have the skills of creative and innovative skills. This study applies Research Based Learning (RBL), in which the level of the students' creative and innovative skills in class will be seen. The application of Research Based Learning (RBL) is done to the 34 students in the modeling class working on the problem of Locating Dominating Set. The data of his study was analyzed qualitatively to determine the level of creative and innovative thinking skills. Based on the result of the research, the level of the students' creative and innovative thinking skill is as follows: Out of 34 students, 3 students were chosen to represent critical thinking skill at level 4, 3, and 2. Each students has different character in accomplishing the A, B, and C test. Also, among those 3 students, the test result was analyzed during 3 meetings. The result showed that there was no students got 0 score of the critical thinking test. It means that the students master creative and innovative thinking skills in solving the problem, particularly in solving locating dominating set.

Keywords— Creative and innovative thinking skills, Research Based Learning, Locating Dominating Set.

I. INTRODUCTION

Mathematics learning is greatly needed by the students. The quality of Mathematics education in Indonesia is relatively low compared with other countries. To overcome these problems, educators should create a fun learning for the students, so that there are aptitude and interests of students towards Mathematics. In this new era, often referred to by the 21st century learning, the development of the 21st century is marked by the use of information and communication technologies in all aspects of life, including in the learning process, both from the aspect of education at schools, universities, as

well as in work place. The ability to think critically, solve problems and collaborate become an important competency in entering the life of this century. One lesson that might be done is Learners-centered learning, which is different to the traditional way of teachers-centered learning, in the sense that they both have different approaches to the content, instruction, classroom environment, assessment, and technology (Ekawati, 2011: 2).

Rotherdam & Willingham (2009) explain that the Partnership for 21st Century Skills demand everybody to master the 21st century skills that cover creative and innovative thinking skills, critical thinking skills, communication skills and collaboration skills, or it is called as the 4Cs. Meanwhile, according to the National Education Association to succeed and compete in the global community, students must be proficient and have the skills as communicators, creators, critical thinkers and collaborators (Assyaibani, 2016).

One of the aspects which are examined in this study is the level of creative and innovative students in solving a problem about locating dominating set. According to Guilford in Satiadarma (2003: 111), creative thinking is the thinking process spread (divergent) with an emphasis on diversity in terms of the number and suitability. Working in a creative idea to make something real and useful into a study where innovation will occur (Anonymous, 2015: 3).

Based on the previous background, there is a need for a specific research about the readiness of educators to face the 21st century education era. Thus, the researchers applied research based learning as a reference in learning process. The results of the research conducted by Assyaibani (2017: 19) has found out that the purpose of the Research Based Learning is to help students develop the intellectual abilities and a strong practical connection between the limits of its own research and student learning. Further, the aim of this research is to analyze

the ability of creative and innovative thinking skills students in solving the problem of locating dominating set by using research-based learning that lead to learning in 21st century, and later, students are able to think independently, and able to build up inspiration and ideas without the help of others.

One model of learning that can support and train the creative and innovative thinking skills of students is Research Based Learning (RBL) learning model. According to Dafik (2015), RBL is a learning method that uses contextual learning, authentic learning, problem-solving, cooperative learning, hands-on and minds on learning and inquiry discovery approach. Meanwhile, according Khamdit, RBL is a learning approach that emphasizes learning by practice, learn from real situations, produce something of the process of thinking, to work systematically, forming the individual's knowledge, using the research process to solve problems, generate response of doubts and analyze their data own (Assyaibani, 2016: 4).

SuchadaPoonpan (2001) states that (RBL) provides an opportunity or an opportunity for learners to search for information, draw up a hypothesis, collect data, analyze data, and make conclusions on data that has been arranged. RBL is a learning system that involves authentic problem solving with the viewpoint of the formulation of the problem and solve the problem, followed by communicating the benefits of the research results (Chamdani, 2015: 674).

The target of the application of RBL is encouraging the creation of high-level thinking skills in lecturers and students. Students are not only provided with information and knowledge, but they also must be encouraged to achieve a higher level, creating or communicating. Achievements to this level in learning theory are known as the achievement of higher level thinking skills translated from the sentences indicating Higher Order Thinking Skills (HOTS) (Dafik, 2015).

Lots of studies in learning, as well as discrete modeling studies, are available these days. Discrete modeling can be used to train students' creative thinking skills as they relate to the real world that can be solved in the right way according to the teaching of discrete modeling. Discrete modeling studies newly developed are pertinent to locating studies Dominating set, particularly dealing with locating Dominating set. We studied the development of dominating set. Dominating set is a concept of determining a point on the graph with the provisions dominating set point as to reach a point in the surrounding areas and to a minimum. The cardinality of the smallest of the so-called domination Dominating set number is represented by $\gamma(G)$. Dominating set D with $|D| = \gamma(G)$ minimum is called Dominating set. The upper

limit of the domination number is the number of points on a graph. When at least one point is needed to set domination in the graph, then $1 \leq \gamma(G) \leq n$ for each graph is air-order n . Value of domination number is always $\gamma(G) \leq |V(G)|$ (Haynes et al, 2002). While locating Dominating set is a graph $G = (V, E)$, which is said to be met if the set point locations domination dominator D qualify any different points outside D namely $V - D$ have different slices with D . For example, V set point and E set edge of the graph G , so that $\{u, v, \in V \setminus D\}$ then apply: $N(u) \cap D \neq \emptyset$ and $N(v) \cap D \neq \emptyset$, $2) u \neq v$ then $N(u) \cap D \neq N(v) \cap D$ (Honkala, 2002: 35).

In this study, there are three indicators to measure creative and innovative thinking skills of students, i.e. Think creatively, Work creatively with others, and implement innovation. The following criteria of three indicators are operative, according to anonymous, 2015. (1) Thinking creatively based on certain criteria, a) Ability to generate creative ideas such as arguments, b) creating something new both ordinary and extraordinary concept, c) collaborating their ideas for improving the creative output. (2) Working creatively with others based on certain criteria, a) Developing and implementing as well as communicating new ideas to others, b) working intensively in the group and were able to provide input into the work, c) Opening and responding to something new and different. (3) performing implementation and innovation with the following criteria, *inter alia*, a) Working in a creative idea to make something real and useful into a study where innovation will occur, b) producing something new, c) being able to work with my own results. Of each indicator criteria above, if the student is able to complete any of the aforementioned indicator properly, then it will get a score of 5 for each criteria.

Having obtained a score for each question for all students according to pre-determined indicators, the total score for each student was achieved. The score can be measured by the level of creative and innovative thinking ability as follows.

Creative Thinking skills level

Critical Thinking Skill Level	Score
Level 0 (Not Creative)	0-72
Level 1 (Hardly Creative)	72-144
Level 2 (Fairly Creative)	144-216
Level 3 (Creative)	216-288
Level 4 (Very Creative)	288-360

II. METHOD

The research method used in this research was descriptive qualitative method, because this study grappled with assessing and analyzing students' ability to solve problems that arose through the RBL. The population in

this study were all 6th-semester students who took a course in modeling. There were 34 people involved.

The steps in this study were divided into three stages, namely preparation phase, the implementation phase, and the final stage of the study. **The preparation stage** involves the establishment of a research group consisting of researchers / lecturers with expertise in the areas that will be studied, developing the syllabus, one-semester lesson plan, RTM (worksheet), MFI, and course outline to implement RBL in learning. **The implementation stage** covers the implementation and administration of the learning process in RBL, Research Activity Test (TAR). These stages include (1) providing basic information about the material being studied, (2) showing the results of the research faculty in the study group or research group concerning the material being discussed, and (3) dividing the students in discussion

groups, (4) distributing the assignment to students in the form of discussion groups on (a) the substance of the research, (b) the research process, (c) method of analysis, (d) formulation of conclusions, and (e) values that emerge from the research results (4) to faculty-led discussions among groups of students, (5) drawing conclusion under lecturer's guidance. At this stage the students were more engaged in learning. Lecturer act more as a facilitator. Where possible, during these discussions, if there are some problems that need literature, lecturers can support the students to gain required information through online media (internet) so that the problems faced by students can be missed. **The final stage**, which was related to doing the data processing, data analysis and drawing conclusion.

The steps in this research can be described in the following flowchart:

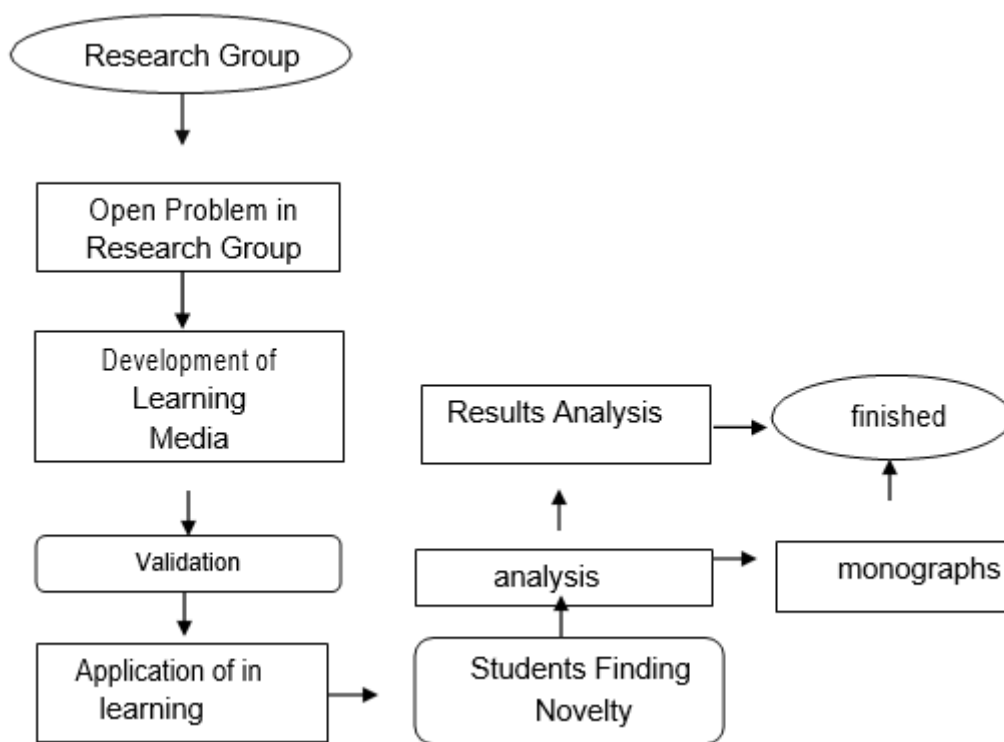


Fig. Flowchart lines of inquiry

In this study, the measured data were related to creative and innovative thinking ability of students accrued through the activities of Research Activities test the ability of students to construct a new graph that had not been studied previously in research locating determination Dominating set. The results of the TAR were then collected and analyzed for creative and innovative thinking skills of students based on three indicators: think creatively, work creatively with others, and implement innovation. Then the students' level of creative and innovative thinking skills were determined based on completeness of these indicators to see scores of

CTT/TBK (Creative Thinking Technique).

III. RESULTS AND DISCUSSION

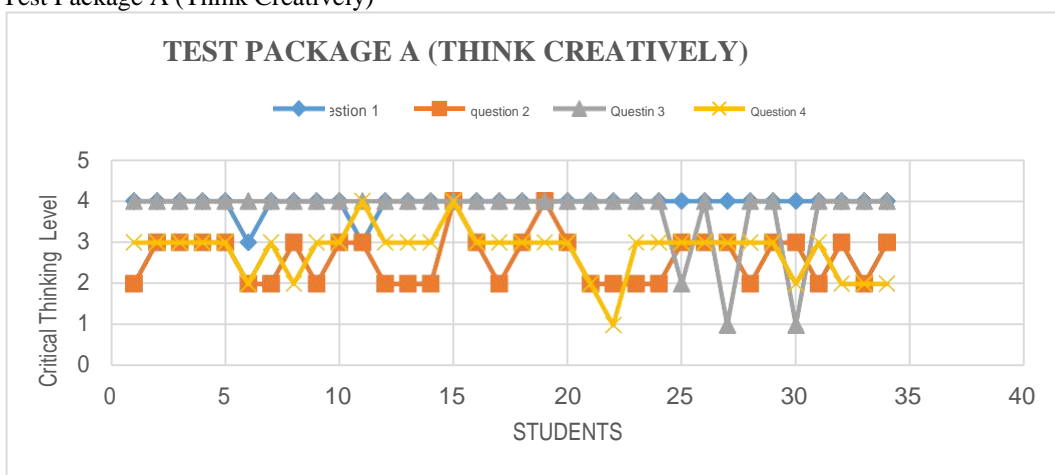
Initial activity in this research was to conduct research of planning in a research group, developing the required instructional instruments, planning the best possible learning implementation and indicators of what is needed to analyze the creative and innovative thinking skills of students of the test results in research activity. After planning, the researchers developed instructional instrument needed in research and the instruments were then validated by experts. The instruments included

validation results, the Student Worksheet and learning achievement test. Results of the validation of instructional instruments in this study were obtained on the mean value so that these results showed that the instructional instruments can be used in research. Once validation was done, the instructional instrument were for use, then the researchers carried out research in the classroom. The research was carried out four times of the meeting, where the first to the third meeting was meant to introduce the concept and flow of research in graph theory about locating Dominating set. Activities of researchers in managing class and activity of students in the class were rated by the observer, which aimed to determine the learning process. Both teacher's activities and activities of students in the class were observed and rated. Implementation of learning through RBL method

1. Test Package A (Think Creatively)

aimed to introduce the concept of Locating Dominating set as the research problem. After the introduction and explanation of the concept related to Locating Dominating set through learning RBL, then at the end of the learning, test was done. With this, students were expected to be able to generate new findings in the form of Determination Locating Dominating set that has never been studied before. Test results of research activities were undertaken by students and then analyzed to determine the students' level of creative and innovative thinking skills. Creative and innovative thinking skills of students were measured by three indicators aforementioned.

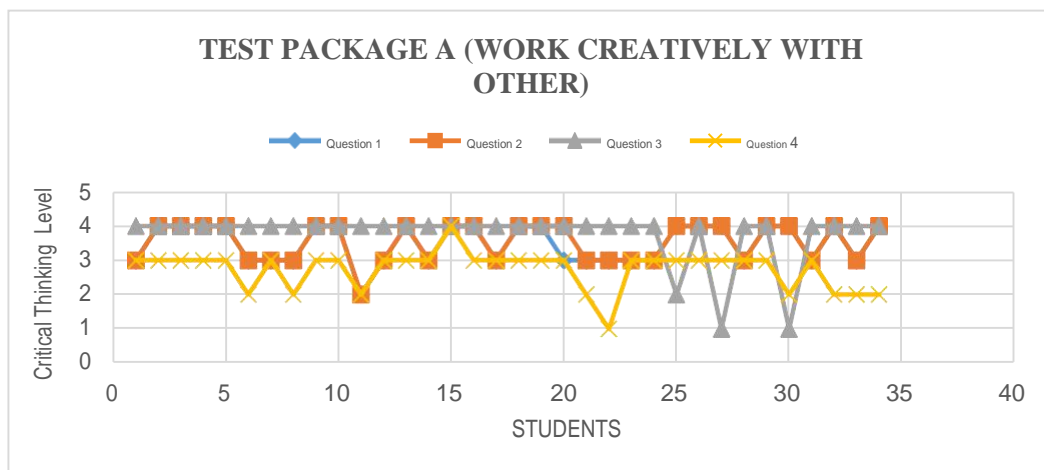
The following is the diagram of the students' test result score of Package A Test, Package B Test, Package C Test, with four (4) questions for each test.



Judging from the diagram above, for Question 1 there were 32 students who received a score of 4, and 2 student achieved a score of 3. The diagram clearly shows that the students are able to solve problem number 1. For question number 2, there were two student who achieved a score of 4. 17 student gained a score of 3, and 15 students obtained a score of 2. This meant that the students were creative and fairly creative in solving question number 2. For question 3, there were 30 students achieving a score of 4, and 10 students achieving a score of 2.

2. Test Package A (Work Creatively with Others)

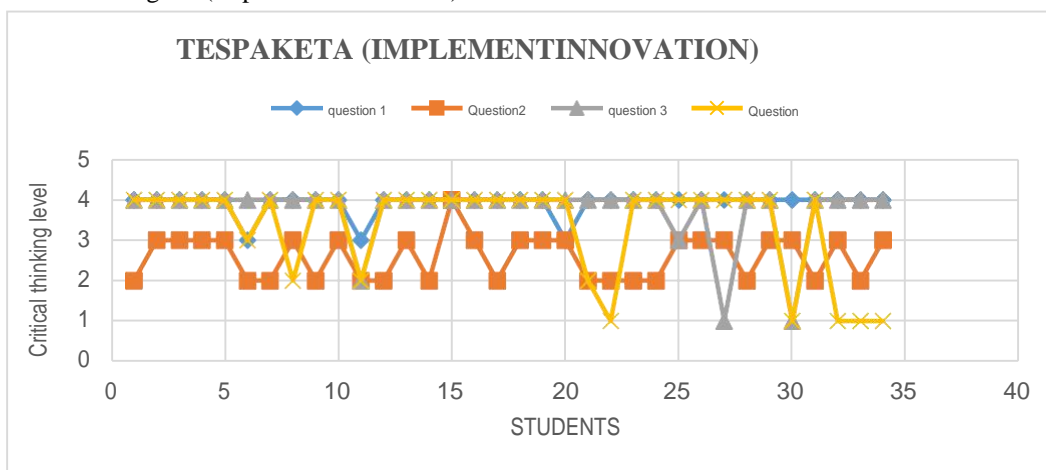
of 4. 2 students achieved score of 2 and 1. These results clearly indicated that the students were very creative, creative enough and there was indication of being hardly creative in solving number 3. On question number 4, 1 student achieved a score of 1. These values represent students' critical thinking levels, be it very creative, creative, fairly creative, or hardly creative in solving number 4, but most of them were creative students in solving the problem.



From the above diagram, 18 students obtained a score of 4. 15 students were at a score of 3, and 1 student was at a score of 2. As regard with question 1, students were proven able to complete the questions at very creative, creative and also fairly creative level upon working with others. In terms of question 2, there were 19 students achieved a score of 4, 14 student gained a score of 3 and 1 student gained a score of 2, which meant that students were very creative, creative and also fairly creative when working with others in solving number 2. For question 3, there were 31 students who obtained score of 4, 1 student was at a score of 2, and 2 students obtained a score of 1.

These figures implied that the students were very creative, hardly creative and fairly creative when working with others in solving number 3, but most students were very creative in completing the very question. On question 4, there was one student who got score of 4, 24 students were at a score of 3, 8 students obtained score 2, and 1 student obtained score 1. These inferred that students were at very creative, creative, fairly creative level and hardly creative work when they worked with others in solving the problem number 4, but most were proven creative in solving it.

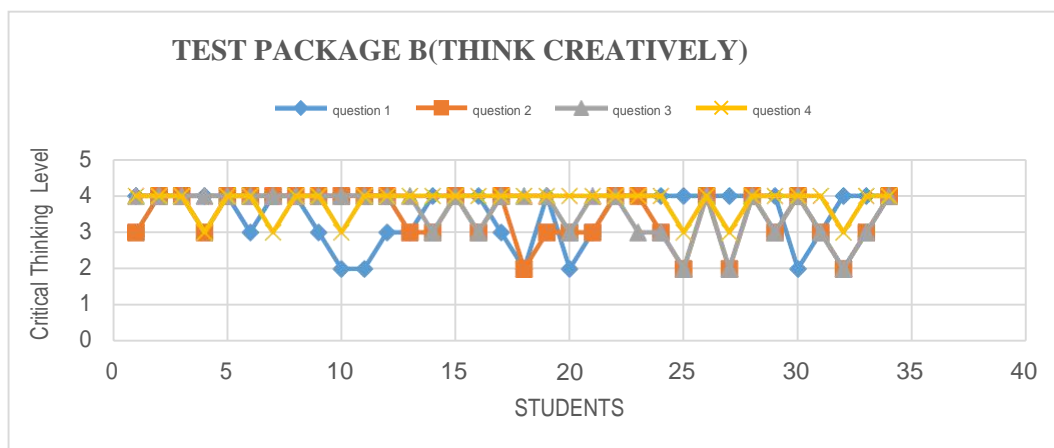
Test Package A (Implement Innovation)



In the diagram above it can be seen that there are 31 students in a score of 4, and 3 students gain a score of 3, meaning that the students are very innovative, and fairly innovative in solving number 1. For Question 2, there is one student at a score of 4, 18 students at a score of 3 and 15 students achieve a score of 2, which means that the students are very innovative, innovative, and fairly innovative in solving number 2, but most of them are innovative upon working on the questions. On question 3, there are 30 students obtaining a score of 4, 1 student achieved a score of 3, 1 student got a score of 2, and 2

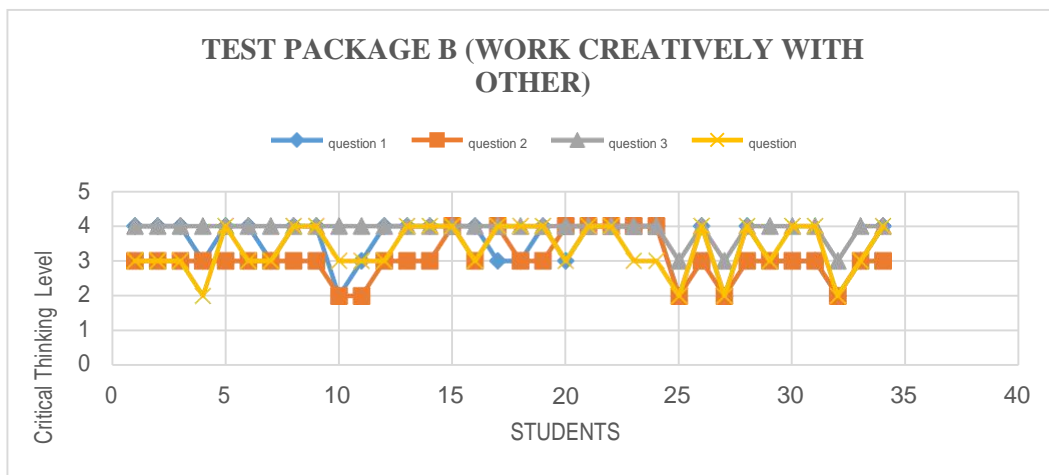
students were at a score of 1, meaning that students are very innovative, innovative, fairly innovative and less innovative in solving number 3, but most students are very innovative. On question 4, there are 25 students at a score of 4, 1 student is at a score of 3, 3 students achieved a score of 2, and 5 students obtained a score of 1, meaning that students were very innovative, innovative, fairly innovative, and hardly innovative in finishing question number 4, but most were very innovative in the finishing.

Test Package B (Think Creatively)



From the diagram above note on Question 1 there are 23 students who get score of 4, 8 students obtain score of 3, and 3 students in get score of 2, which shows that there are students who are very creative, hardly creatively and also fairly creative. However, most scores are very creative students in solving number 1. For question number 2 there are 17 students at a score of 4, 11 students at a score of 3, and 6 students at a score of 2, meaning that there are students who are very creative, creative, and fairly creative in solving problem number 2. On question 3, there are 23 students in a score of 4, 8 students in scores of 8 and 3 students at a score of 3, which means that there are students who are very creative, creative, and fairly creative in solving number 3. As for question number 4, there are 28 students who achieve score 4 and 6 students are at score 3. It means there are students achieving very creative and creative thinking level upon working on question number 4.

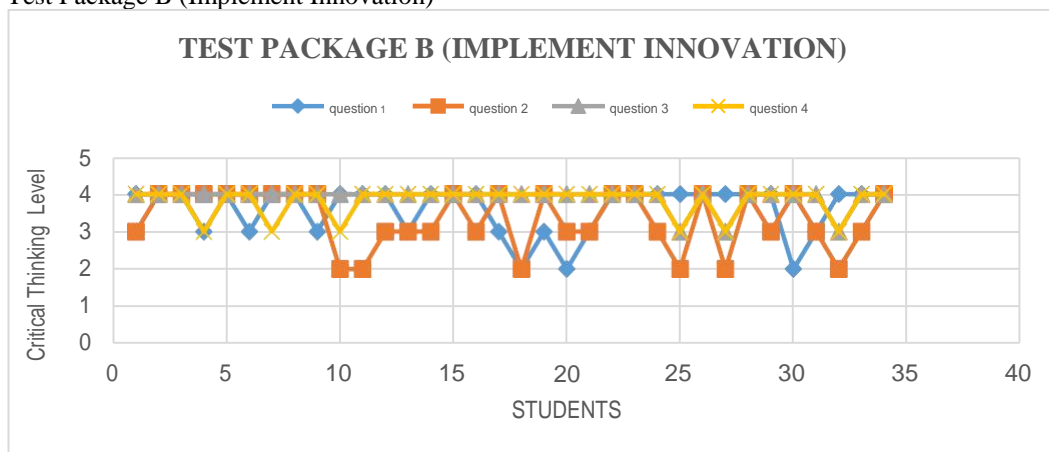
5. Test Package B (Work Creatively With Other



In the diagram above, on question 1, there are 20 students obtaining a score of 4. 10 students achieve a score of 3, and 4 students achieve a score of 2, meaning that the majority of students are very creative when working with the others. On question 2, there are 6 students who obtain a score of 4. 23 students are at a score of 3 and 5 students in a score of 2, it means some of the students work creatively with others in the problem number 2. On

6. Test Package B (Implement Innovation)

question 3, there are 31 students who get a score of 4, 3 students gaining a score of 3, which means students work very creatively with others when working on question number 3. While on question 4, there are 16 students who get a score of 4, 14 students who achieve a score of 3, and 4 students obtaining the score 2. That indicates that students are able to work together with other creative on question 4.

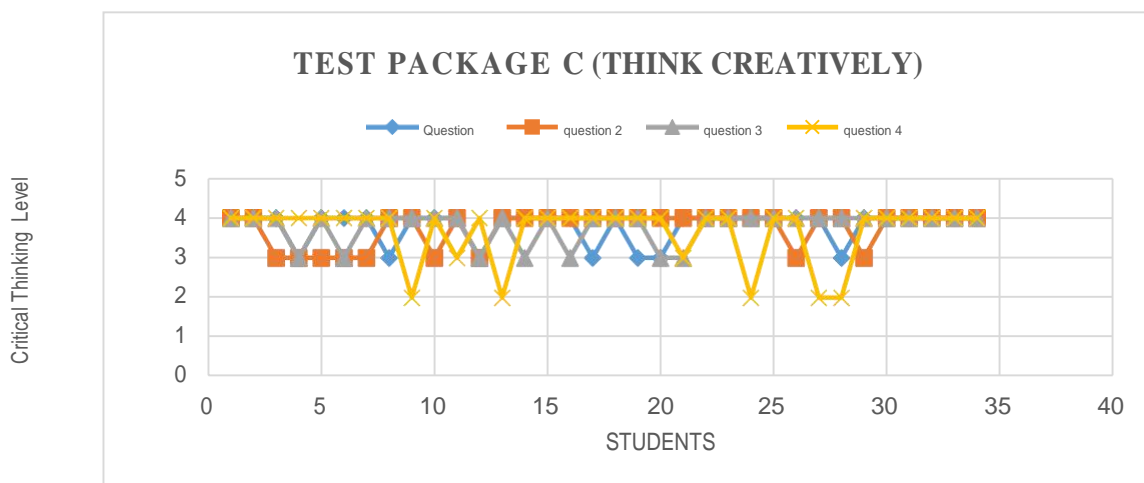


The results of the diagram above shows that there are 23 students who obtain a score of 4 and 8 students who get a score of 3 when working on the problem number 1. This means that the majority of students are very innovative. On Question 2, there are 17 students who gain a score of 4, 11 students who obtain a score of 3, and 6 students who gain a score of 2, so the majority of students are very

innovative on the problem number 2. In question number 3, there are 31 students who obtain a score of 4, and 3 students who gain score 3. It can be seen that the majority of students are very innovative in solving the problem number 3. While in question 4, there are 28 students who get a score of 4 and 6 students who achieve a score of 3, which means that the average students work innovatively

in working on question 4.

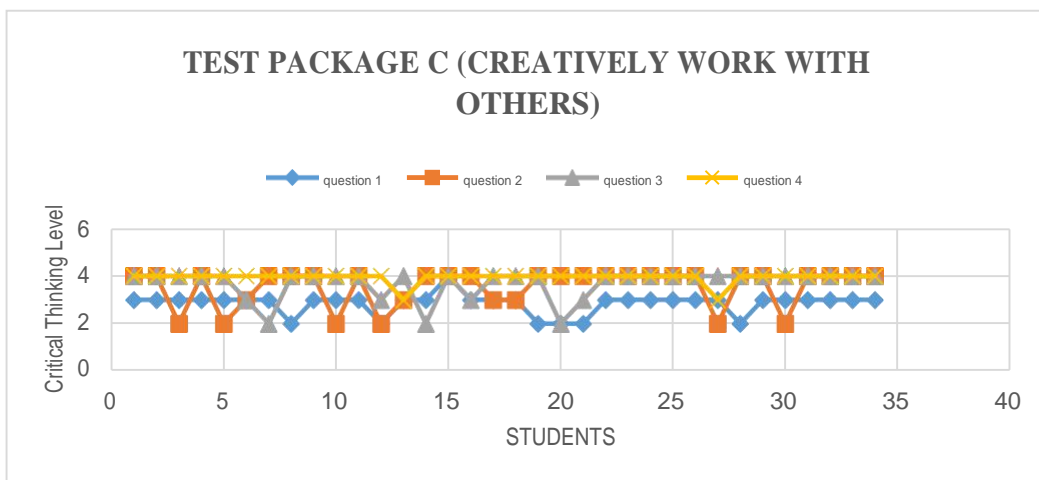
7. Test Package C (Think Creatively)



In the diagram above, there are 27 students who achieve a score of 4, 6 students who obtain a score of 3, and 1 student who gets a score of 2, which means that students are mostly very creative in solving question number 1. For question number 2 and 3, there are 27 students getting score 4, and 7 students achieving a score of 3, 8.

meaning that the students are very creative in solving number 2. As to question 4, there are 26 students who achieve a score of 4, 3 students who get a score of 3, and 5 students who get score 2. This means that the majority of students are very creative in solving problems on Question 4.

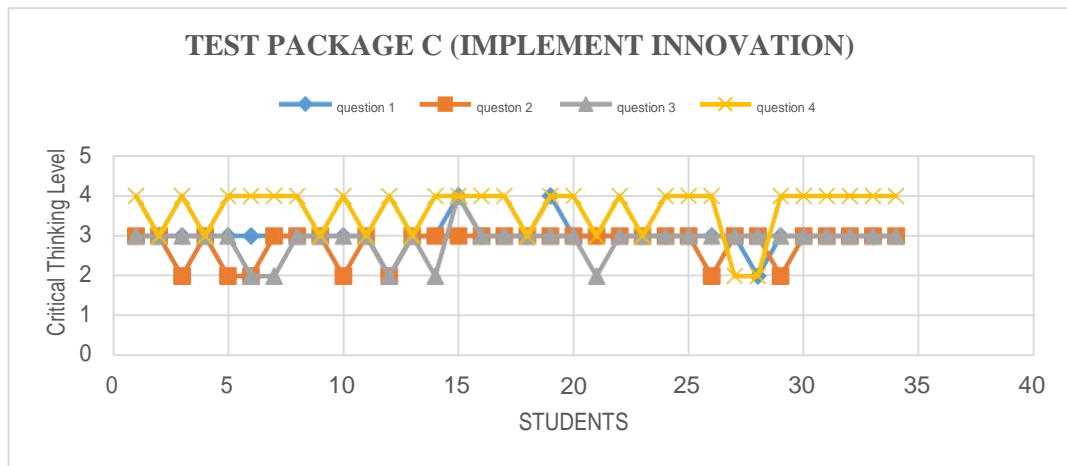
8. Test Package C (Work Creatively with Others)



As shown in the diagram above, there is one student who receives a score of 4. 27 students receive a score of 3. 6 students receive a score of 2. This means that most of the students are able to work creatively with others on the problem number 1. For question number 2, there are 24 students who receive a score of 4, 4 students who get a score of 3, and 6 students who gain a score of 2. Most students are at a score of 4, which means that students are very creative in working creatively with others in solving

number 2. On question number 3, there are 27 students who get a score of 4, 4 students who get score of 3, and 3 students who obtain a score of 2. This also includes highly capable students who can work creatively with others in solving question 3. On question 4, there are 32 students who get a score of 4, and 2 students who get a score 3, meaning that students are very capable of working creatively with others in solving number 4.

9. Test Package C (Implement Innovation)

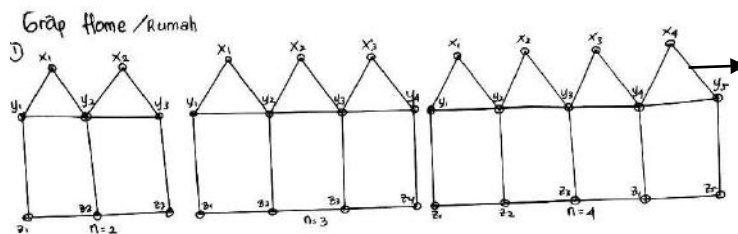


The diagram above shows that on question 1 there are two student who gets a score of 4, 30 students who receive a score of 3, and 2 students who get a score of 2, so most students are innovative in solving the problems. On question 2, there are 27 students who get a score of 3 and 7 students who receive a score of 2, which means that students are innovative in solving problems. On question 3, there is one student who achieve a score of 4. 28 students achieve a score of 3 and 5 students achieve a score of 2. Therefore, the majority of the students are at level 3. These figures have concluded the students are innovative in solving question number 3. On question 4, 1. Subject 1 (Critical thinking level 4), Nurul Fatkiyah

there are 24 students who receive a score of 4, 8 who students obtain a score of 3 and 2 students who achieve a score of 2, meaning that the students are very innovative in solving number 4.

Analysis of the Students' Creative and Innovative Thinking Skills

The graphs below show the analysis on process students go through upon solving the questions, indicative of creative and innovative thinking skills based on test package A



This graph can be expanded to $n = 4$

2) Menentukan kardinalitas

$$V = \{x_i ; 1 \leq i \leq n\} \cup \{y_i, z_i ; 1 \leq i \leq n+1\}$$

$$|V| = 3n + 2$$

$$E = \{x_i y_i ; 1 \leq i \leq n\} \cup \{x_i y_{i+1} ; 1 \leq i \leq n\} \cup \{y_i y_{i+1} ; 1 \leq i \leq n\} \cup \{y_i z_i ; 1 \leq i \leq n+1\} \cup \{z_i z_{i+1} ; 1 \leq i \leq n\}$$

$$|E| = 5n + 1$$

The cardinality is correctly determined because the result is correct as evinced by the odd and even graph

③ Menentukan Locating dominating set

$D = \{x_2, y_1, z_2\}$
 $V \setminus D = \{x_1, y_2, y_3, z_1, z_3\}$
 $N(x_1) = \{y_1, y_2\}$
 $N(y_2) = \{y_1, y_3, x_1, x_2\}$
 $N(y_3) = \{x_2, y_2, z_3\}$
 $N(z_1) = \{z_2, y_1\}$
 $N(z_2) = \{z_1, y_2, y_3\}$
 $N(x_1) \cap D = \{y_1\}$
 $N(y_2) \cap D = \{y_1, x_2, z_2\}$
 $N(y_3) \cap D = \{x_2\}$
 $N(z_1) \cap D = \{z_2, y_1\}$
 $N(z_3) \cap D = \{z_2\}$

There are 3 points dominator on graph $n = 2$

known point apart from dominator

Given also the point that side by side with $V \setminus D$

found resultsslice in different means penentuantik dominator correct proven.

Symbol of locating Dominating set

④ Kesimpulan

$\delta(r_2) = 5$
 $\delta(r_3) = 5$
 $\delta(r_4) = 6$
 Jadi $\delta(r_n) = \frac{3n+1}{2}, n \text{ ganjil}$
 $\frac{3n}{2}, n \text{ genap}$

Known locating results Dominating set at n odd and even

lead to the conclusion with formula n odd and even

2. Subject 2 (TBK 3), Ratna Damayanti

① Menentukan grap beserta ekspansinya

No listed the name of graph

Unknown how many graph n

Cardinality determination under proved to be true, to graph above

② Menentukan kardinalitas

$V = \{A, x_i; 1 \leq i \leq 2n\}$
 $|V| = 2n+1; n \geq 2$
 $E = \{Ax_i; 1 \leq i \leq 2n\} \cup \{x_i x_{i+1}; 1 \leq i \leq n\}$
 $|E| = 3n; n \geq 2$

③ Menentukan Locating Dominating set

$D = \{x_1, x_3\}$
 $V \setminus D = \{A, x_2, x_4\}$
 $N(A) = \{x_1, x_2, x_3, x_4\}$
 $N(x_2) = \{A, x_1\}$
 $N(x_4) = \{A, x_3\}$
 $N(A) \cap D = \{x_1, x_3\}$
 $N(x_2) \cap D = \{x_1\}$
 $N(x_4) \cap D = \{x_3\}$

symbol locating Dominating set

3 points dominator

point apart dominator

result different slices, LDS proved true

$D = \{x_1, x_3, x_5\}$
 $V \setminus D = \{A, x_2, x_4, x_6\}$
 $N(A) = \{x_1, x_2, x_3, x_4, x_5, x_6\}$
 $N(x_2) = \{A, x_1\}$
 $N(x_4) = \{A, x_3\}$
 $N(x_6) = \{A, x_5\}$
 $N(A) \cap D = \{x_1, x_3, x_5\}$
 $N(x_2) \cap D = \{x_1\}$
 $N(x_4) \cap D = \{x_3\}$
 $N(x_6) \cap D = \{x_5\}$

④ Kesimpulan

$S(DR_2) = 2$
 $D = \{x_1, x_3\}$
 $S(DR_3) = 3$
 $D = \{x_1, x_3, x_5\}$
 Jadi $S(DR_n) = n$

Dominator known the results of each graph

Graph formula besides no information, apply for n odd or even

3. Subject 3 (TBK 2), Recha Batista

① Membuat graf beserta ekspansinya

No names grap

Not clear F is a symbol of what gap name

② Menentukan Kardinalitas

$V = \{x_i; 1 \leq i \leq 2n\} \cup \{y_i; 1 \leq i \leq n+1\}$
 $|V| = 3n+1$
 $E = \{x_i y_i; 1 \leq i \leq 2n\} \cup \{x_i y_{i+1}; 1 \leq i \leq n\}$
 $|E| = 4n$

Determinatio cardinality is correct

Writing the wrong side symbol, which correct is only E

The above results are the works done by S1, S2 and S3. Here are the results of interviews with subject 1 (S1), the subject 2 (S2), and subject 3 (S3) in solving the problem of locating Dominating set class.

1. a. Interview with S1 (student name)
(TBK 4) Problem number 1

S1 : Ma'am, is it okay to do the graph this way?

P : It's okay. What is the name of the graph you created?

S1 : Is it fine if I name it home?

Q : Please, carry on. But make sure that the result is aligned with the graph.

S1 : for the notation can I use x, y, and z, Ma'am?

Q : Sure you can.

S1 : Okay thank you Ma'am.

P : Yes. You are welcome,

From the interviews above, it is clear that student S2 is very meticulous in determining graph, as seen from the response given by S1.

b. Interview with S1 Problem number 2

S1 : Ma'am, I try to determine the cardinality graph $n = 2$, the result is like this and if $n = 10$ means very long I write cardinality Ma'am.

Q : Do you remember the cardinality exemplified earlier on the board?

S1 : yes Ma'am, I do. This I noted. What's the matter Ma'am?

P : try to pay attention to how you can generalize it. Only then you can avoid working too much upon determining the cardinality.

S1 : I see, sorry. Let me give it a go, Ma'am.

Q : OK. Please carry on.

Based on the interview, it is clear that S1 was at first confused with how to determine the cardinality as he was not well prepared and did not pay attention to the examples previously given. However, S1 was very clever and quick to understand something new, and the result was very good, S1 could complete the question well and correctly according to what has been taught by the researcher.

c. interviews with S1 Question 3

Q : how is question number 3, can you do that?

S1 : Insya Allah (seems like we can) Ma'am.

P : If you've found a dominator point, try to check whether your graph meets the known dominator point.

S1 : Yes ma'am I have tried in about $n = 5$, and the results are patterned.

Q : Okay, so it means you have succeeded

in determining dominating set. Please proceed to the next question.

S1 : Yes ma'am, ready. Thank you ma'am.

Q : All right.

As seen from the interview above, it is clear that S1 did not have a problem to solve the number 4. That means S1 has mastered the material.

d. S1 interview question number 4

Q : Do you have difficulty in determining the number and dominating set to find the formula?

S1 : Alhamdulillah (Thanks god) I found no difficulty.

Q : Alhamdulillah, good then.

From this brief interview, we can conclude that S1 found it very easy to solve question number 4, and there were no problems at all, it means that the S1 was very creative in solving problems.

2. a. Interview with S2 (student name)
(Critical thinking level 3) Problem number 1

Q : What are difficulties you experienced when determining new graph?

S2 : No trouble ma'am, God has directed my imagination to make this graph. After that, I immediately proceed to the next step.

P : Okay, when you have to determine notation, are there any difficulties?

S2 : Maybe if I was given a new graph done by others, I would have difficulty Ma'am, because they do not understand the plot. But in my graph, I found no trouble, because I made a graph similar to what you had previously shown.

Q : Okay.

Judging from the above conversation, S2 found no trouble in finding the new graph, because when trying to create graph, S2 did not take a long time. He could immediately figure it out. But, S2 said that if given a new graph done by others, it might be difficult to resolve.

b. S2 interviews with Question 2

Q : What do you know about cardinality?

S2

Q : In determining the cardinality, is there any trouble?

S2 : No Ma'am

Q : Alhamdulillah. Good then.

S2 does not seem to have difficulties in determining cardinality, after researchers looked at the results of S2 on question 2. He could finish the problem properly.

c. interview with S2 Question 3

P : After completing question 3 especially dealing with determining locating dominating set, what

have you learnt?

S2 : I found that to determine locating dominating set was very difficult, because many failed attempts I did. After a few minutes I did finally find locating the Dominating set. It turned out that it was unique material. It made me curious.

P : Well, with a sense of wonder of that kind, then you have proven that you are successful at Dominating set. Keep it up.

S2 : Yes Ma'am thank you.

From the interview above, S2 is very interested in the lesson, because this material is very unique and intriguing. Usually with curiosity possessed, students will gain the spirit of learning.

d. interview with S2 Question 4

P : On question 4, concluded by Dominating number, do you find it difficult?

S2 : If you've found locating graph Dominating set for all the odd and even sets, it is not difficult to conclude. It's simply like searching and matching Ma'am.

Q : Matching?

S2 : yes mean after I found the formula in conclusion, I match whether the conclusions which I determine are correct.

Q : I see, okay thanks.

It can be seen from the above interviews that S2 does not find any difficulty in concluding formula in Locating Dominating sets when dominating number to graph odd and even has been found.

3. Interview with S3 (student name) (Critical thinking level 2)

a. interview with S3 Question 1

Q : How do you find the new graph?

S3 : Initially I make a scribble on blank paper Ma'am, thoughtfully, I was thinking about whether the graph I created would make perfect graph. After that, once I found graph, it turned out that it had something in common with my friend's. Finally, I replaced a new graph, until I discovered that I made this graph.

Q : In your opinion, is it a difficult question?

S3 : Yes it was difficult Ma'am. It took quite a long time to find a new graph. And it got me confused. I am looking for ideas for this graph.

P : Well, that is important to be enthusiastic in seeking graph, I guess. Also it is important not to be desperate to find a new graph.

S3 : Yes Ma'am. Thank you

Q : You're welcome.

The conversation above shows that the S3 found it very difficult to determine a new graph. According to her

response, it required a very long time to create a graph. Moreover, he thought that her work should not be the same as her classmates'. However, S3 was able to find a new graph.

b. S3 interview with Question 2

P : Well, on question 2, to find cardinality, are there any difficulties?

S3 : at first there might be problem, Ma'am, because at first I tried to determine my cardinality, yet it was not generalizable. But after that I worked with a friend next to me, and finally I was able to determine the cardinality of graph I created.

Q : Okay if so. Would anyone like to ask?

S3 : No, Ma'am.

P : All right then.

From the conversation above, it can be seen that the S3 has been accustomed to determining cardinality which is not generalizable. Although generalizations can facilitate students, with the lack of communication with his peers, S3 finally was able to finish the problem.

c. interview with S3 Question 3

Q : In determining locating Dominating set, did you work on your own?

S3 : Yes Ma'am

Q : Is there any problem?

S3 : The difficulty was when understanding the existing point Ma'am. That made it difficult and it took a long time.

Q : Do you feel bored when you searched the dominator point?

S3 : Not at all Ma'am, but irritated, as the result of the cut was always the same.

Q : But it is unique right?

S3 : Yes Ma'am.

Q : There is a silver lining in every cloud, right? So, your patience will be trained. Please, continue.

S3 : yes Ma'am.

From the interview above, S3 difficulty in determining the dominator point, but with patience he did eventually manage to solve the issue.

d. interview with S3 Question 4

Q : For question number 4, I think there is nothing wrong in writing. Maybe you have less scrupulous, or was tired because it was irritated by Question 3 earlier.

S3 : No Ma'am, it's because I lack the focus on the writing.

Q : Do you find something wrong?

S3 : Yes Ma'am there are some. It should be but I write f. Sorry Ma'am.

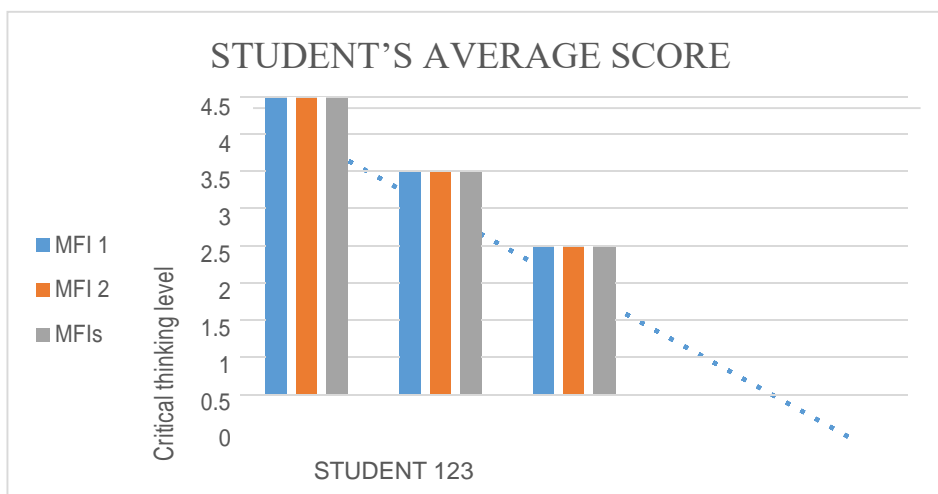
P : Okay, no problem. Next time you must be thorough and focused.

S3 : Yes Ma'am.

From interviews with S3 above, it is clear that S3 was hardly careful in doing the task, eventually an error

occurred.

The following diagram shows the students' average score on test package A, B, and C.



The results of the analysis of creative and innovative thinking skills of students can be classified into four levels of creative thinking and the three indicators. Of the 34 students, drawn 3 students who score critical thinking level 4, 3, and 2. It is also clear that every student has a different character in accomplishing the test package A, B, and C. Of the three students analyzed according to the results of the test class for 3 meetings, no student achieve 0. This critical thinking level indicates that the students are creative and innovative in solving problems, especially in resolving locating dominating set.

IV. CONCLUSION

Researchers/lecturers can apply this research into learning through RBL methods so that students would know the progress of the latest research, and students gain experience in conducting research. Students will be directed to a higher level thinking of creative and innovative thinking. Being creative in this study relates to how students can find a new graph that has not been previously investigated and the findings of these students are then analyzed to determine the level of creative and innovative thinking of the students. Based on the results, the application of RBL method to analyze the creative and innovative thinking skills of students revealed that, out of 34 students, 3 students achieved critical thinking level 4, 3, and 2. Also, the study reveals that the student has a different character in accomplishing the test package A, B, and C. Of the three students analyzed according to the results in test class for 3 meetings, the results show no students achieving critical thinking level 0. This means that the students are creative and innovative in solving problems, especially in resolving locating dominating set.

Based on those results, we propose the following suggestions for further research:

1. How can RBL be applied in other research studies?
2. What is the novelty in assessment obtained in the application of the RBL?
3. What are the obstacles faced by researchers when applying RBL in learning?

ACKNOWLEDGMENTS

We thank the support of the "Research Group" CGANT - Jember University in 2018.

REFERENCES

- [1] AD Jumani, L. Chand, Dominating Number of Prism Cycle over C_n , Sindh University Research Journal (Science Series), Sindh Univ. Res. Jour. (Sci. Ser) Vol.44 (2) 237-238 (2012).
- [2] Afidah et al. 2012. The Influence Of Application Method Socratic Circles With Images Media Toward Student's Creative Thinking Skill. Vol 4. No. 3. 1-15.
- [3] Anonymous. 2015 "21st Century Student Outcomes". P21 Partnership For 21st Century Learning: 3.
- [4] Argiroffo, GR, Bianchi, SM .2015. "A polyhedral Approach to Locating Dominating Sets in Graphs". Electronic Notes in Discrete Mathematics, 50: 89-94.
- [5] Arvyati et al. 2015. Effectivity Of Peer Tutoring Learning To Increase Mathematical Creative Thinking Ability Of Class XI IPA KendariSman 3, 2014. International Journal of Education and Research, Vol. 3 No. 1 January 2015, pages 613-628.
- [6] Caroli, ME and Sagone E., 2009. Creative Thinking And Big Five Personality Factors Of Measured In Italian Schoolchildren. Sage journals, Vol 105, Issue

- 3,
2009.[http://journals.sagepub.com/doi/pdf/10.2466/P
R0.105.3.791-803](http://journals.sagepub.com/doi/pdf/10.2466/P
R0.105.3.791-803).
- [7] Chamdani et al. 2015. Based Learning Model Development Research Scientific Approach Through Lesson Study in Learning Ips Primary Schools Year 2015. Proceedings of the national seminar on education. Ponorogo: Guidance and Counseling, University of Muhammadiyah.
- [8] Dafik. 2015. Handbook for the Implementation of RBL (Research-Based Learning) in the Courses. Jember: Jember University.
- [9] Dafik. 2016 PBR Development (Research Based Learning) in a subject.
- [10] Environmental Impementasi Unej PBR. Jember: Jember University.
- [11] Foucaud, F. Henning, MA 2016. "Locating-Dominating Sets in Twin-Free Graphs".
- [12] *Journal of Discrete Applied Mathematics*, 200: 52-58.
- [13] Khamdit, Sinthawa. 2014. Research-Based Learning (RBL) in Higher Education.
- [14] SUTHIPARITHAT Vol.28 # 85 January - March, 2014.
- [15] Siswono, EkoYuliTatag. 2011. Level of student's creative thinking in mathematics classroom. *Educational Research and Review* Vol. 6 (7), pp. 548-553, July 2011, ISSN 1990-3839 © 2011 Academic Journals.
- [16] Slater, PJ 2002. Locating Fault-Tolerant Dominating Sets. *Discrete Mathematics*, 249: 179-189.

Improve Performance of FLASE Alarm Detection by using CFAR and Low Pass Filter

Anita Didel

Abstract— Cyber-Physical System (CPS) is an integration of physical systems with computation, communication and controlling. CPS has various applications such as power networks, transportation networks, healthcare applications, infrastructures and industrial process. CPS connects the virtual world with the physical world. Wireless Sensor Networks (WSN) are the vital part of CPS because they have the strong sensing capabilities. In CPS healthcare application various sensors are used to collect the data from patients. Many times these sensors generate a large number of false alarms. Due to these false alarms confusion is created and it reduces the efficiency of overall healthcare services. There are still a lot of challenges in healthcare such as interoperability, security and privacy, autonomy and device verifiability. In this paper, we improve the performance of false alarm detection by using CFAR (constant false alarm rate) and the low pass filter. Thus we are using low pass filter here because our actual values will be present in the lower frequency region. The noise has

higher frequency thus we tend to remove them by using a low pass filter.

Keyword— CFAR, CPS, WSN.

I. INTRODUCTION

Cyber-Physical system is attracting a lot of attention in recent years but it is still consider as a nascent technology. CPS combines the physical systems with the information (cyber) systems. CPS was identified as a key research area in 2008 by the US National Science Foundation (NSF) and was selected as a number one research priority by the President’s Council of Advisors on Science and Technology. CPS have wide range of applications such as transportation, power management, healthcare, infrastructure, assisted living and monitoring network. The architecture of the CPS must contain the variety of physical information, reliable data analysis, event detection and security.

The architecture of CPS in healthcare is given below:-

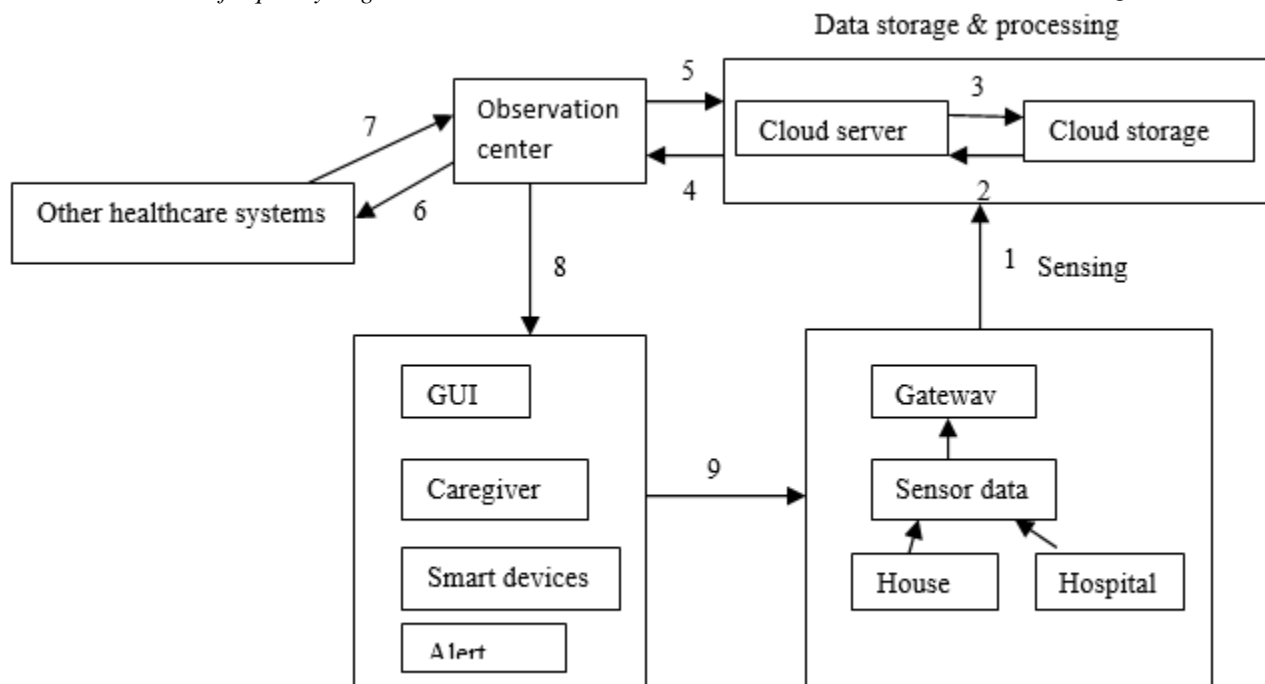


Fig.1: Architecture of CPS in Healthcare

In the above fig. we explain that how data is sensed and then transferred to the different units for the processing.

- The data is collected from the houses and hospitals via sensors and sent to the data storage and processing unit via gateway.
- In data storage and processing unit the cloud server calls the data which is stored in cloud storage and then again stored it on into cloud storage.
- Stored data is then sent to the observation center for processing.
- If it is required physicians approach other healthcare systems for consultation.
- The observation centre then sent the decision to the actuation components.
- Necessary actions are taken on the patients.

In health care application, a wide variety of sensors are used. Sensors can be heterogeneous as well as homogenous. There can be multiple sensors for a person and a single parameter sensing system for a group of people .The medical data is vital for saving patients life, all data must be readily available and accessible to the authorized medical persons and healthcare center. The sensors must alert the clinical in any emergency case. Many times the sensors generate a lot of unwanted false alarms. Due to presence of noise signals the actual alarm are missed. In this paper, we use the CFAR (constant false alarm rate) and low pass filter (trapz filter).By using this low pass filter we get only actual alarms.

Literature Review

In this section we have discuss the previous work .

- [SHAH AHSANUL HAQUE,et-al]He proposes the anticipated configuration a way to ensure the location configuration. It means to blend the edge alert procedure with various classifiers in call set. Moreover, the anticipated configuration intends answer some nonreciprocal questions like culmination, cautioning discovery and right caution era.

The configuration proposes to use various classifiers and contrast those and essential wellbeing data from patients for location cautioning of medicinal sensors. He proposes a structure that is relied upon to perform higher with respect of exactness, power and great cautioning gadget. But this approach does not guides us the exact location or the configuration to be cured.

- [TIANBO LU, et-at]He proposes a security system consoling the wellbeing of digital physical systems and examine fundamental colleges and organizations figuring out CPS security and their relations in 3 levels: CPS security targets, CPS security methodologies and security in particular CPS applications. The most security methodologies on location digital physical assaults and consoling CPS security are recorded and dissected.

There are still a few difficulties confronting planners, administrators and scientists. This is regularly unacceptable, and ideally, by giving an outline of the writing endeavors done; the synopsis can contribute in giving reference to research laborer inside of the space of CPS security.

- [LU-AN TANG, et-at] He proposes a route alluded to as True Alarm that discovers dependable alerts. Genuine Alarm evaluates the areas of articles delivering alerts; builds an article alert diagram and completes attribute surmising upheld coupled data inside of the Graph. Inside and out trials demonstrate that True Alarm sift through commotions and false data quickly and ensures not missing any deliberate alerts. This paper concentrates on the matter of attribute examination in digital physical systems. The creators propose the caution and item trust models of finder system. Inside of the True Alarm structure, the system builds an article caution diagram and does the attribute illation on the connections of such chart. Inside and out analyses are directed to show the quantifiability and pertinence of anticipated ways.

II. PROBLEM STATEMENT

In CPS healthcare application doctors and physicians play an important role. They have to observe the patient from anywhere and anytime .The patient data must be access by them accurately. False alarm detection is a very important in healthcare monitoring. In CPS healthcare application, various type of medical sensors are used, however these sensors produce a larger than average mixture of false alerts. It depends on Probability of false alarm and Probability of detection. According to previous work probability of detection is low, that means system is not able to detect false alarm and it is passing to the receiver. So that means as the SNR (signal to noise ratio) get increase the Probability of false alarm detection get low.

III. PROPOSED METHODOLDY

Here we have proposed CFAR in CPS where using threshold filtering, remove the unwanted noise and regain for our required output. We can observe the change in detected and ghost bits on basis of required SNR for various systems. We are also introducing trapz filter function. Thus we are using low pass filter here because our actual values will be present in the lower frequency region. The noise has higher frequency thus we tend to remove them using a low pass filter. According to proposed methodology probability of false alarm detection is getting increase. System is more able to get false alarm detection. By the proposed system PD is getting increase and the PFA is decreasing that means system is more perfect to detect false alarm system.

CFAR (constant false alarm rate) identification alludes to a typical type of adaptive algorithm utilized as a part of radar systems to recognize target returns against a foundation of interference, clutter and noise

In radar receiver returning echoes are commonly gotten by the antenna, amplified, down converted and after that went through detector circuitry that concentrates the envelope of the signal (known as video-signal). This video-signal is relative to the force of the got echo and involves the needed echo-signal and the undesirable power from external clutter, interference and internal receiver noise.

The part of the circuitry of constant false alarm rate is to focus the threshold power above which any arrival can be considered to presumably start from an objective. On the off chance more targets is then recognized for low threshold to the detriment of expanded quantities of false alarms. On the

other hand, fewer targets is recognized for too high threshold, however the quantity of false alarms will likewise be low. Most radar-detectors, threshold is situated with a specific end goal to accomplish an obliged probability of false alarm (or comparably, false rate alarm or the time in between false-alarms.

In the event that the foundation against that targets are detected is then constant with the space and time, and then an altered threshold level can be picked that gives a predefined probability of false alarm, represented by probability-density-function of noise, that is generally thought to be a Gaussian. Detection Probability is then functions of target return SNR. Notwithstanding, in most fielded systems, interference sources and undesirable clutter imply which the noise-level changes both temporally and spatially. For this situation, a changing threshold can be utilized, where the threshold level is raised and brought down to keep up constant-probability of a false-alarm. It is known as CFAR detection.

Proposed False Alarm Detection Architecture:-

The proposed architecture in CPS healthcare application integrates physical and virtual systems by sensing, computation and communication. New technologies are advance in integration and miniaturization of sensors, microcontrollers and radio interfaces on one chip. Wireless networking and micro fabrication generates the wireless sensor networks which are suitable for many applications [2]. Many wearable medical devices and sensors are playing an important role in application of healthcare [2,3, 12-14].

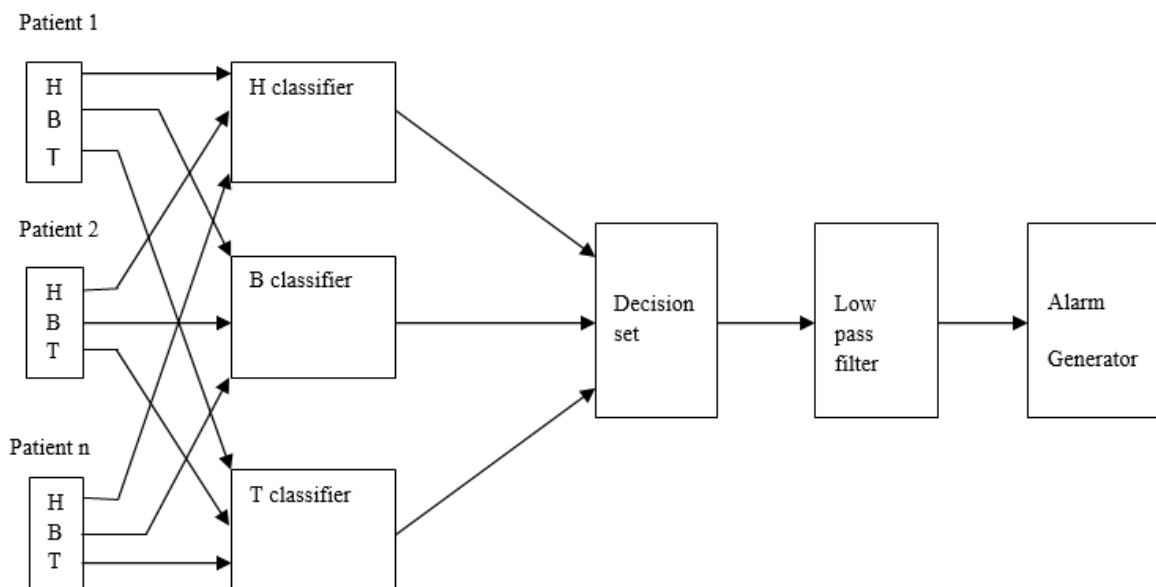


Fig.2: Proposed alarm architecture.

In the above architecture we consider n no. of patients having their heart rate(H), brain signal(B),body temperature signals provided by sensors respectively. These signals are then passes to their respective classifiers. After this the signals are transferred to the decision set. Decision set passes the signals only which crosses the threshold value to the low pass filter. In low pass filter the noise signals (high frequency signals) are rejected and the signals with low frequency are passes. Then the alarm is generated for actual signals.

Mathematical calculations:-

Probability of detection is calculated by

$$PD = ND/NS$$

Where

ND= No.of detected bits

NS=total no. of signal bits

Probability of false alarm is calculated by

$$PFA = NG/Nn$$

Where

NG=No. of ghost bits

NnS=total no. of noise bits

IV. RESULTS

MATLAB simulations have been conducted to calculate the approximate threshold alarm generation. For samples 5, 10,100,500,1000,2000,5000,7500,10000 and 20000 incidents and the threshold level is variable. The probability of detection is increases and the probability of false alarm is decrease in comparison with previously calculated. It means that the result is improved. This can be easily understand by the given table:-

Fig.3: Table for SNR(db)=10

S.no	No.of samples	PD of base paper	PD of improved paper	PFA of base paper	PFA of improved paper
1.	5	0.667	0.750	0.000	0.000
2.	10	0.400	0.500	0.000	0.000
3.	100	0.481	0.686	0.000	0.000
4.	500	0.512	0.697	0.000	0.017
5.	1000	0.522	0.552	0.002	0.007
6.	2000	0.505	0.521	0.003	0.003
7.	5000	0.519	0.577	0.001	0.005
8.	7500	0.493	0.470	0.001	0.006
9.	10000	0.488	0.465	0.001	0.005
10.	20000	0.503	0.533	0.001	0.007

This table shows the results when the SNR (db)=10. Similarly we can calculate for different values of SNR.

The probability of detection is higher for less SNR(signal to noise ratio) and probability of detection is decreases for high SNR values.

The graph generated for SNR(db)=10 is given below:-

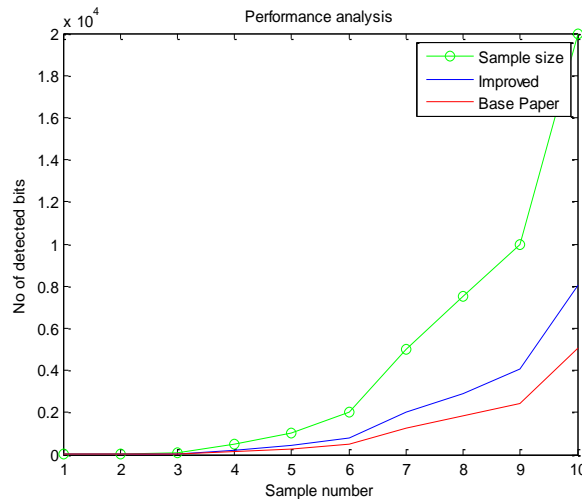


Fig.4: Comparison with previous results.

The graph with different values of SNR and the probability of detection is shown :-

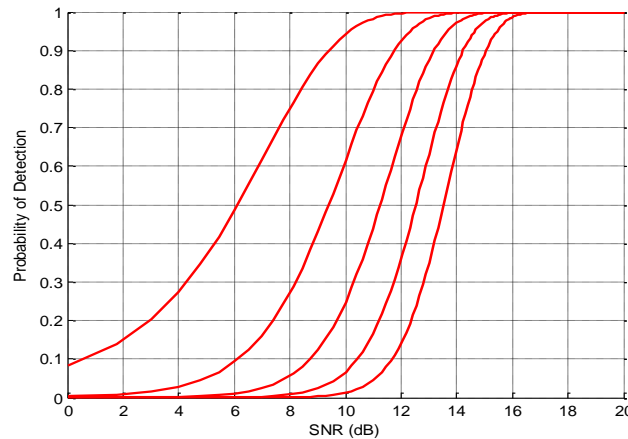


Fig.5: Relation between SNR and Probability of detection

V. CONCLUSION AND FUTURE WORK

False alert location plan for CPS health care application has been arranged. CFAR and low pass filter are able to detect more False alarms The Value of PD get increase according to the proposed methodology. In future we resolve to investigate the security issue and execute ideal model outline amid a health care situation.

REFERENCES

[1] J. Wang, H. Abid, S. Lee, L. Shu, and F. Xia, "A Secured Health Care Application Architecture for Cyber-Physical Systems," *Control Engineering and Applied Informatics*, 2011.
 [2] A. Milenkovic, C. Otto, and E. Jovanov, "Wireless sensor networks for personal health monitoring: Issues and an implementation," *Computer Communications*, vol. 29, pp. 2521-2533, 6 March 2006.

[3] E. Jovanov, A. Milenkovic, C. Otto, and P. C. d. Groen, "A wireless body area network of intelligent motion sensors for computer assisted physical rehabilitation," *Journal of NeuroEngineering and Rehabilitation*, vol. 2, 2005.
 [4] V. Shnayder, B.-r. Chen, K. Lorincz, T. R. F. F. Jones, and M. Welsh, "Sensor networks for medical care," presented at the Proceedings of the 3rd international conference on Embedded networked sensor systems, San Diego, California, USA, 2005.
 [5] F.-J. Wu, Y.-F. Kao, and Y.-C. Tseng, "From wireless sensor networks towards cyber physical systems," *Elsevier Pervasive and Mobile Computing*, pp. 397-413, 2011.
 [6] A. Lounis, A. Hadjidj, A. Bouabdallah, and Y. Challal, "Secure and Scalable Cloud-based Architecture for Health Wireless sensor networks," in *International*

- Conference on Computer Communication Networks (ICCCN)*, Munich, Germany, 2012.
- [7] R. R. Rajkumar, I. Lee, L. Sha, and J. Stankovic, "Cyber-Physical Systems: The Next Computing Revolution," presented at the Design Automation Conference, Anaheim, California, USA, 2010.
- [8] F. Xia, L. Ma, J. Dong, and Y. Sun, "Network QoS Management in Cyber-Physical Systems," presented at the Int'l Conf. Embedded Software and Systems Symp., 2008.
- [9] F. Xie. (2006, Component-Based Cyber-Physical Systems.
- [10] C. O. Rolim, F. L. Koch, C. B. Westphall, J. Werner, A. Fracalossi, and G. S. Salvador, "A cloud computing solution for patient's data collection in health care institutions," presented at the Second International Conference on eHealth, Telemedicine, and Social Medicine, ETELEMED '10, St. Maarten, Netherlands, 2010.
- [11] B. Perumal, P. Rajasekaran.M, and H. M. Ramalingam., "WSN Integrated Cloud for Automated Telemedicine (ATM) Based e-Healthcare Applications," presented at the 2012 4th International Conference on Bioinformatics and Biomedical Technology IPCBEE, Singapore, 2012.
- [12] D. Arney, S. Fischmeister, J. M. Goldman, I. Lee, and R. Trausmuth, "Plug-and-Play for Medical Devices: Experiences from a Case Study," *Biomedical instrumentation & technology / Association for the Advancement of Medical Instrumentation*, vol. 43, pp. 313-317, 2009.
- [13] J. M. Feldman, M. H. Ebrahim, and I. Bar-Kana, "Robust Sensor Fusion Improves Heart Rate Estimation Clinical Evaluation," *The Journal of Clinical Monitoring*, vol. 13, pp. 379-384, 1997.
- [14] Z. Jiang, M. Pajic, and R. Mangharam, "Cyber-Physical Modeling of Implantable Cardiac Medical Devices," *Proceedings of the IEEE*, vol. 100, pp. 122-137, January 2012 2012.
- [15] M. Imhoff and S. Kuhls, "Alarm algorithms in critical care monitoring," *Anesthesia and analgesia*, vol.102, pp. 1525-1537, 2006.
- [16] P. Kulkarni and Y. O'ztu'rk, "Requirements and Design Spaces of Mobile Medical Care," *Mobile Computing and Communications Review*, vol. 11, pp. 12-30, 2007.
- [17] C. C. Y. Poon, Y.-T. Zhang, and S.-D. Bao, "A novel biometrics method to secure wireless body area sensor networks for telemedicine and m-health " *IEEE Communications Magazine*, vol. 44, pp. 73-81, 2006.
- [18] W. Dargie and C. Poellabauer, *Fundamentals of Wireless Sensor Networks Theory and Practice*: Wiley, 2010.
- [19] C. Buratti, A. Conti, D. Dardari, and R. Verdone, "An Overview on Wireless Sensor Networks Technology and Evolution," *Sensors*, vol. 9, pp. 6869-6896, 2009.
- [20] L.-A. Tang, X. Yu, S. Kim, J. Han, C.-C. Hung, and W.-C. Peng, "Tru-Alarm: Trustworthiness Analysis of Sensor Networks in Cyber-Physical Systems," presented at the IEEE International Conference on Data Mining, Sydney, NSW, 2010.

Multiple-criteria stem bucking (*Picea abies* L. Karst.) for maximizing monetary value of timber trade

Teijo Palander^{1*}, Joonas Mutanen², Kalle Kärhä³, Juha-Antti Sorsa⁴, Tapio Räsänen⁵

^{1,2}University of Eastern Finland, P.O. Box 111, FI-80101 Joensuu, Finland

³Stora Enso Wood Supply Finland, P.O. Box 309, FI-00101 Helsinki, Finland

^{4,5}Metsäteho Ltd. Vernissakatu 1, FI-01300 Vantaa, Finland

Abstract— In this study, timber trade scenarios are considered in a wood procurement region of Finland. This multiple objective decision-making situation includes the timber purchase from forest owners and the lumber sales from sawmill to abroad. The situation is further complicated by a number of stem bucking instructions of sawmill during different periods. In practice, this decision problem has been solved by applying single-objective stem bucking instructions in harvesters. Due to the complex nature of the problem, single-objective solution can't be directly used to support the timber trade in a manner that it is techno-economically relevant to the forest owners and industries. In this study, stand parameters and timber trade attributes were measured in local wood procurement conditions to improving the bucking instructions. Three scenarios of how the simulation system works based on the real stem diameters and optional monetary value of logs are investigated in the timber-trade process. The Finnish timber trade market is subjected to agreements regarding stem bucking regulations. These agreements could be made on the basis of the three criteria suggested in this study accounting for the effects of stand classification on the timber sales of forest owners and the lumber sales of export companies.

Keywords— cut-to-length method, forest industry, forest owner, multi-criteria analysis, stem bucking, wood procurement.

I. INTRODUCTION

In Finland, the average annual timber trade of industrial softwood logs has been 23 million m³ (sob) during recent years of which the share of Norway spruce (*Picea abies* L. Karst.) logs cuttings were 54% (Forest wood removals by forestry centre 2017). In the current wood procurement logistics, the cut-to-length method with stand's harvesting instructions are used for managing the timber trade process in a manner that wood procurement of forest industry is acceptable to forest owners (Palander 1998, Palander et al. 2009). On the one side of the wood procurement process,

stands can be harvested into favorable log dimensions (log assortment) to sawmill. In this customer-driven process, the sawmill customer has market information about the demand of lumber markets for constructing of a target distribution of logs. On the other hand, stand's harvesting instructions of the forest industry are subject to the available wood supply of timber trade markets (Palander et al. 2009). Therefore, the target distribution must consider various agreements of different timber trades and preferences of forest owners in the markets (Figure 1).

In forest stands, harvester's computer optimizes several bucking alternatives for each stem by taking into account stand's bucking instructions for the harvester operator, which include the price matrix, target distribution and the various other bucking guidelines. The operator can use the bucking proposals displayed by the harvester computer (i.e. automatically bucking) at the harvesting site. The harvester operator can also utilize manual bucking to cut damaged or defected parts of log stems (Kärhä et al. 2017). If the manual bucking is used, the operator decides the crosscutting point of logs without the bucking proposals displayed by the automatically bucking system. In this respect, the harvester operator can consider local wood procurement conditions for improving the bucking outcome. By the other words, the operator can subjectively adjust the bucking solution to better solve the combinatorial complexity of the timber trade.

In addition to the consideration of different log assortments, the quality of stem of Norway spruce (*Picea abies* L. Karst.) does not vary significantly, and correspondingly the monetary value changes are small in different lumber grades. If the value of lumber of Scots pine (*Pinus sylvestris* L.) is considered, it is more dependent on the quality of stem. For consideration of the

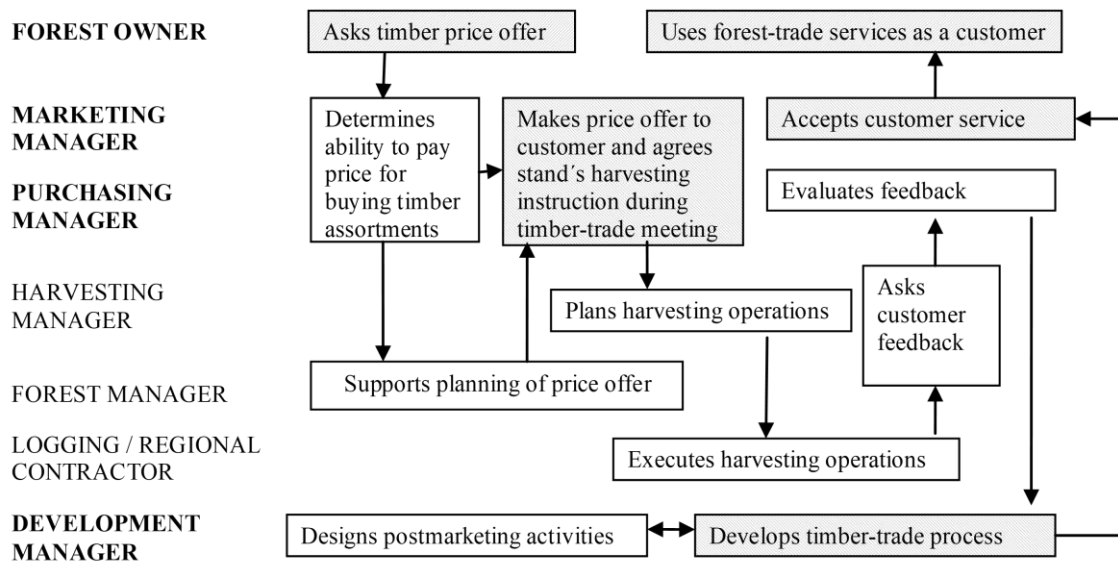


Fig.1: Wood supply of timber-trade markets in Finland (Palander et al. 2009).

quality aspect, the harvester operator can utilize manual (quality) bucking on the pine stem. However, several research groups have studied stem bucking and suggested that the benefits of computer-aided bucking are larger than the benefits of manual bucking (Wang et al. 2004, 2009, Akay et al. 2010, 2015, Serin et al. 2010). So, computer-aided bucking of stems does not significantly decrease the quality of lumber. After harvesting, the goodness of bucking outcome can be evaluated with several attributes, for instance by using the log percentage or apportionment degree (Malinen and Palander 2004).

In the study by Kärhä et al. (2016), the harvester operators were asked when they use manual bucking? The results revealed that more than a half (55%) of the harvester

operators regarded automatic bucking as significantly better than manual bucking to produce the best bucking outcome with spruce log stems. In the study, the log percentage received the highest weight as the criterion for goodness of bucking outcome, which are used by forest owners (Figure 2) (Kärhä et al. 2017). Its relative weight was, on average, 29%. Furthermore, the operators raised the apportionment degree, the log reject percentage and the production value of logs as the important criteria for evaluation of bucking outcome, which are used by a mill customer. The relative weights of these criteria were 20–25%, which were at very similar levels with both spruce and pine stems. In the study of Kärhä et al. (2017), the variation of opinions among the harvester operators was

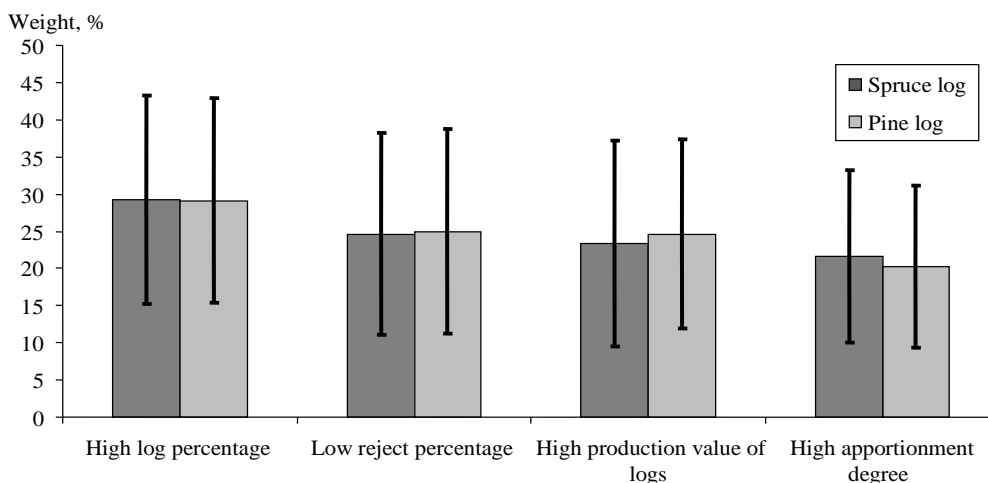


Fig.2: The weights of the criteria for the good bucking outcome in cutting log stands. The bars describe the average opinion of harvester operators and the black lines the standard deviation (Kärhä et al., 2016).

large between the statements, which indicate different preferences of interest groups.

In the 2000s, the multi-criteria based methods were implemented in participatory decision support of wood procurement in Finland. For example, Palander (1998) aggregated the preferences of various interest groups over feasible sets of wood procurement alternatives using multi-criteria methods. This wood procurement planning approach was later specified at the timber harvesting management level (Laukkanen et al. 2004), but in the timber-trade management (Figure 1) the multi-criteria approach is a new issue. In this study, the purpose is to examine its applicability in the actual timber trade decision-making situation, in which the ultimate goal is assumed to be the maximization of monetary value.

In Finland, stem bucking is managed conventionally. Same systems have been applied during decades (Näsberg 1985, Bergstrand 1990, 1994, Möller and von Essen 1997, Malinen and Palander 2004, Kivinen et al. 2005), while computers and information networks have been developed largely without any limits for more efficient systems. It is reasonable to ask; could it be beneficial to use different bucking instructions, if average volumes of stems in stand removal are for instance 450 and 900 dm³? It has been shown that the apportionment degree of stem bucking varies depending on the size of trees, because small-sized trees have fewer bucking alternatives than large trees (Bergstrand 1994). Actually, group of stands could be systematically classified using parameters of local forest information that describe stand and trees: location/geography, site class, age, cutting method, shares of tree species, the average volume of stems in stand

rot, branches). Figure 3 depicts an example for the stand classification based on the local forest information about the average diameter of stems in stand removals.

So far, no studies have been accomplished on the effects of using multiple criteria for construction of bucking instructions of softwood (i.e. Norway spruce) stands in the timber trade decision-making situation. This could be made by applying the stand classification in timber-trade simulations. Therefore, we undertook a study on:

- The accuracy of forest information on the stand classification,
- The effects of stand classification and monetary value classification on the bucking outcome,
- The relationship of criteria for the maximization of monetary value of timber trade, e.g., the log percentage (%), value of stand (€) and relative production value of logs (€/m³).

The hypothesis of our study was: In respect to the timber trade, the best bucking outcome is achieved for the timber sales of forest owners and the lumber sales of export companies, when the bucking instructions of stands are subject to the multiple criteria and stand classification.

II. MATERIAL AND METHODS

The stem bucking and cutting production files of 11 Ponsse forest harvesters was collected from July 2013 to June 2014 at the stands of Stora Enso Wood Supply Finland. There were totally 216 harvesting sites (stands, *n*) in eastern Finland. The data collection was done at the beginning of August 2014. The total volume of softwood log section of stem data was 60,000 m³, which varied from

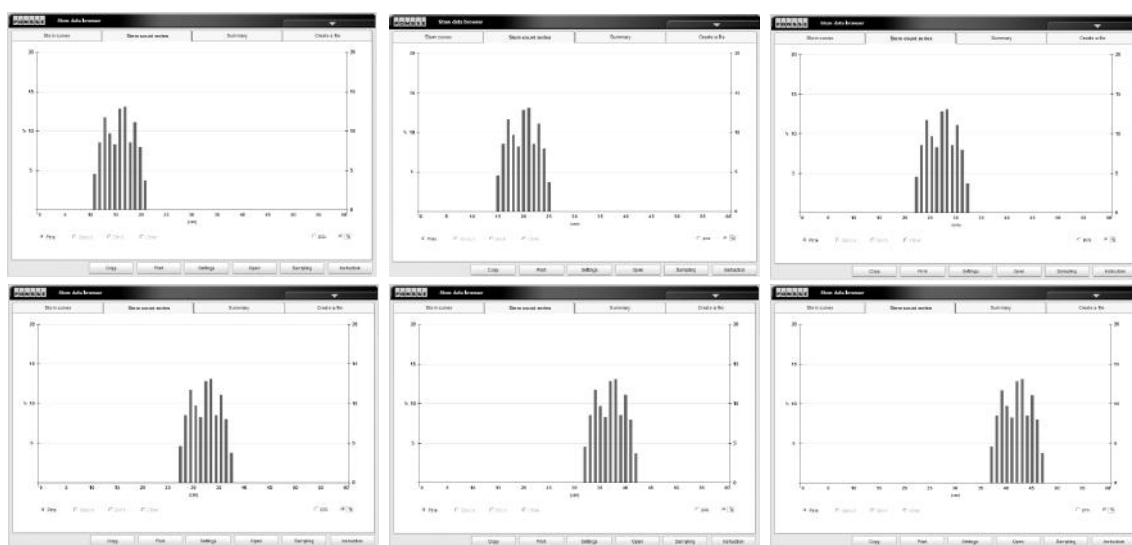


Fig.3: Six stand classes which depict differences between average frequency distributions of stem diameter (1.3 m) in stand removal.

removal, average diameter of stems in stand removal, average length of stems in stand removal, quality (e.g. butt

Table.1: Target distributions of stem bucking in timber trade simulations.

Wood procurement period 2013-14	Reference	Stand classification		
		Scenario 1 (predicted)	Scenario 2 (harvester)	Scenario 3 (implicit)
1.7 – 2.9.2013	Target distribution 1	Three target distributions for stand classification (7,8,9)	Three target distributions for stand classification (7,8,9)	Target distribution (6)
3.9 – 17.9.	Target distribution 2			
18.9 – 7.10.	Target distribution 3			
8.10 – 20.10.	Target distribution 4			
21.10 – 1.1.	Target distribution 5			
2.1 – 30.6.2014	Target distribution 6			

Table.2: Price matrices of stem bucking in timber trade simulations.

Wood procurement period 2013-14	Reference	Stand classification		
		Scenario 1 (predicted)	Scenario 2 (harvester)	Scenario 3 (implicit)
1.7 – 2.9.2013	Price matrix 1	Three price matrices for stand classification (5,6,7)	Three price matrices for stand classification (5,6,7)	Logs' monetary values of sawmill (8)
3.9 – 17.9.	Price matrix 2			
18.9 – 7.10.	Price matrix 2			
8.10 – 20.10.	Price matrix 3			
21.10 – 1.1.	Price matrix 3			
2.1 – 30.6.2014	Price matrix 4			

1,848 to 12,897 m³ per harvester in the study. In addition to the harvesters' stem data, the data from sawmill's production system and company's forest information system were collected. There were six bucking instruction files in production during the study periods: 1.7.2013–2.9.2013, 3.9.2013–17.9.2013, 18.9.2013–7.10.2013, 8.10.2013–20.10.2013, 21.10.2013–1.1.2014, 2.1.2014–30.6.2014.

The research data was used in the investigation of the efficiency of different criteria for a successful bucking instruction of timber trade. Actually, the stem bucking outcome of the stands was considered as the indicator. The results of the bucking outcome were calculated after the following timber trade simulations (Tables 1 and 2): 1) reference using stem bucking instruction files of production 1.7.2013–30.6.2014, 2) stand classification using instruction files prepared from planning information provided by timber purchase managers (Scenario 1), 3) stand classification using instruction files from real production information measured by harvester (Scenario 2), and 4) implicit stand classification using instruction files prepared from sawmill's production value of logs (Scenario 3). Stem bucking of the timber trade simulations was executed using Ponsse Optimu software.

Two stand classifications (scenarios 1 and 2) were constructed using the following limits of the average volume of stems in stand removal: 650 dm³ ("Small stem"), 650–860 dm³ ("Medium stem") and >860 dm³ ("Large stem"). The price values of log dimensions for the matrices 5, 6 and 7 were calculated as average values from

the price values of the matrices 1, 2, 3 and 4. The efficient criteria were selected by evaluating the goodness of stem bucking outcome for maximizing the monetary value of timber trade with the following attributes;

- Forest owners as the customer on the timber trade: utilization of a log section of the stem (volume, length, top diameter of log section), the log percentage, log's dimensions (volume, length, top diameter of the log) and the monetary value of the stand.
- Sawmill as the customer: the apportionment degree, logs' reject percentage and the relative production value of logs. The apportionment degree, the production values and the reject percentage were measured at the batch level of harvesting sites (i.e. the combination of 1...n stands). The rest of the attributes were the harvesting site-specific (stand-specific) variables.

III. RESULTS

3.1 Accuracy of forest information for stand classification
 Mechanized harvesters cut stands, which produced the share of Small spruce log stems, on average, 21%, while the share of the Medium and Large stems was 41% and 38%, respectively (Figure 4). There was the statistically significant difference between the shares of produced and predicted Small spruce log stems, when the share of produced log stems was compared to the predictions of purchasing managers of the forest industry. The purchasing managers overestimated the volume of Small log stems (Figure 4).

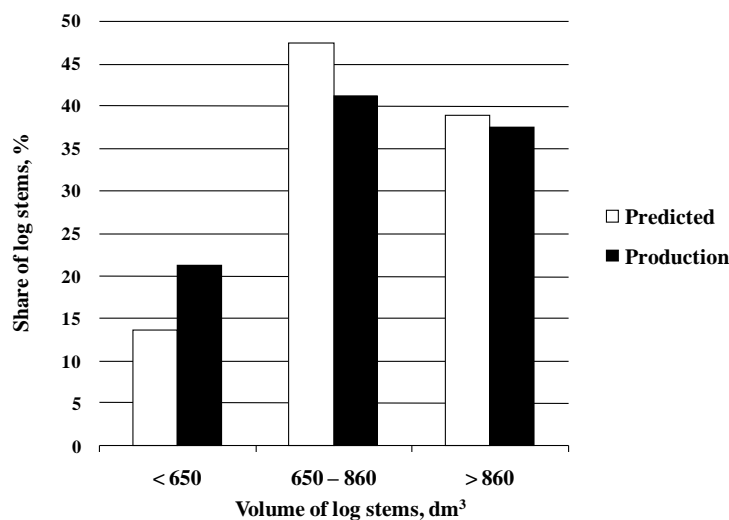
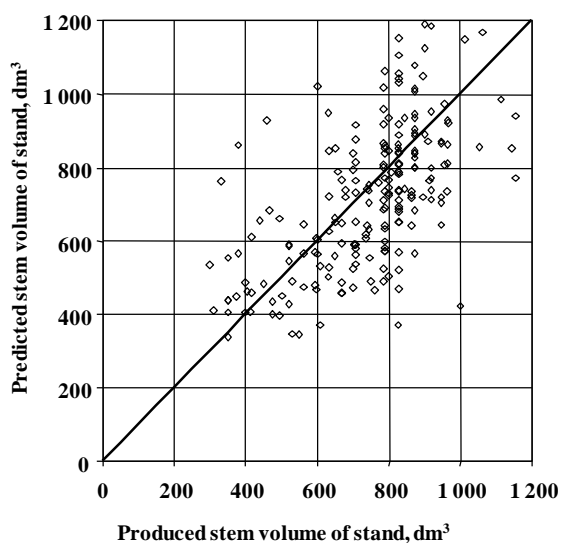


Fig.4: Comparison of produced (harvester) and predicted (purchase managers) stem volumes of Norway spruce stands.

3.2 Simulation of stand classification and monetary value classification

The consequences of stand classification were significant in the stem bucking to logs (Table 3) at the forest level. When the accuracy of the forest information for the stand classification was good (scenario 2), the utilization of a log section of stems was more successful as it is compared to scenario 1: the total volume of logs was larger (0.5%), the number of logs was lower (1.0%) and the average volume of logs was larger (1.5%). When the monetary value approach (scenario 3) was used, i.e., sawmill’s production value of logs instead of even prices in the price matrices, the total volume of logs was smaller (1.5%). Furthermore, the number of logs was lower (6%). Consequently, the average volume of logs was larger (5%).

classification (scenario 3), when sawmill’s production value of logs was used in the timber trade simulation.

3.3 Criteria for timber trade

The relationships of three criteria were assessed on the selection of successful bucking instruction for the timber trade. When the log percentage is high, the utilization of log section of stems is higher, which can be used as the criterion of forest owners in the timber trade. Figure 5 shows that the log percentage slightly increased, when the stand classifications 1 and 2 (scenarios 1 and 2) were used in the stem bucking simulations. However, the criterion

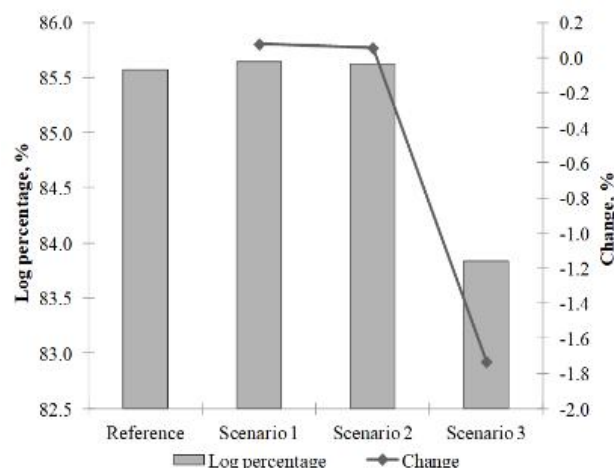


Fig.5: Effects of stand classification (scenarios 1 and 2) and monetary value classification (scenario 3) on log percentage.

In the next assessment, Figure 6 shows that stands’ value (€) increased, when the stand classifications 1 and 2 were used in the simulations, which can be used as the criterion of forest owners in the timber trade. In this respect, the best result (0.8%) was achieved, when the stand classification

Table.3: The effects of the stand classification (scenarios 1 and 2) and monetary value classification (scenarios 3) on the stem bucking in Norway spruce stands.

	Reference	Scenarios		
		1	2	3
Volume of logs [m ³]	65,500	65,600	65,800	64,400
Number of logs	287,000	283,500	284,500	269,000
Log’s volume [dm ³]	228	231	232	240

value decreased (1.7%) in the monetary value

was used with accurate forest information.

Finally, the relationship of logs' production value to stand classifications and monetary value classification was assessed after the timber trade simulation (Figure 7). The relative production value of logs (€/m³) was lower (1.6%) with the reference, when it was compared to the simulation with the monetary value classification (scenario 3). Correspondingly, the relative production value of logs was lower (1.3%), when the stand classifications (scenarios 1 and 2) were used in the simulation.

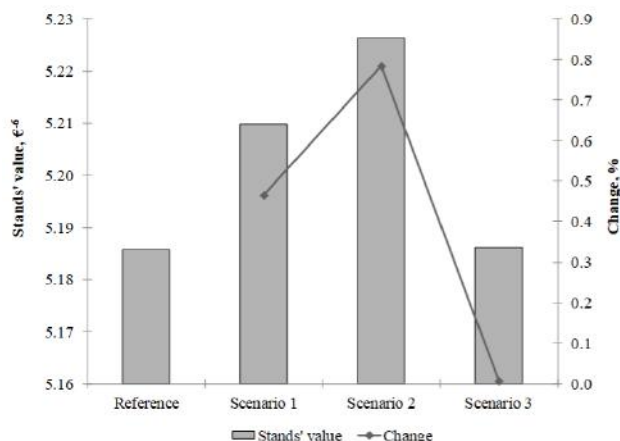


Fig.6: Effects of stand classifications (scenarios 1 and 2) and monetary value classification (scenario 3) on stands' value (€).

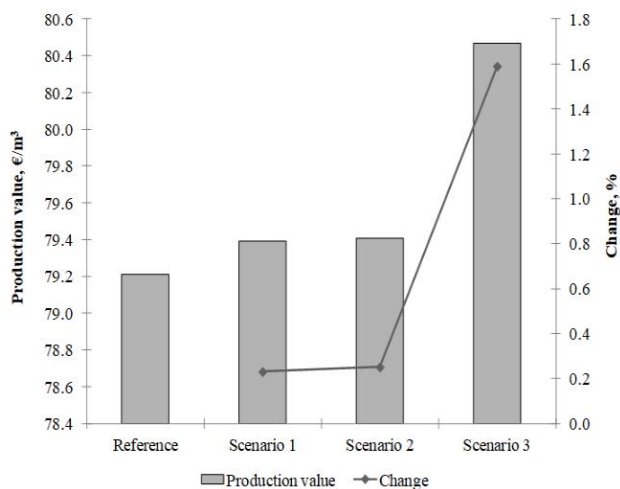


Fig.7: Effects of stand classification (scenarios 1 and 2) and monetary value classification (scenario 3) on relative production value of logs (€/m³).

There was an interesting connection between two criteria, the relative production value of logs and the stands' value, because the monetary value changes were positive in the scenario 2. On the other hand, the stands' value was significantly lower, when the monetary value classification (scenario 3) was used in the timber trade. These criteria can be used for considerations of preferences of forest owners and forest industry in the multi-objective timber trade.

IV. DISCUSSION AND CONCLUSIONS

The objective of this research is to investigate softwood log buying from forest owners and also to evaluate potential effects of lumber production on the timber trade using scenarios involving multiple criteria for maximizing monetary value of timber trade. A simulation model of timber trade was first used to determine the baseline softwood log supply on Norway spruce (*Picea abies* L. Karst.) stands (total volume of logs, number of logs and log's size). The baseline results were then compared with the results from the three alternative scenarios of timber trade incorporating the parameter and attribute changes in local wood procurement conditions. The bucking outcome of simulations revealed the effects of utilization of multiple criteria on timber trade. Log bucking with baseline instructions would provide the largest number of softwood logs for sawmill; however, there would be a significant change in the total volume of logs and log's size of log delivery to sawmill in the alternative timber-trade scenarios. The bucking instruction of monetary value classification (scenario 3) would decline number of softwood logs based on the effects on sawmill's production value of logs. This result is consistent with Bergstrand 1994, Möller and von Essen 1997, Malinen and Palander 2004 and Kivinen 2006, who found that the bucking-to-demand system can increase the monetary value in the added value chain, despite the timber supply constraints imposed by changed log distribution of stand for achieving a more customized wood procurement.

The simulation results also show that the share of log section removal of stands (m³) decreased in the bucking outcome, when the production value of logs was used in the price matrix. There was the significant difference in the log percentage (1.7%) criterion at the forest level between the monetary value classification (scenario 3) and the reference (baseline). On the other hand, the results of multi-criteria timber trade analysis suggested that the largest beneficiaries of the stand classification would be forest owners (in criteria of log percentage and stand value) due the stand classification with accurate forest information (scenario 2) increasing by 1.7% (from 83.8% to 85.7%) and by 0.8% (from 5.188 to 5.228 million €), respectively. In addition, the increase in the stands' value also support the findings of Nakahata et al. (2014), who used accurate stand data to examine the optimal bucking to maximize profits in commercial harvesting operations. They observed that considering log sizes could help determine the optimal harvesting of different stands, due to significant differences with respect to stems with a diameter (1.3 m) less than 20 cm. According to several studies, it is also useful to conduct optimal bucking with a consideration of harvesting costs and profitability as well as revenue (Akay et al. 2010, Haynes and Visser 2004,

Olsen et al. 1991, Sessions et al. 1989, Wang et al. 2009), although a construction of a comprehensive system for wood procurement is impossible (Palander 1998).

Depending on the aspects with which the timber-trade criterion evaluates the goodness of stem bucking outcome for forest owners or sawmill customers, two recommendations for the utilization of timber-trade criteria can be drawn up for maximization of timber trade value:

- If the ultimate goal for stem bucking is to maximize logs' monetary value for sawmill customer in logs' cutting, i.e. production value of logs, then the results suggest that stems' relative monetary value ($\text{€}/\text{m}^3$) must be maximized.
- If the main stem bucking goal is other than the maximum monetary value of logs for sawmill customer, then the results suggest that you must maximize the log percentage (%) and stand's monetary value (€).

The log payments to forest owner or the log valuations to sawmill can traditionally be based on the price matrix in the bucking-to-value system. Actually, we used even-value price lists in the bucking-to-demand system in the reference, scenario 1 and scenario 2. The price list was changed in the scenario 3. In theory, when changing to a bucking-to-demand system, sawmill customer should compensate for the potential monetary value discrepancy (stand value loss for the log seller). However, determination of this discrepancy is problematic in timber trade markets. Therefore, a compromise solution between two recommendations (A and B above) with the utilization of stand classification suggested in this study would be beneficial to both forest owner and sawmill customers. Furthermore, the approach can be based on the accurate stand information.

In theory, the monetary value of timber trade could be maximized by harvester operators' self-bucking. However, it is not a potential approach with spruce log stems in the future (Kärhä 2016). Whatever the timber-trade criteria are in this study, it can be suggested that the harvester operators' self-bucking of stems have to be at the lower level than currently. These results are consistent with Wang et al. (2004, 2009), Akay et al. (2010, 2015), Serin et al. (2010) and Kärhä et al. (2017). On the other hand, harvester operators' self-bucking can be seen as a productivity-decreasing and cost-increasing factor of timber harvesting, because human resources are used for monitoring the quality of harvesting instead of cutting. Furthermore, operators' self-bucking work can also be a causing factor of the psychological stress, because the operator works under the hectic pace and suffer from psychological burden of work (Ovaskainen and Heikkilä, 2007). These results suggest that "socially" cost-efficient wood procurement requires harvester's computer-aided bucking and a semi-automatic planning system for

preparing more efficient bucking instructions, which can be supported by a smart stem classification suggested in this study.

Actually, the monetary value of the timber trade and the efficiency of stem bucking could be already increased at the stand level, if the bucking instructions are determined using local forest information. The accuracy of forest information could be increased currently by collecting large forest data files, which would contain stand information from separate geographical areas. Harvesters already record automatically stem data from forests, which could be used for stand classification (Palander et al. 2013). All kinds of pre-measurement systems (Manual, Laser, Machine vision) of timber trade are too expensive and inaccurate when compared to the harvester's measurement system (Murphy 2008). Above mentioned sophisticated digital systems are tested in practice, but the monitoring and maintenance of them are currently too expensive. Two decades ago stands' manual pre-measurement system was used in Finland, but it was omitted for the same reasons. Since, timber purchasing managers have made stands' quality estimation for wood procurement of forest industry. The data collection of this study demonstrated the file systems for geographical data system suggested above. Especially, the stem data of harvester was large. Although, the data of sawmill was smaller, it provided us with reliable results on the lumber production. In the study, the stem size predictions of purchasing managers were utilized as the attributes of the local forest information for the stand classification, because current enterprise resource planning data provides this forest information. The results demonstrated that there is a large difference between harvesters' production figures and related predictions of purchasing managers with volumes of small and medium spruce log stems by stand (cf. Figure 6). This is not a desirable situation when you are maximizing the monetary value of the timber trade. Several developments could be made to current timber harvesting systems to improve the accuracy of the stand information (Palander et al. 2013). At least it will require advanced information systems for stem size data collection by forest harvesters in the future.

The Finnish timber trade market is subject to agreements regarding stem bucking regulations. These agreements could be made on the basis of multiple criteria suggested in this study (the log percentage, value of stand and relative production value of logs) accounting for the effects of stand classification on the timber sales of forest owners and the lumber sales of export companies. Further, the timber trade problem could even be solved by applying multi-objective methods in cutting simulations of wood procurement planning. By using e.g. goal programming, in theory, the criteria of forest owners and sawmill customers are possible to consider at the same time, and to find a

compromise solution for the stem bucking instructions of stand by determining target values of criteria to stakeholders in wood procurement planning (Palander 1998). In addition to developing multi-criteria methods for better applicability, development of user interfaces would be a necessity for stakeholders of timber trade. Lessons have been learned during this study as outlined above, and the methods and systems will be developed in future.

ACKNOWLEDGEMENTS

This study was funded by University of Eastern Finland and Stora Enso Wood Supply Finland. This research did not receive any other funding.

REFERENCES

- [1] Akay, A.E., Session, J., Serin, H., Pak, M. and Yenilmez, N. 2010 Applying optimum bucking method in producing Taurus fir (*Abies cilicica*) logs in Mediterranean region of Turkey. *Baltic Forestry*. **16**, 273–279.
- [2] Akay, A.E., Serin, H. and Pak, M. 2015 How stem defects affect the capability of optimum bucking method? *Journal of the Faculty of Forestry Istanbul University*. **65**, 38–45.
- [3] Bergstrand, K.G. 1990. Fördelningsaptering- ett sätt att tilgodose sågverksönskemål. *Resultat No. 11*. Forskningsstiftelsen Skogsarbeten, Stockholm, Sverige. In Swedish
- [4] Bergstrand, K.G. 1994. Fördelningsaptering. In optimal förlust och fördelningsgrad. Dokument. Skogforsk, Stockholm, Sverige. In Swedish
- [5] Haynes, H.J.G. and Visser, R.J.M. 2004 An applied hardwood value recovery study in the Appalachian Region of Virginia and West Virginia. *International Journal of Forest engineering*. **15**, 25–31.
- [6] Kärhä, K., Änäkkälä, J., Hakonen, O., Palander, T., Sorsa, J-A., Räsänen, T. and Moilanen, T. 2016 Utilization of manual bucking in cutting softwood log stems in Finland. In *From Theory to Practice: Challenges for Forest Engineering. Proceedings and Abstracts of the 49th Symposium on Forest Mechanization*. Gendek, A. and Moskalik, T. (eds). Formec, Warsaw, Poland, pp. 61–67.
- [7] Kärhä, K., Änäkkälä, J., Hakonen, O., Palander, T., Sorsa, J-A., Räsänen, T. and Moilanen, T. 2017 Analyzing the Antecedents and Consequences of Manual Log Bucking in Mechanized Wood Harvesting. *Mechanics, Materials Science & Engineering*. **12**, 1-15.
- [8] Kivinen, V.-P., Uusitalo, J. and Nummi, T. 2005 Comparison of four measures designed for assessing the fit between the demand and output distributions of logs. *Canadian Journal of Forest Research*. **35**, 693–702.
- [9] Laukkanen, S., Palander, T. and Kangas, J. 2004 Applying voting theory in participatory decision support for sustainable timber harvesting. *Canadian Journal of Forest Research*. **34**, 1511–1524.
- [10] Malinen, J. and Palander, T. 2004 Metrics for distribution similarity applied to the bucking to demand procedure. *International Journal of Forest Engineering*. **15**, 33–40.
- [11] Möller, J.J. and von Essen, I. 1997 Fördelningsaptering- en fungerande metod även på små trakter och vid liten tillåten värdeavvikelse. *Resultat No. 14*. Skogforsk, Stockholm, Sverige. In Swedish
- [12] Murphy, G. 2008 Determining Stand Value and Log Product Yields Using Terrestrial Lidar and Optimal Bucking: A Case Study. *Journal of Forestry*. **106**, 317–324.
- [13] Nagahata, C., Aruga, K. and Saito, M. 2015 Examining the Optimal Bucking Method to Maximize Profits in Commercial Operations. *Croatian Journal of Forest Engineering*. **34**, 45–61.
- [14] Näsberg, M. 1985 *Mathematical programming models for optimal log bucking*. D.Sc. (Agr. and For.) thesis. Department of Mathematics, Linköping University, Linköping, Sverige. 199 pp.
- [15] Natural Resources Institute of Finland. 2017 *Forest wood removals by forestry centre, statistics*. (accessed on 10 November, 2017).
- [16] Olsen, E., Pilkerton, S. Garland, J. and Sessions J. 1991 Computer-aided bucking on a mechanized harvester. *Journal of Forest Engineering*. **2**, 25–32.
- [17] Ovaskainen, H. and Heikkilä, M. 2007 Visuospatial cognitive abilities in cut-to-length single-grip timber harvester work. *International Journal of Industrial Ergonomics*. **37**, 771–780.
- [18] Palander, T. 1998 *Tactical models of wood-procurement teams for geographically decentralized group decision-making*. University of Eastern Finland, Faculty of Science and Forestry. Joensuu, Finland. 152 pp.
- [19] Palander, T., Ovaskainen, H. Tikkanen, L. 2009 Profiles of private forest owners and the importance of landscape-scale management in the timber trade process of Finnish wood procurement. *Forestry*. **82**, 227–239.
- [20] Palander, T., Nuutinen, Y., Kariniemi, A. and Väätäinen, K. 2013 Automatic time study method for recording work phase times of timber harvesting. *Forest Science*. **59**, 472–483.
- [21] Serin, H., Akay, A.E. and Pak, M. 2010 Estimating the effects of optimum bucking on the economic

-
- value of Brutian pine (*Pinus brutia*) logs extracted in Mediterranean region of Turkey. *African Journal of Agricultural Research*. **5**, 916–921.
- [23] Sessions, J., Olsen, E. and Garland, J. 1989 Tree bucking for optimal stand value with log allocation constraints. *Forest Science*. **35**, 271–276.
- [24] Wang, J., LeDoux, C.B. and McNeel, J. 2004 Optimal tree-stem bucking of northeastern species of China. *Forest Products Journal*. **52**, 45–52.
- [25] Wang, J., Liu, J. and LeDoux, C.B. 2009 A three-dimensional bucking system for optimal bucking of central Appalachian hardwoods. *International Journal of Forest Engineering*. **20**, 26–35.

Analysis of Irregular High Raised RCC Buildings by Using Tuned Mass Damping System

B. Siva Konda Reddy¹, A. Madhavi Latha², Ch.Srikanth³

¹Dept. of Civil Engg., JNTUH College of Engineering, Hyderabad, T.S, India

²Water Resource Department, A.P, India

³I&CAD Department, T.S, India

Abstract— Tall buildings are indispensable in urban areas due to high cost of land, shortage of open spaces and scarcity of lands. The tall buildings are in general highly vulnerable to lateral forces arising out of cyclones and earthquakes. Designing the structures to withstand these occasional lateral forces is very expensive; hence it is not always desirable.

The measures to reduce the lateral forces are by way of reducing the weight of the structure and by reducing the exposed faces to thwart wind. However the architectural requirement and the utility of the building have to be honored at all times by the structural designer.

Though the technique of Tuned mass damping (TMD) is very well appreciated, the mathematical implications involved in finding the magnitude of mass, stiffness and damping of the TMD is highly intricate and suitable TMD system for a given building structure, which shall remain an integral part of the structure itself, placed on top of the building yet serves the purpose of reducing the earthquake effects on buildings.

The TMD methodology adopted for three irregular R.C. framed models having + (Plus)-shape, C-shape and T-shape in plan. This apart the device shall find its utility for all zones of seismic activity and ground/structural conditions and introduces various structural motion control methodologies with focus on tuned mass damping systems. The control properties and some aspects of TMD parameters are outlined.

ETABS software is used for dynamic analysis of various shapes of the framed buildings.

Keywords— Irregular High Raised RCC Buildings, Tuned Mass Damping System, Dynamic analysis.

I. INTRODUCTION

To perform better analysis of Irregular High Raised RCC Buildings the Tuned mass damper (TMD) system is applied which involves in positioning of a structure over an existing building to reduce the effects of dynamic loads. The TMD will have a certain mass, damping and stiffness. Tuning of TMD refers to suitably adjust in the values of mass, damping and stiffness to reduce the dynamic effects of given building subjected to dynamic

forces/displacements. The TMD concept was first applied by Frahm in 1909 to re rolling motion of ships as well as ship hull vibrations. However not much of headway was made in possible is the field of TMD due to absence of rational theories of structural dynamics. At present with the advent of computer aided packages it is possible to apply reasonably valid dynamic theories coupled with parametric studies to assess the contribution of the TMD in reducing the effects of dynamic loads on the structure. This project presents the effectiveness of tuned mass dampers work for in reducing the seismic response of structure, duly ensuring its structural stability when subjected to earth quake loads. The concept of TMD is still not understood for real time structures, more so when damping is involved. In this context, a brief insight into the concept of TMD is presented.

Tuned mass damper (TMD) which is a passive energy absorbing device consisting of a mass, a spring and a damper. The frequency of the damper is tuned to a particular Structural frequency. so that when that frequency is excited, the damper will resonate out of phase with the structural motion. Energy is dissipated by the damper inertia force acting on the structure. There are many types of TMD systems which can be adopted for different kinds of structural systems. In this present work it is proposed to develop a TMD system which is easily constructible economically viable and easily maintainable.

II. ANALYSIS

2.1. Problem Definition

In present case study three irregular R.C. framed models with Fifteen (15) storey's were taken up and modeled using ETABS package.. The models are + (plus) -shape in plan, C-shape and the other is T-shape (from "Fig.1 to 3"). The + (Plus) - shaped building has plan dimensions of 100.0 m (25 bays of 4.0 m each) x 100.0 m (25 bays of 4.0 m each).The C-shaped building has plan dimensions of 68.0 m (17 bays of 4.0 m each) x 52.0 m (13 bays of 4.0 m each). The T-shaped building has plan dimensions of 100.0 m (25 bays of 4.0 m each) x 60.0 m (15 bays of 4.0 m each). The height of each storey is 3.5 m. The tuned

mass damping device was placed at the centre of the grid in plan. The effect of TMD was evaluated by performing response spectrum analysis of all the models. 5% damping was considered. SRSS was used for adding the modal responses. The TMD was first analyzed separately and its natural frequency was obtained. Keeping the TMD so designed on top of the building, the structure was once again analyzed using dynamic analysis and the time period, displacements at the corresponding locations was compared with the results obtained without TMD to illustrate the utility of the study.

2.2. Dimensions of the structural elements

Size of beams = 0.30 m x 0.50 m

Size of column = 0.30 m x 0.75 m

Thickness of slab = 0.125m

Thickness of outer walls = 0.23 m

Thickness of inner walls = 0.115 m

Number of water tanks = 3

2.3. Material Properties and Loads

Grade of concrete, f_{ck} = M30

Grade of reinforcement, f_y = Fe415

Specific weight of RCC = 25 KN/m³

Specific weight of brick = 20 KN/m³

Young's Modulus of Concrete = $5000\sqrt{f_{ck}} = 27386 \times 10^3$ KN/m²

Seismic zone = IV (Table2, IS1893(part1) :2002)

Type of soil = Medium

Response spectra = 3 as per IS 1893(Part1):2002

Imposed load = 3 KN/m (assumed to act uniformly on all floors)

2.4. Stiffness calculations

Moment of inertia of column (I) = 0.010546 m⁴

Stiffness of each column (K) = $12EI/L^3 = (12 \times 27386 \times 10^3 \times 0.010546)/(3.5^3)$
= 80833.90 KN/m

Total Stiffness = no. of columns x stiffness of each column = 126×80833.90
= 10185071.40 KN/m

Stiffness of columns of water tank = $5/100 \times 10185071.40$
= 509253.57 KN/m

Stiffness of each column of water tank = $1/12 \times 509253.57 = 42437.80$ KN/m

2.5. Calculation of depth of column of water tank

Let d_1 , b_1 be the depth and width of water tank

Stiffness of each column of water tank = $12EI_1/L^3 = 42437.80$; $I_1 = 5.5366 \times 10^{-3} \text{ m}^4$

Assuming width of column of water tank (b_1) = 0.30 m

$I_1 = b_1 \times (d_1)^3/12 = 5.5366 \times 10^{-3} \text{ m}^4$; $d_1 = 0.60$ m

Size of each column of water tank = 0.30 m x 0.60 m

Total weight calculation at each floor:

Weight of slab = thickness of slab in m x area of slab x unit wt. of concrete = $[(60 \times 20) + (20 \times 20)] \times 0.125 \times 25 = 5000$ KN

Weight of Beams = c/s area of beam x total length x unit wt. of concrete = $[(60 \times 6) + (20 \times 27)] \times 0.3 \times 0.50 \times 25 \times 15 = 50625$ KN

Weight of Columns = c/s area of column x height x no of columns x unit wt. of concrete = $0.30 \times 0.75 \times 3.5 \times 126 \times 25 = 2480.625$ KN

Weight of outer walls = $[(60 \times 1) + (20 \times 3) + (40 \times 2)] \times 0.23 \times 3.5 \times 20 = 3220$ KN

Weight of inner walls = $[(60 \times 4) + (20 \times 20)] \times 0.115 \times 3.5 \times 20 \times 15 = 77280$ KN

Imposed load = $3 \times 20 \times 20 \times 4 = 4800$ KN

Total weight at each floor = weight of (slab + beams + columns + outer walls + inner walls + imposed load) = 143405.625 KN

Weight of 3 water tanks with columns = $5/100 \times 143405.625 = 7170.28$ KN

Weight of each water tanks with columns = $7170.28 / 3 = 2390.10$ KN

Weight of 4 columns of water tank = $4 \times 0.30 \times 0.6 \times 3.5 \times 25 = 63$ KN

Weight of water tank = $2390.10 - 63 = 2327.10$ KN

III. RESULTS AND DISCUSSION

3.1. For the 15 storey building + (Plus)-shape in plan

The natural time period of the building without TMD was found to be 2.6827 sec. The natural time period of the building with TMD placed on top of the building was found to be 1.5043 sec. The natural time period of the building got reduced by 43.92% and When shear walls were placed along with TMD the natural time period of the building was found to be 0.4905 sec. The time period got reduced further by 33.91% (from Table 1). The building was subjected response spectrum of IS 1893:2002. The base shear of the building without and with TMD was 5675.00 KN and 2945.00 KN respectively. The base shear of the building got reduced by 51.89% when the TMD was placed on top of the building. The base shear of the building when shear walls were provided along with TMD was found to be 2315.00 KN. The base shear got reduced further by 26.71%. The roof displacements for the response spectrum case for the building without TMD, with TMD and shear walls were found to be 47 mm, 10 mm and 0.13 mm respectively (from "Fig" 4 to 8). The building was subjected to time history of random ground acceleration. The response of the structure was plotted with respect to time (from "Fig" 9 to 10).

3.2. For the 15 storey building C-shape in plan

The natural time period of the building without TMD was found to be 2.58 sec. The natural time period of the building with TMD placed on top of the building was found to be 1.49 sec. The natural time period of the building got reduced by 43.92% and When shear walls

were placed along with TMD the natural time period of the building was found to be 0.594 sec. The time period got reduced further by 33.90% (from Table 2). The building was subjected response spectrum of IS 1893:2002. The base shear of the building without and with TMD was 5980.00 KN and 2975 KN respectively. The base shear of the building got reduced by 49.75% when the TMD was placed on top of the building. The base shear of the building when shear walls were provided along with TMD was found to be 2245.00 KN. The base shear got reduced further by 25.72%. The roof displacements for the response spectrum case for the building without TMD, with TMD and shear walls were found to be 54 mm, 12 mm and 0.12 mm respectively (from "Fig" 11 to 15). The building was subjected to time history of random ground acceleration. The response of the structure was plotted with respect to time (from "Fig" 16 to 17).

3.3. For the 15 storey building T-shape in plan

The natural time period of the building without TMD was found to be 2.657 sec. The natural time period of the building with TMD placed on top of the building was found to be 1.504 sec. The natural time period of the building got reduced by 52.48% and When shear walls were placed along with TMD the natural time period of the building was found to be 0.5626 sec. The time period got reduced further by 35.13% (from Table 3). The building was subjected response spectrum of IS 1893:2002. The base shear of the building without and with TMD was 5325.00 KN and 2845.00 KN respectively. The base shear of the building got reduced by 53.42% when the TMD was placed on top of the building. The base shear of the building when shear walls were provided along with TMD was found to be 2543.00 kN. The base shear got reduced further by 37.78%. The roof displacements for the response spectrum case for the building without TMD, with TMD and shear walls were found to be 50 mm, 15 mm and 0.15 mm respectively (from "Fig. 18 to 22 "). The building was subjected to time history of random ground acceleration. The response of the structure was plotted with respect to time (from "Fig. 23 to 24").

IV. FIGURES AND TABLES

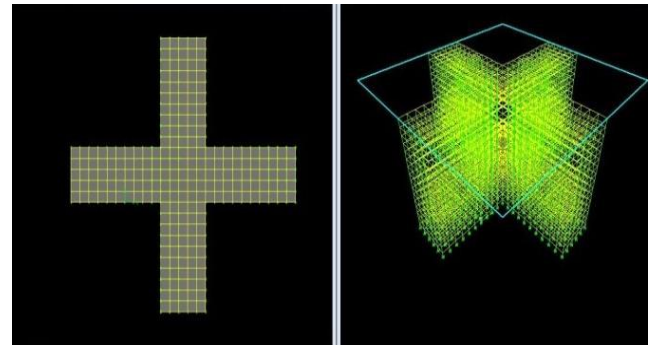


Fig. 1: Building + (Plus) - Shape in plan

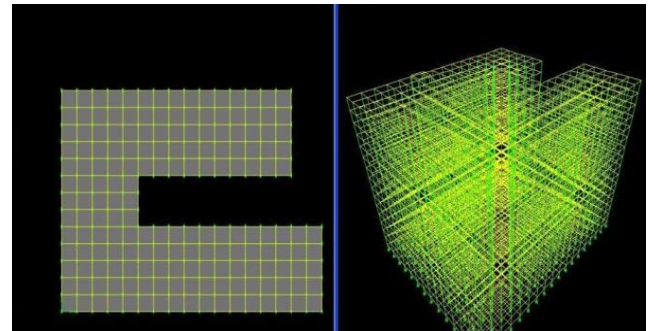


Fig. 2: Building C - Shape in plan

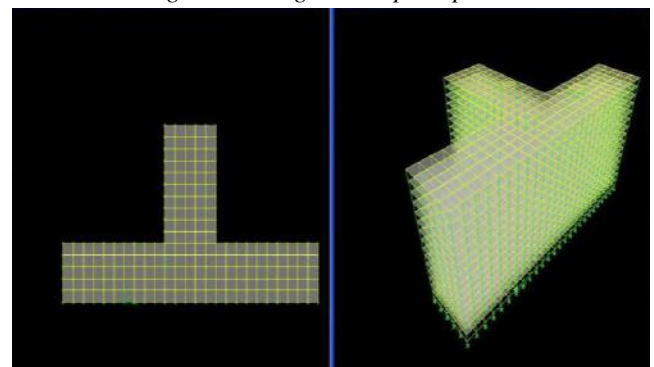


Fig. 3: Building T - Shape in plan

Table.1: Time Period for '+' (Plus)-Shape Building

Mode No.	Time period without	Time period	Percentage decrease in time	Time period with shear	Percentage decrease in
1	2.683	1.50	56.08	0.44	83.63
2	2.263	1.43	63.25	0.37	83.76
3	1.897	1.35	71.54	0.39	79.44
4	0.890	1.28	69.46	0.30	66.68
5	0.620	1.20	51.49	0.33	47.51
6	0.530	1.12	47.09	0.28	47.85
7	0.378	1.04	36.24	0.36	48.97
8	0.352	0.96	36.60	0.39	75.12
9	0.224	0.87	25.56	0.40	83.45
10	0.185	0.78	23.51	0.30	84.22

% decrease in time period was calculated w.r.t. time period.

Table.2: Time Period for 'C'-Shape Building

Mod e No.	Time perio d without TMD (sec)	Tim e perio d with TM D (sec)	Percenta ge decrease in time period (%)	Time period with shear wall and TMD(sec)	Percenta ge decrease in time period (%)
1	2.58	1.50	58.31	0.42	83.84
2	2.26	1.43	63.25	0.37	83.76
3	1.90	1.36	71.54	0.28	85.00
4	0.89	1.28	69.46	0.40	55.62
5	0.62	1.20	51.49	0.43	31.45
6	0.53	1.13	47.09	0.42	53.16
7	0.38	1.04	36.24	0.48	65.26
8	0.35	0.96	36.60	0.50	78.24
9	0.22	0.88	25.56	0.30	82.19
10	0.19	0.79	23.51	0.32	82.33

% decrease in time period was calculated w.r.t. time period.

Table.3: Time Period for T-Shape Building

Mod e No.	Time perio d without TMD (sec)	Tim e perio d with TM D (sec)	Percenta ge decrease in time period (%)	Time period with shear wall and TMD(sec)	Percenta ge decrease in time period (%)
1	2.66	1.50	56.60	0.43	83.62
2	2.13	1.43	67.21	0.33	83.75
3	1.94	1.35	70.03	0.30	79.43
4	0.88	1.28	68.86	0.40	66.67
5	0.69	1.20	57.59	0.42	47.52
6	0.63	1.12	56.13	0.39	47.84
7	0.52	1.04	50.06	0.47	48.98
8	0.40	0.96	41.12	0.43	75.14
9	0.37	0.87	42.37	0.39	83.47
10	0.36	0.78	45.75	0.37	84.21

% decrease in time period was calculated w.r.t. time period.

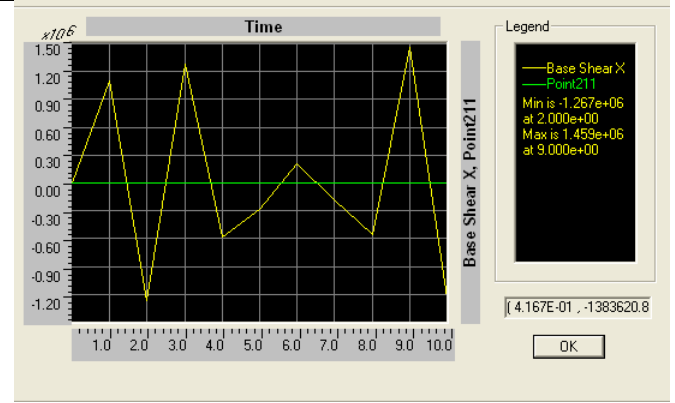


Fig.4: Displacement (m) vs Time(sec)-without TMD for Building + (Plus) - Shape in plan

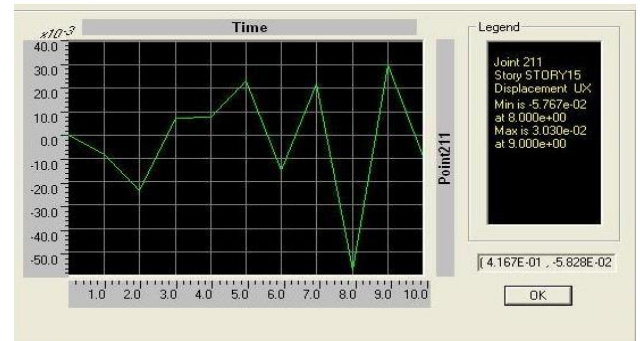


Fig.5: Displacement (m) vs Time(sec)-with TMD for Building + (Plus) - Shape in plan

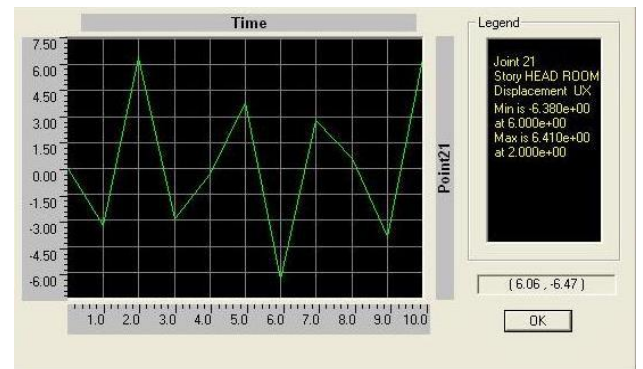


Fig.6: Displacement (m) vs Time(sec)-with TMD and shear walls for Building + (Plus) - Shape in plan

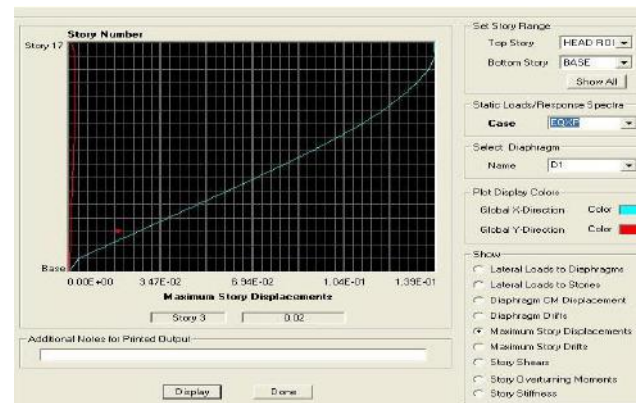


Fig.7: Storey number Vs storey displacement (m) -without TMD for Building + (Plus) - Shape in plan

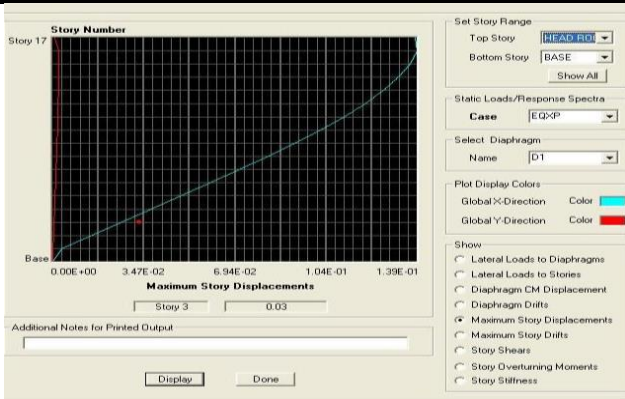


Fig.8: Storey number Vs storey displacement (m) -with TMD for Building + (Plus) - Shape in plan

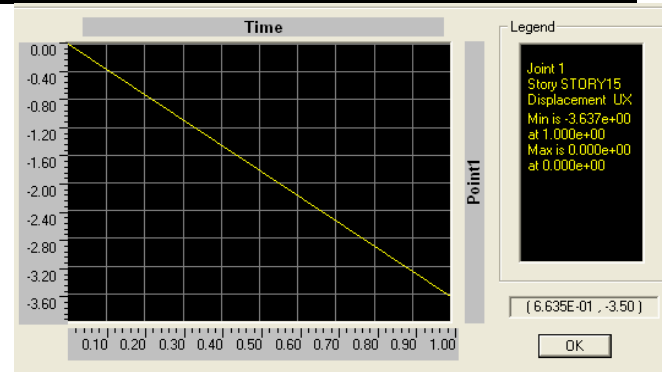


Fig.11: Displacement (m) vs Time(sec)-without TMD for Building C-Shape - Shape in plan

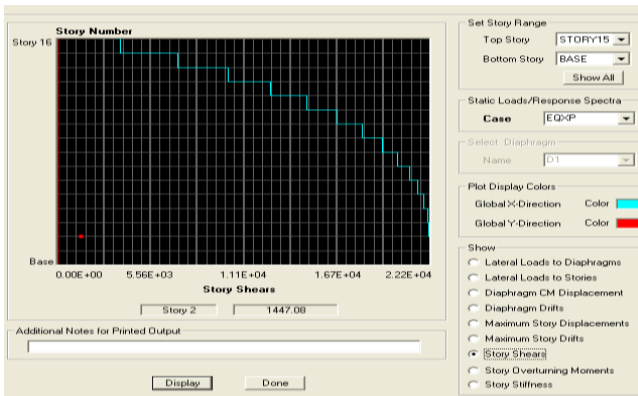


Fig.9: Storey number vs. story shear (KN) -without TMD for Building + (Plus) - Shape in plan

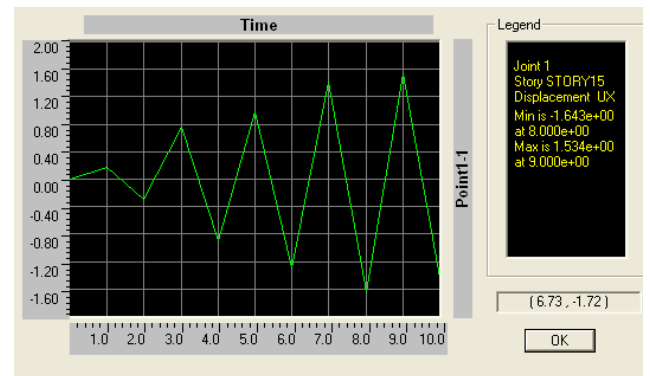


Fig.12: Displacement (m) vs Time(sec)-with TMD for Building C-Shape - Shape in plan

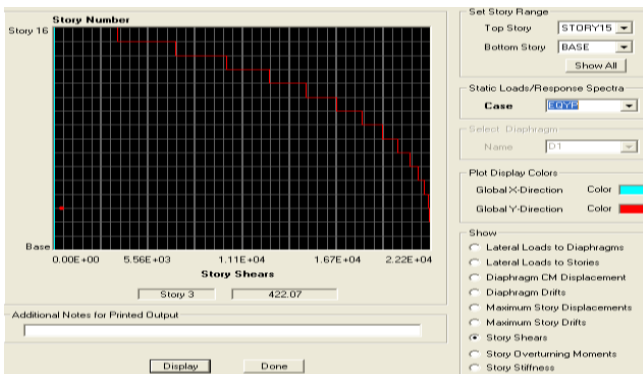


Fig.10: Storey number vs. story shear (KN) -with TMD for Building + (Plus) - Shape in plan

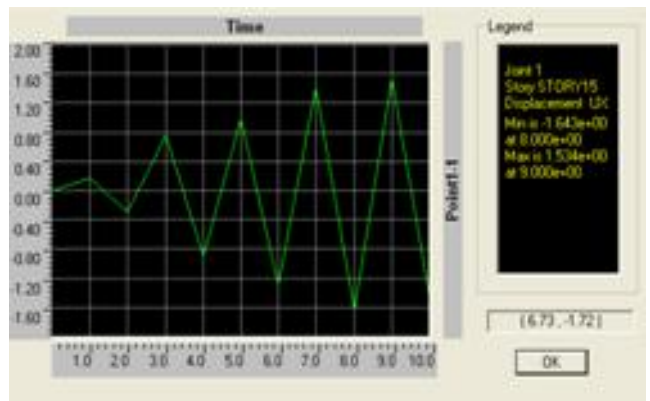


Fig.13: Displacement (m) vs. Time(sec) -with TMD and Shear wall for Building C-Shape - Shape in plan

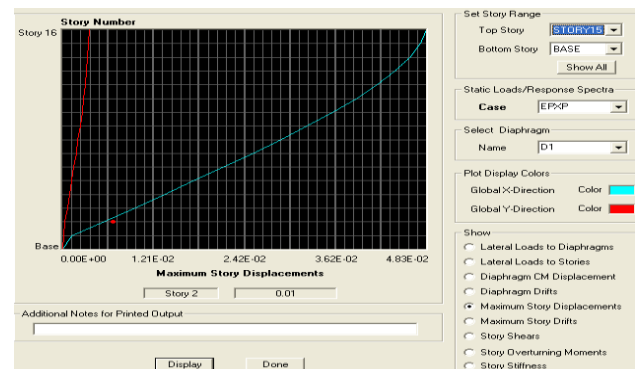


Fig.14: Storey number Vs storey displacement (m) - without TMD for Building C-Shape - Shape in plan

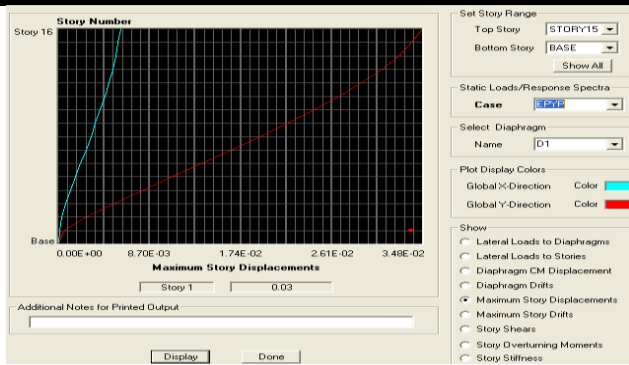


Fig. 15: Storey number Vs storey displacement (m) -with TMD for Building C-Shape - Shape in plan

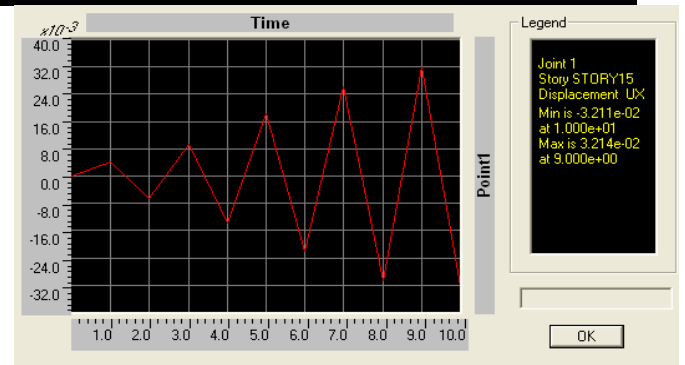


Fig. 19: Displacement (m) vs Time(sec)-with TMD for Building T-Shape - Shape in plan

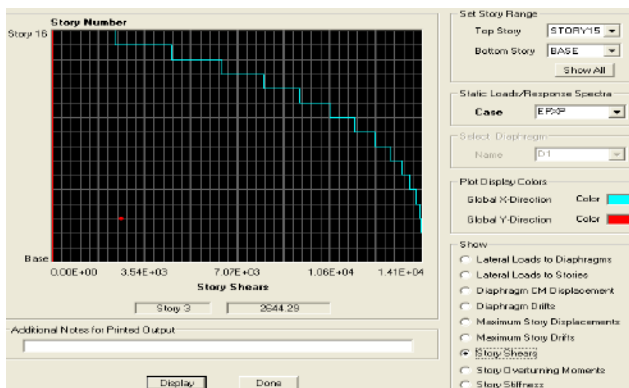


Fig. 16: Storey number vs. story shear (KN) –without TMD for Building C-Shape - Shape in plan

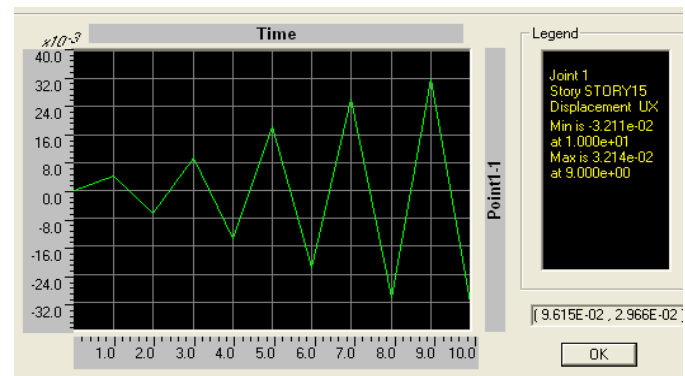


Fig. 20: Displacement (m) vs. Time(sec) –with TMD and Shear wall for Building T-Shape - Shape in plan

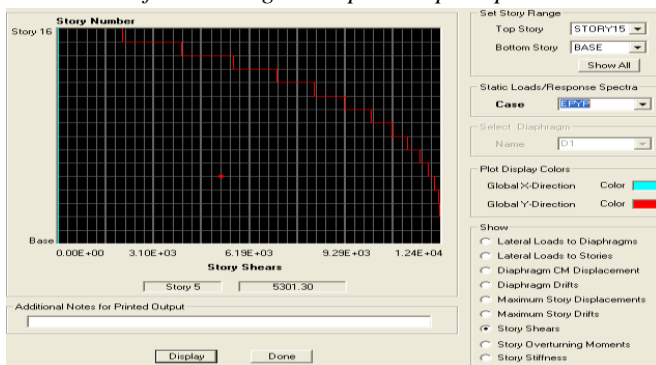


Fig. 17: Storey number vs. story shear (KN) –with TMD for Building C-Shape - Shape in plan

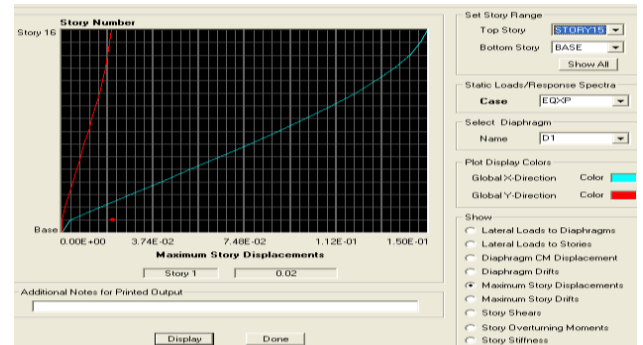


Fig. 21: Storey number Vs storey displacement (m) - without TMD for Building T-Shape - Shape in plan

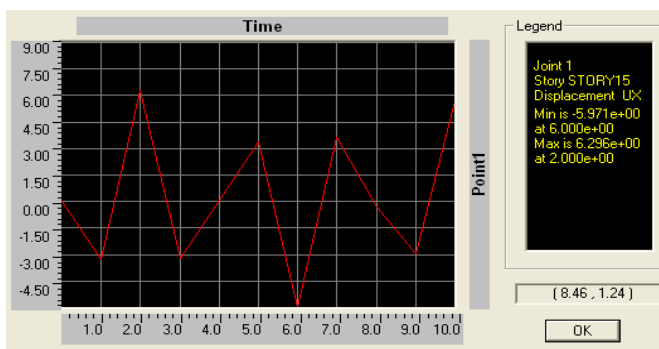


Fig. 18: Displacement (m) vs Time(sec)-without TMD for Building T-Shape - Shape in plan

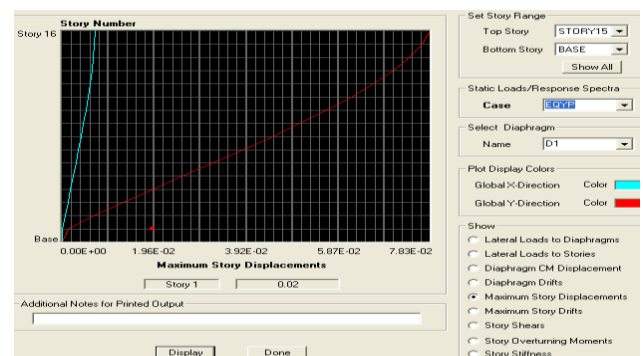


Fig. 22: Storey number Vs storey displacement (m) -with TMD for Building T-Shape - Shape in plan

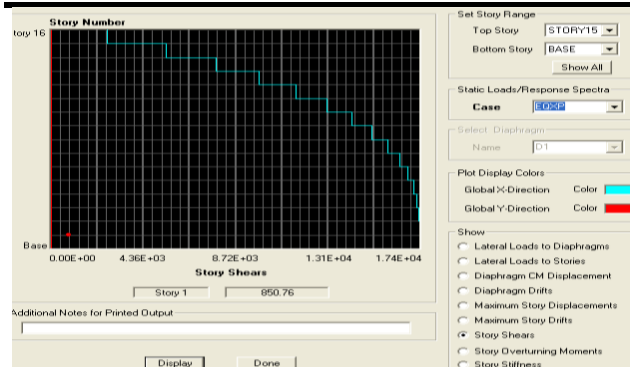


Fig.23: Storey number vs. story shear (KN) –without TMD for Building T-Shape - Shape in plan

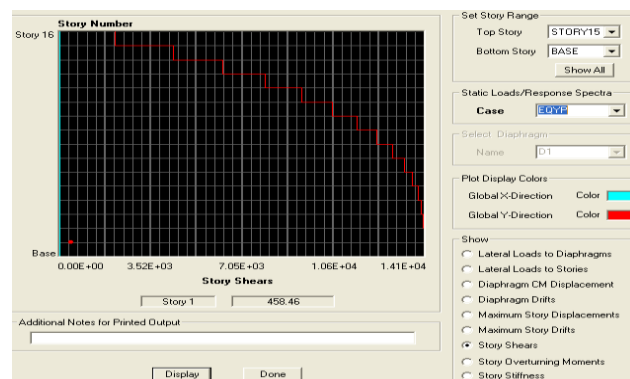


Fig.24: Storey number vs. story shear (KN) –with TMD for Building T-Shape - Shape in plan

V. CONCLUSION

- The elevated R.C. water tank placed on top of the building with hinged supports is found to be an effective TMD mechanism.
- The effectiveness of TMD (water tank) was noticed when its mass was approximately 5% of the total mass of one floor.
- The sectional dimensions- of the TMD were so proportioned that its frequency matches with the frequency of the structure.
- The introduction of shear walls did not significantly influence the functioning of the TMD's.
- The methodology adopted in the present study may be used to design a suitable TMD for each type of R.C. building structure regular or otherwise.

SCOPE FOR FUTURE WORK

- Future study may be with the effect of TMD made of steel on framed structures.
- The effect of TMD can be validated with experimental studies.

REFERENCES

- [1] Jaiswal, O. R., and Sachin Bakre (2002), Use of Weak Storey at Top Floor as Tuned Mass Damper for Controlling Seismic Response of Multi Storied

Buildings, National Seminar on Structural Dynamics in Civil Engineering, IISc Bangalore.

- [2] Srinivas, V., and Jaiswal, O. R. (2005), Use of TMD to Control Wind Response of Tall Chimneys, M.Tech project report, Visvesvaraya National Institute of Technology, Nagpur, India.
- [3] Jaiswal, O. R. (2004), Simple Tuned Mass Damper to Control Seismic Response of Elevated Tanks, 13th World Conference on Earthquake Engineering, Vancouver, Canada, Paper no. 2923.
- [4] Kevin K. F. Wong and Jerod Johnson (2009), Seismic Energy Dissipation of Inelastic Structures with Multiple Tuned Mass Dampers, Journal of Engineering Mechanics, Vol. 135, No. 4.
- [5] Joshua Kirk and Hang Hao (2003), Numerical Investigation of Floor Isolation for Passive Earthquake Energy Dissipation, 16th Engineering Mechanics Conference, University of Washington, Seattle.
- [6] Chi-Chang Lin, Jin-Min Ueng, Teng-Ching Huang (1999), Seismic Response Reduction of Irregular Buildings Using Passive Tuned Mass Dampers, Engineering Structures Vol. 22, pp. 513-524.
- [7] Jangid, R. S., and Joshi, A. S. (1997), Optimum Parameters of Multiple Tuned Mass Dampers for Base Excited Damped Systems, Journal of Sound and Vibration, Vol. 202(5), pp. 657-667.
- [8] Chopra, A. K. (2007), Dynamics of Structures: Theory and Applications to Earthquake Engineering, 3rd edition, Prentice Hall, New Jersey.
- [9] Bungale S.Taranath (2005), Wind and Earthquake Resistant Buildings– Structural Analysis and Design, Mc Graw-Hill.

Integrated Management of Chronically ill Patients: Nurse-client interactions and follow-up care

Edith N. Chiejina, Monica C. Makachi

Department of Nursing Science, Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus Nigeria.

Abstract— *Follow-up care ensures continuity of client care, gives room for provider-client interactions and sustains self-management measures in the client with chronic illness. This study examined nurse-client interactions and follow-up care in integrated management of the chronically ill patient. 240 nurses were selected from secondary and tertiary health institutions in Anambra State of Nigeria using purposive sampling technique. Two research questions and two null hypotheses guided the study. The instrument used for data collection was questionnaire on nursing interventions in integrated management of chronically ill patients. Standard descriptive statistics was used to summarize the variables. Mean scores were used to answer the research questions while chi-square test was adopted in testing the hypotheses at 0.01 level of significance. The result indicated high level of nurse-client interaction (mean = 3.1368) but average level of follow-up care (mean = 2.1556) of clients by nurses. Client's medical diagnosis was observed to have significant influence on nurse – client interaction; also nurse-client interactions was found to differ significantly across the levels of health care institutions.*

Keywords— *Chronic Illness, Follow-up care, Integrated care, Nurse-client interaction, Health care institutions.*

I. INTRODUCTION

A chronic illness is one that lasts for an extended period, usually six months or longer, and often throughout the persons life (Kozier, Erb, Berman and Snyder, 2004). Chronic illnesses usually have slow onset and periods of remission when the symptoms disappear, and exacerbation when the symptoms reappear (Kozier et al. 2004). WHO (2002) defined Chronic conditions as requiring ongoing management over a period of years or decades. Chronic conditions cover a wide range of health problems such as heart disease, diabetes, lung disease eg asthma, HIV/AIDS, mental disorders (such as Depression and Schizophrenia), disabilities and impairments such as musculoskeletal disorders and cancer (WHO, 2002; Nolte

and Mckee, 2008; Coleman et al 2008). Studies have revealed that chronic conditions frequently go untreated or are poorly controlled until more serious and acute complications arise (McGlynn et al. 2003). Advances in healthcare that keep people alive while controlling, although not curing their conditions have led to growing numbers of people surviving with chronic illnesses (TNS Opinion and Social, 2007). The Common theme is that people with chronic illness require a complex response over an extended time period that involves co-ordinated inputs from a wide range of health professionals, and access to essential medicines and monitoring systems, all of which need to be optimally embedded within a system that promotes patient empowerment (Conrad and Shortell, 1996; Unwin et al. 2004; Nolte and Mckee, 2008).

According to Plochg and Klazinga (2002), the increasing prevalence of chronic illness is posing considerable challenges to health systems. Patients may receive care from many different providers, often in different settings or institutions, even when they have only a single disease such as diabetes. They are frequently called upon to monitor, coordinate or carryout their own treatment plan while receiving limited guidance on how to do so. Plochg and Klazinga (2002) pointed out that there is pressing need to bridge the boundaries between professionals, providers and institutions through development of more integrated or coordinated approaches to service delivery so as to provide better support for the patients. Integrated care connotes a range of approaches that are deployed to increase coordination, cooperation, continuity, collaboration and networking across the different components of health care delivery (Simeons and Scott, 1999) involving patient and family (Blackie, 1998). Professional integration include joint working, group practices, contracting or strategic alliances of health care professionals within and between institutions and organizations (Shortel et al. 1994; Simeons and Scott 1999; Delnoij et al. 2002).

Chronic illness confronts patients with a spectrum of needs that requires them to alter their behavior and

engage in activities that promote physical and psychological well-being to interact with healthcare providers and adhere to treatment regimen, monitor their health status and make associated care decisions, and to manage the impact of the illness on physical, psychological and social functioning (Clark, 2003). Bayliss et al. (2003) noted that the increasing responsibility taken by patients for self management can create particular challenges for those with multiple conditions as they may experience aggravation of one condition by treatment of another, for example, a patient with chronic respiratory disease may struggle to adhere to exercise programmes designed for his/her diabetes. Grumbach (2003) observed that the goals of chronic care are not to cure but to enhance functional status, minimize distressing symptoms, prolong life through secondary prevention, and enhance quality of life. According to Nolte and Mckee (2008), it is clear that these goals are unlikely to be accomplished by means of traditional approach to health care that focuses on individual diseases and based on a relationship between an individual patient and a physician; but it is clear that what is needed is a model of care that takes a patient-centred approach by working in partnership with the patient and other healthcare personnel to optimize health outcomes. Crumbie (2005) stated that the advantage of integrated team work is that the patient is treated more holistically and is more likely to be able to see the value of the services provided.

Wagner et al. (2001) developed the influential chronic care model (CCM) aimed to provide a comprehensive framework for the organization of healthcare to improve outcomes for people with chronic conditions, which was based on the premise that high-quality chronic care is characterized by productive interactions between the practice team and patient, involving assessment, self-management support and optimization of their therapy and follow-up. Eventhough not exhaustive, inclusive in these health professionals that make up the practice team are physicians, nurses, pharmacists, physiotherapists, radiographers, laboratory scientists, record officers, social workers, psychologists, and ancillary staff. Nolte and Mckee (2008) opined that effective responses will require initiatives at all levels to ensure that the right resources can be assembled in the right place at the right time while establishing support and initiatives for everyone to work together to achieve this shared aim. Nolte and Mckee (2008) further added that there is also considerable scope for shared learning from each others successes and failures. It is against this background that this study examined nurse-client interactions and follow-up care in integrated care of chronically ill patients.

Research Questions

- To what extent do nurses interact with their patients/clients while discharging their integrated care of the chronically ill patients?
- What is the extent of nurses follow-up care of their clients in integrated management of chronically ill patients?

Hypotheses

- Patient's medical diagnosis does not significantly influence nurse-patient interactions in integrated management of chronically ill patients.
- Nurse-patient interactions in integrated management of chronically ill patients do not significantly differ between secondary and tertiary health care institutions.

II. MATERIALS AND METHODS.

Design and Sampling.

The study was a cross-sectional research design. Purposive sample of 240 nurses working in two levels of Health care institutions (five General Hospitals and two Teaching Hospitals) in Anambra State of Nigeria were used for the study. Ethical approval was obtained for the study, and informed consent was obtained from the respondents.

Inclusion criteria for the study were all registered nurses with different areas of specialty attending to chronically ill patients in any of the selected health institutions. Exclusion criteria were nurses who have never attended to chronically ill patients and those who indicated not to participate in the study.

Instrument.

Questionnaire on Nursing Interventions in Integrated Management of Chronically ill Patients (QNIIMCIP) was used to obtain data from the respondents. QNIIMCIP was developed by the researchers based on the framework on chronic care model by Wagner et al. (2001). Section A of the instrument elicited information on the demographic characteristics of the respondents (eg.. professional qualifications, sex, years of working experience, setting/unit, and collaboration team). Section B of the questionnaire elicited information on patient-reported demographics and chronic conditions (eg. Age, sex, medical diagnoses, duration of illness, self-management measures, etc), while section C of the instrument elicited information on nursing interventions in integrated care of chronically ill patients (eg interactions between the nurses and patients, health assessment of the patients, self-management supports, interactions with the practice team, etc). The responses to section C of the instrument were scored on a 4- point scale ranging from 1 point for

less/rarely often, 2 points for fairly often, 3 points for moderately often, and 4 points for very often. The instrument (QNIIMCIP) was tested for reliability. 20 nurses working in a health institution in another zone of Nigeria were used. Internal consistency reliability coefficient was calculated using Cronbach alpha for the entire scales, and a reliability coefficient of 0.70 was obtained.

Data Analysis

Standard descriptive statistics of means, frequency and standards deviation were used to summarize the variables. Mean score and standard deviation were used to answer the research questions. Chi-square test was used to test the null hypotheses at 0.01 level of significance. SPSS version 21 was used in the data analysis.

III. RESULT

Table.1: Descriptive statistics of the measured variables

Variables	N	Minimum	Maximum	Mean	SD
Age of patients	240	3.00	84.00	47.4	16.06701
Interaction between Nurses and Patients.	240	1.00	4.00	3.1368	0.56260
Health Assessment of Patients	240	1.00	4.00	3.0250	0.61769
Self-management support	240	1.00	4.00	3.1017	0.57056
Optimization of client Therapy	240	1.00	4.00	2.9806	0.51649
Interaction Between Practice Team	240	1.00	4.00	2.7212	0.59982
Follow-up care of Patient	240	1.00	4.00	2.1556	0.68311
Evaluating Programme of care/Nursing Audit	240	1.00	4.00	2.9033	0.84941
Valid N (Listwise)	240				

Table 1 shows the descriptive statistics of the measured variables. Out of the 240 chronically ill patients, the least age was 3 years, maximum age 84 years, mean age 47.4 with standard deviation (SD) of 16.06701. The mean for interaction between nurses and patients was 3.1368 with SD 0.56260; for health assessment of the patients, the mean was 3.0250 with SD of 0.61769. Self-management support had a mean of 3.1017 with SD of 0.57056;

optimization of client therapy had a mean of 2.9806 with SD of 0.51649. For interaction between the practice team, the mean was 2.7212 with SD of 0.59982. Follow-up care of patients had mean of 2.1556 with SD of 0.68311, while evaluating programme of care/nursing audit had mean of 2.9033 with SD of 0.84941. Total number of each variable was 240.

Table.2: General characteristics of the nurses and the chronically ill patients

	Frequency	Percent
Nurses		
Professional Qualification:		
Single	81	33.75
Multiple	159	66.25
Total	240	100.0
Sex:		
Male	51	21.25
Female	189	78.75
Total	240	100
Years of working:		
2-5 years	98	40.8
6-10 years	59	24.6
Above 10 years	83	34.6
Total	240	100.0

Setting/Health Institution:		
Tertiary	143	59.6
Secondary	97	40.4
Total	240	100.00
Unit:		
Medical Unit	156	65.0
Surgical Unit	43	17.9
OPD/Emergency Unit	30	12.5
ICU	9	3.8
Others	2	0.8
Total	240	100.00
Patients/clients		
Sex of Patients:		
Male	113	47.1
Female	127	52.9
Total	240	100.0
Diagnoses:		
Diabetes	58	24.2
Hypertension	48	20.0
Mental illness (Schizophrenia, psychosis)	6	2.5
Hereditary disorder (sickle cell Disease, Asthma, epilepsy)	45	18.8
Peptic ulcer	22	9.2
Cancer	21	8.8
Heart disease	14	5.8
Arthritis	7	2.9
Stroke	13	5.4
Infections (eg PTB, HIV)	2	0.8
Burns	1	0.4
Liver cirrhosis	1	0.4
Missing system	2	0.8
Total	240	100.0
Duration of illness:		
1-5years	142	59.2
6-10 years	53	22.0
Above 10 years	45	18.8
Total	240	100.0
Self-management measures by patients:		
Self-care	7	2.9
Multiple measures (include Health care provider, family support, peer assistance, etc)	232	96.7
Missing system	1	0.4
Total	240	100.0

Table 2 shows the general characteristics of the nurses and the chronically ill patients. For professional qualification of the nurses, holders of single qualification constituted 33.75% while holders of multiple

qualifications were 66.25% Male nurses were 21.25% while the females were 78.75%. 40.8% of the nurses had 2-5 years working experience, 24.6% had 6-10 years, while those with more than 10 years experience

constituted 34.6%. Tertiary health institution constituted 59.6% while secondary level was 40.4%. 65% of the nurses were working in medical unit, 17.9% in surgical unit, 12.5% in OPD/Emergency unit, 3.8% in ICU and 0.8% in other units of the health institutions. For the clients/patients with chronic illnesses, table 2 shows that 47.1% were males and 52.9 were females; for medical diagnoses of the patients, 24.2% had diabetes mellitus, 20.0% had hypertension, while 2.5% had mental illness. 18.8% had hereditary disorders (like sickle cell disease, asthma and epilepsy), 9.2% had peptic ulcer, 8.8% had

cancer, 5.8% had heart disease, 2.9% had arthritis, while 5.4% had stroke. 0.8% of the patients had infections (HIV and pulmonary tuberculosis) while 0.4% had burns and liver cirrhosis respectively. For duration of the clients' illnesses, 59.2% had their illnesses for a period of 1-5 years, 22% for 6-10 years while 18.8% for more than 10 years. For the self-management measures adopted by the clients, 2.9% adopted self-care while 96.7% included health care providers, family support and peer assistance in their self-management measures.

Table.3: Health Professionals in Collaboration with nurses in Integrated Management of Chronically ill patients

Collaborative Team	Involvement	Frequency	Percent
Medical Doctor	Yes	240	100
Laboratory Scientist	Yes	214	89.2
	No	26	10.8
Physiotherapists	Yes	132	55.0
	No	108	45.0
Dieticians	Yes	181	75.4
	No	59	24.6
Radiographers	Yes	122	50.8
	No	118	49.2
Social Worker	Yes	98	40.8
	No	142	59.2
Psychologist	Yes	90	37.5
	No	150	62.5
Pharmacist	Yes	225	93.75
	No	15	6.25
Record Officer	Yes	239	99.6
	No	1	0.4

Valid N = 240

Table 3 shows that nurses had 100% (240) collaboration with Medical Doctors in integrated management of chronically ill patients. The extent of collaboration with laboratory scientists was 89.2% (214); 55% (132) collaboration with physiotherapist 75.4% (181) with

dieticians 50.8% (122) with radiographers, 40.8% (98) with Social workers, 37.5% (90) with Psychologists, 93.75% (225) with Pharmacists and 99.6% (239) collaboration with record officers.

Table.4: Extent of Nurse-client interactions in integrated management of chronically ill patients.

Variable	N	\bar{X}	SD
Nurse-client interactions in integrated management of chronically ill patients	240	3.1368	0.56260

NB: Mean score was based on 4-point scale. Mean score <2= poor; score 2= fair; score 2.5 = Good; score > 2.5 = Very Good/high.

In table 4, The mean score for extent of interaction between nurses and the chronically ill clients was 3.1368 with SD of 0.56260.

Table.5: Follow-up care of clients by nurses in integrated management of chronically ill patients.

Variables	N	\bar{X}	SD
Follow-up care of chronically ill clients by nurses.	240	2.1556	0.68311

NB: Mean Score was based on 4-point scale. Mean score <2= poor; Score 2 = fair; Score 2.5 = good; Score > 2.5 = very good/high.

Table 5 shows that the mean score for extent of the follow-up of the chronically ill clients by nurses was 2.1556 with SD of 0.68311.

Table.6: Chi-square test of the Influence of Patients' Medical Diagnoses on Nurse-client Interactions.

Variables	Clients' Medical Diagnoses	N	Mean Rank	df	X ²	p-value
Clients' diagnoses/Nurse-client interaction	Diabetes	58	119.99	11	25.826	0.007
	Hypertension	48	111.13			
	Mental Illness	6	77.33			
	Hereditary Disorders	45	112.80			
	Peptic Ulcer	22	90.57			
	Cancer	21	117.86			
	Heart Disease	14	158.43			
	Arthritis	7	174.43			
	Stroke	13	151.54			
	Infections	2	210.25			
	Burns	1	235.00			
Liver Cirrhosis	1	75.50				

Level of significance = 0.01

In table 6 above, the X² of 25.826 was more than the p-value of 0.007. The null hypothesis is rejected. Medical

diagnosis of chronically ill patient significantly influence the interactions between nurses and the clients.

Table.7: Chi-square test comparison of the nurse-patient interactions between tertiary and secondary health care institutions.

Variables	Health care Institution	N	Mean Rank	df	X ²	p-value	Level of significant
Interactions between nurses and chronically ill patients across health institutions	Tertiary	143	107.86	1	11.770	0.001	0.01
	Secondary	97	139.13				
	Total	240					

Table 7 shows that at 0.01 level of significance, the X² of 11.770 was more than the p-value of 0.001. The null hypothesis is therefore rejected. Interactions between

nurses and chronically ill patients significantly differ between secondary and tertiary health institutions.

IV. DISCUSSION

Findings from the study indicate that the mean for extent of interaction between the nurses and chronically ill patients was 3.1368 (table 4). This result indicates high level of interaction. Wagner et al (2001) explained that interactions are more likely to be productive if patients are active, informed participants in their care. According to Wagner et al (2001), patients must have the information, skills and confidence to make best use of their involvement with their practice team. On the other hand, practice teams must have the necessary expertise, relevant patient information, time and resources to act so as to ensure effective clinical and behavioural management. Crumbie (2005) stated that the ability to communicate effectively and to be able to listen to the patient's concerns can have a huge impact upon the patient and his or her family. Nolte and Mckee (2008) stated that high quality chronic care is characterized by productive interactions between practice team and patients. Also DeLaune and Ladner (2002) added that the time frame within which interaction occurs influences the outcomes.

The mean of 2.1556 (table 5) for the extent of follow-up care of the clients by nurses, even though fair, needs to be intensified. Donabedian and Rosenfeld (1964) observed that something is known about how patients are cared for in hospitals but much less about how they fare when they are discharged. Several follow-up studies have demonstrated the high frequency with which chronically ill patients fail to abide by medical recommendations; lack of compliance had also been found to be associated with recommended modifications in diet, exercise, habits, activities, intake of prescribed drugs, etc (Donabedian and Rosenfeld, 1964). High quality chronic illness care is characterized by productive interactions between practice team and patients that consistently provide the assessments, support for self-management, optimization of therapy and follow-up associated with good outcomes (Wagner et al, 2001). Follow-up care of chronically ill patients can be in form of out-patient clinic visits by the client, home care/visits by the nurse, telephone calls, office visits, etc (Donabedian and Resenfeld, 1964). These services have their general and specific benefits. Follow-up care is not confined to face-to-face visits. Wagner et al (2001) observed that the use of telephone, for example, allows for more intensive cost-efficient follow-up of chronically ill patients. Kamalam (2005) stated that follow-up services are done in some problems identified in Health Centre, Schools and hospitals. The implications of these findings are that follow-up care of the chronically ill patient ensures continuity of care, reduces relapse in the client's condition, reduces rate of hospital readmissions of the client, promotes the client's

self-management ability and also increases the client's self esteem.

Findings from the study indicate that the medical diagnosis of chronically ill patient significantly influence the interaction between nurses and the client ($X^2 = 25.826$; $p\text{-value}=0.007$) (table 6). DeLaune and Ladner (2002) stated that therapeutic interaction involves discussing the client's problems, needs or concerns. This implies that client's problem obviously arise from client's medical diagnosis. Clark (2003) noted that chronic illness confronts patients with a spectrum of needs that require them to interact with healthcare providers and adhere to treatment regimens. Lorig and Holman (2003) reported that most interventions address medical or behavioural management tasks; and that this depends on the disease process involved, for example, support programmes for patients with cancer are more likely to address the emotional aspect of the disease than programmes for patients with asthma where correct use of medication comes first.

Findings from the study indicate that nurse-client interactions in integrated management of the chronically ill patients differ significantly between secondary and tertiary health institutions ($X^2 = 11.770$; $p\text{-value} = 0.001$) (table 7). DeLaune and Ladner (2002) stated that the complexity of health care services varies according to the delivery setting. Kozier et al (2004) pointed out that the services provided by the health care system is commonly categorized according to type and level.

V. CONCLUSIONS

This study revealed high level of nurse-client interactions and average level of follow-up care by nurses in integrated management of chronically ill patients. Also client's medical diagnosis was observed to have significant influence on nurse-client interactions. In addition, nurse-client interaction was noted to differ significantly between secondary and tertiary health institutions.

REFERENCES

- [1] Bayliss EA, Steiner JE, Fernald DH, Crane LA, Main DS. (2003). Descriptions of barriers to self-care by persons with comorbid chronic diseases. *Ann Fam Med*, 1:15-21.
- [2] Blackie C. (1998). *Community Healthcare nursing*. Edinburgh: Churchill Livingstone.
- [3] Clark NM. (2003) Management of chronic disease by patients. *Ann Rev Public Health*, 24: 289-313.
- [4] Coleman MP, Alexe D, Albrecht I, Mckee M. (2008). *Responding to the challenge of cancer in EUROPE*. Ljubljana: Government of Slovenia and European Observatory on Health System and Policies.

- [5] Conrad DA, Shortell SM. (1996). Integrated Health Systems: promise and performance, *Front Health Service Manage*, 1996, 13:3-40.
- [6] Crumbie A. (2005). Primary Health Care and the management of chronic illness. In Mike Walsh (Ed.). *Watson's Clinical Nursing and Related Sciences* (6th ed.). pp 74-92. New York: Bailliere Tindall.
- [7] DeLaune SC, Ladner PK. (2002). *Fundamentals of Nursing: Standards and Practice* (2nd. Ed.). New York: Delmor Thomson Learning.
- [8] Delnoij D, Klazinga N, Glasgow I. (2002). Integrated care in an international perspective. *International Journal of Integrated Care*, 2:1-4.
- [9] Donabedian A, Rosenfeld LS. (1964). Follow-up study of chronically ill patients discharged from hospital. *Journal of Chronic Diseases*, 17,847-862.
- [10] Grumbach K. (2003). Chronic illness, comorbidities and the need for medical generalism. *Annual Family Medicine*, 1, 4-7.
- [11] Kamalam S. (2005). *Essentials in Community Health Nursing Practice*. New Delhi: Jaypee Brothers Medical Publishers Ltd.
- [12] Kozier B, Erb G, Berman A, Snyder SJ. (2004). *Fundamentals of Nursing: Concepts, Process and Practice* (7th ed.). Upper Saddle River, New Jersey, Pearson Prentice Hall.
- [13] Lorig KR, Holman H. (2003). Self-management Education: history, definition, outcomes and mechanisms. *Ann Behav Med*, 26, 1-7.
- [14] McGlynn EA, Asch SM, Adams J. et al. (2003). The quality of health care delivered to adults in the United States, *N Engl J Med*, 348:2635-45.
- [15] Nolte E, Mckee M. (2008). Caring for people with chronic conditions: an introduction. In Ellen Nolte and Martin Mckee (Ed.). *Caring for People with Chronic Conditions: A health system perspective*, pp 1-14. London: McGraw Hill Open University Press.
- [16] Nolte E, Mckee M. (2008). Integration and chronic care: a review. In Ellen Nolte and Martin Mckee (Ed.). *Caring for people with chronic conditions*, pp 64-91. New York: McGraw Hill.
- [17] Ploch J, Klazinga N. (2002). Community-based integrated care: myth or must? *International Journal of Quality Health Care*, 14:91-101.
- [18] Shortell S, Gillies R, Anderson D. (1994). The new world of managed care: creating organized delivery systems. *Health Affairs*, 13:46-4
- [19] Simeons S, Scott A. (1999). *Towards a Definition and Taxonomy of Integration in Primary Care*. Aberdeen: University of Aberdeen.
- [20] TNS Opinion & Social. (2007). *Health in the European Union. Special Eurobarometer 272e*. Brussels: European Commission.
- [21] Unwin N, Epping Jordan J, Bonita R. (2004). Rethinking the terms non-communicable disease and chronic disease. *Journal of Epidemiology Community Health*, 58:801.
- [22] Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. (2001). Improving chronic illness care: Translating Evidence Into Action. *Health Affairs*, 20(6), 64-78.
- [23] WHO. (2002). *Innovative Care for Chronic Conditions: Building Blocks for Action*. Geneva: World Health organization.

Epistemological Character of Sustainability

Jacira Lima da Graça¹, Flávio de São Pedro Filho², Antonio Vicente da Graça Filho³,
Marcelo Augusto Mendes Barbosa⁴, Izabel Cristina da Silva⁵

¹Master student in the Program Business Administration Graduate Studies at the Federal University of Rondônia (PPGMAD/UNIR), Brazil. Accounting and management disciplines professor at University Center São Lucas (UNISL), Brazil. E-mail: jacira.lima.graca@gmail.com

²Post-Doctor in Management and Economics from the University of Beira Interior, Covilhã, Portugal (2017). PhD in Administration from the University of São Paulo, Brazil (2010). PhD in Business Management from the Universidad Autónoma de Asunción, Paraguay (2009). Coordinator of the Research Group on Management of Innovation and Technology (GEITEC / UNIR / CNPq), Brazil. Professor of Socioenvironmental Management Discipline in the PPGMAD / Federal University of Rondônia, Brazil. Email: flavio1954@gmail.com

³Accountant undergraduated at Pontifícia Universidade Católica de São Paulo, Brazil. Entrepreneur, Business Improvement Consultant, Auditor, IT/IS Auditor, Risk Assessment Advisor and System Developer. Email: vicente.graca@gmail.com

⁴Master in Regional Development and Environment at the Federal University of Rondônia (PGDRA / UNIR). Coordinator of the Administration and Technological Management Courses of the University Center São Lucas (UNISL). Member of the Research Group in applied social sciences (Diálogos), University Center São Lucas (UNISL), Brazil. Email: marcelopvh@gmail.com

⁵Member of the GEITEC / UNIR / CNPq, Brazil. Is Licenciariate in Pedagogy and is Environmental Analyst. Today is Technique of the Municipal Secretariat of Education SEMED in the Municipality of Porto Velho city, Brazil. E-mail: izabelcrisrondonia@gmail.com

Abstract— Epistemology has as its function, among others, to define what provides conditions for examining relations between facts and theories. The question is what does conceptual aspect contribute to awareness and improvement to the relation of capital, labor, and society? Apply the Theory U as argumentation in this relation. The general and main objective of this experiment is to deal with the epistemological aspect of sustainability against the capital, labor, and society based on the Theory U; the specific objectives are collecting the sustainability theoretical-conceptual character to explain its epistemological core (1); identify the relation of capital, labor, and society (2); and identify the conceptual innovation required from the contextualized indoctrinated constitution. Apply the Content Analysis Method and procedures such as cleavage, categorization, and criticism. As result, the conceptual aspect contributes to awareness and improvement of the relation of capital, labor, and society considering the discourses treated; in fragile environments in the western Amazon, there is a latent concern related to solid waste, deserving a conceptual highlight in which the origin of sustainability becomes the emergency; the mechanisms created by capital with domination over human labor, make the worker passive in the society marked by capitalist hegemony; lead structural changes is an epistemological question witch happen pragmatically, increasing the fragile aspect of perception and awareness resulting in innovations to sustained development, motivating learning

where leaders promote changes in complex systems. This article interests researchers and others people involved in theoretical issues to delineate researches in the axis of applied social sciences.

Keywords—Epistemology, Management, Innovation, Sustainability, Theory U.

I. INTRODUCTION

Epistemology has as its function, among others, to define what provides conditions for examining relations between facts and theories. What it does is asking scientific principles, because requires relational relevance. It is possible to consider the epistemology as the core of the research because the fact-theory relation must have an epistemology conflict to affect the contra condition and theoretical principles or other experimental phenomena, and a dialogical process with committed interlocutors may create ideological path face before the truth that is sought to find.

II. OBJECTIVES

This article expectation is answer the question: what does the conceptual aspect contribute to awareness and improvement of capital, labor and society? Therefore the main goal is deal with sustainability epistemology aspect before the capital, labor and society based on Theory U. The specific goals are identify the theoretical concept of sustainability to clarify its epistemological character (1), identify the capital, labor, society relationship (2), and

indicate the conceptual innovation required from doctrinal constitution brought into context (3).

III. CONCEPTUAL THEORETICAL REVIEW

Conceptual aspects identified into capitalism contribute to sustainability epistemological awareness requiring a doctrine to satisfy the complexity regarding the subject. Apply the Theory U as a capital, labor and society relationship argumentation. That theory was proposed by Otto Scharmer and other Massachusetts Institute of Technology (MIT) researchers - who commune the learning and the organization changes -; explores the knowledge in phases, and serve to help other people, singly, or to teams to deeply act before of intention and performance proposal. So, the theory becomes a systematic guide to show the main valid interaction movements to advance the transformation that is transfigured in the letter U on its representative diagram.

3.1 Epistemology concepts

Norris (2007) says to make Science it must openness and democracy of work so that can meet the knowledge complexities. There are the traditional epistemologies boundaries inside some sectors which keep knowledge dissemination. That author argues the cartesianism that represents the holistic prism of the modern demands, and the versatility of the problems.

The fact finding done by Dias (2015) says the pillars and values of sustained development, what evidence the learning about organizational culture and its beliefs. Those supports guide the awareness on learning while redirect to sustainability requirements satisfaction. The author also states the education to sustainability development covers changing of the sustainability concept, now in the cross-disciplinary way, considering the context and using the available techniques to reflective and participative learning. That theoretical dimension results in decision making improvement, in a community plan, in a participative way, socially tolerant, with environmental responsibility, while adjust the work force and life quality. Jacomossi and Demajorovic (2017) compile determinant elements in the organizational learning process that are elucidative before of structural features to sustainability. Those promote deep changes, and collaborative network to the actual mental models. This enables the development of learning competencies, useful to the challenge before of sustainability desired. So it has rigid and methodic characteristics in an epistemological environment because it pursuits the competencies and environmental responsibility development where the making decision capacity can be extended to a social community through the participation that generates a sustainable life.

3.2 Sustainability concepts

Cassar (2013) in his approach about the caring on solid waste is regarding to have attention on utilization and discharge. The author reaffirms the traditional concept about sustainability through the tripod economic, social and environmental factors. He conceptualizes the sustainable development as a way through modern generations satisfies their needs no jeopardizing the next ones. Sustainability can be considered as a transformation process, and the limitations regarding sustainable development are in the management, enhance new Technologies and social organizations linked by educational criteria which begin with awareness.

To Philippi (2016) a new thought for a sustainable business must be based on efficient production processes and includes corporative representative values incubators. Those results in a big mindset changing based on rationality and intentionality which benefit the company and its production chain.

According Dias (2015), the learning to reach sustainability is a process coming from human existence. It promotes the comprehension regarding a critical and active citizenship questioning. Its effects always result on organizational strategies which minimize economic, social and environmental risks. Thereafter, it creates changing on organizational culture, and on the transforming people minds located on social level. The literature can affirm the sustainability bring the best future expectation, including the productive sector provided it includes rational values essentially intentional which creates benefits to the whole society.

3.3 Capital, labor and society interaction concepts

The capital, labor and social relationship are characterized by the subordination to an economic structure regulated by the Market. Dias (2015) sustain the feasibility idea about progress and wealth growing consubstantiated on capitalism aiming profit that submit the work and the society to reach it. The author argues that the buying and consumption came from work force exploitation and natural resources irresponsibly used.

Philipi (2016) indicates to a reality when the economy and sustainability are in intrinsically linked, and are incorporated by organizations on their decision processes, aiming profit and the systematical market maintenance. The author emphasizes that the sustainability permeates the scientific, political, corporate and social environment. That reading allows affirm that capital creates domination mechanisms on human work, in addition to the wage issue.

3.3.1 Conceptual capital definition

According to Fulgencio (2007), the capital can be defined as the means of production created by the work, and used to produce other tangible or intangible assets. The author

says it should not consider natural resources, just social production means. According to him, the economic capitalism system is based on preponderance of capital over the work force, and it is regulated by the market and by the formation prices mechanisms under the demand and offer law. This demand govern intervention focused on common wellness to curb economic crisis which results on unbalanced relation with a Strong consequence all over the system, and on the sustainability required on the processes involved is broken.

A research done by Comparato (2014) says the capital accumulation is the capitalism goal where the existence depends on the Market; the capital becomes an economic and political power tool used in a concealed way. The Max Weber's materialism is reduced when he affirms the capital transforms everything into merchandise, including people (workers and customers). So, the capital becomes the most valuable asset in the life because it transform people and moral into merchandise, depending on the legislation and institutional path which absorb those concepts. The consequence it will be become the human into a walking or a dead weigh once their dignity will not overcome the capital value.

3.3.2 Work concepts

Cassar (2013) says work represent the activity done due to transformation which satisfies the human needs. It pursuits the solution problems measurement once it is created a model of tasks. It can modify the initial conception; promote the maintenance of the human species and the quality of life of those involved directly or indirectly with the activities inherent in this task.

Borges e Mourão (2013) say the work is the man-nature confront; that mediation is done using Technologies, and people relationship. The goal is an activity driven to achievement of their own goals; after that to an object (such as a raw material or nature) and, also, to other people (community). At the same time the work requires an objective where something is produced. The authors affirm worker is the agent who exerts physical, mental or volatile force on a matter to be formed and taken to a Market in the society, oriented to an objective. The performance in the work becomes the set of actions oriented, purposely, to transform the matter that generated some value. So, the value generation is the main goal of the work. Nevertheless that value need be the lowest possible because of the competition. Thus, the human work creates results for the organization to reach its objectives and generate value.

Brito (2013) does abide the human work philosophical concept. Gather actives attributes on spiritual forces, moral or material in the pursuit of the desired. The author affirms in every physical work exist some intellectual task highlighting the distinction between human and animal

labor is the freedom insofar as man can decide stop to do what he does.

All three authors agree that the labor always intervenes in nature, when the man confront it using Technologies, or during then social interaction with or without physical or mental force. The objective is add value and create profit.

3.3.3 Society concepts

According to Martins (2013), at Anthony Ellit and Bryan Turner conception, there is some meanings of society, categorized by structure, solidarity and creation or their combinations. So, it can develop a new category as a tool to understand all global changes: structure – stands out among the social actors the competition, conflict and rivalry; solidarity – concept based on interdependence of members who share the social life, sense of belonging, predominant social unity; and creation – advocates the willingness to promote change on the power structure and praise values such as, curiosity, innovation, communication, joy to a social life, and the tolerance on social relations.

Camargo (2017) sees the society as human interaction system culturally standardized on symbols, values, rules, position and roles. The author indicates that the concept is more comprehensive because it does not reduce just to a set of people in the same geographical space presupposing the existence of the social organization with institutions ruled by laws.

Iamundo (2012) conceptualizes societies are both structured and moved through social institutions, and these are formed throughout history inserted by multiple social and cultural determinations; since individuals undergo social structure and function that are intertwined with institutional norms, i.e. the state, family, school, business, and others. Such institutions and their norms pressure and impose cultural standards that become rules of conduct and promote changes in cultural and social institutions and functions.

The trilogy of authors agrees that society structures itself in social institutions that press social functions and promote changes in culture. These pressures generate conflicts, competition, rivalry; which produce interdependence and sense of belonging within a geographic space determined by the unity of some factors. Strong institutions that overlap with time are those that are inserted historically and impose political, economic, social power and are constitutive factors of society.

3.3.4 Concepts on innovation based on Theory

U can be considered as the argumentative way of the relation capital, labor and society. Or, then, the trajectory proposed by Otto Scharmer is highlighted, in the U that he has diagrammed in order to delineate the path of social

changes required and therefore valid, if applied to the relationship now treated. In fact, the author indicates innovation in his systemic script. In spite of these arguments, it is worth emphasizing the planetary emergency in confrontation with the said Theory. The Theory U can still be treated as a social technology, when associated with complex themes in which learning is involved in the path of change; led by leaders willing to operate conditions from an emerging future. Here the leadership process focused on structural change and

communication will happen in a pragmatic way. It involves the aspect related to perceptive awareness and awareness of individuals; this would be the fundamental credible condition for achieving innovative, effective and effective results. In essence, the proposition is based on the improvement of relations, but serves, as a priority, as an inducer of gradual and process changes, and also because of the adequacy of the structuring means of a systemic nature, as shown in Figure 1, which follows.

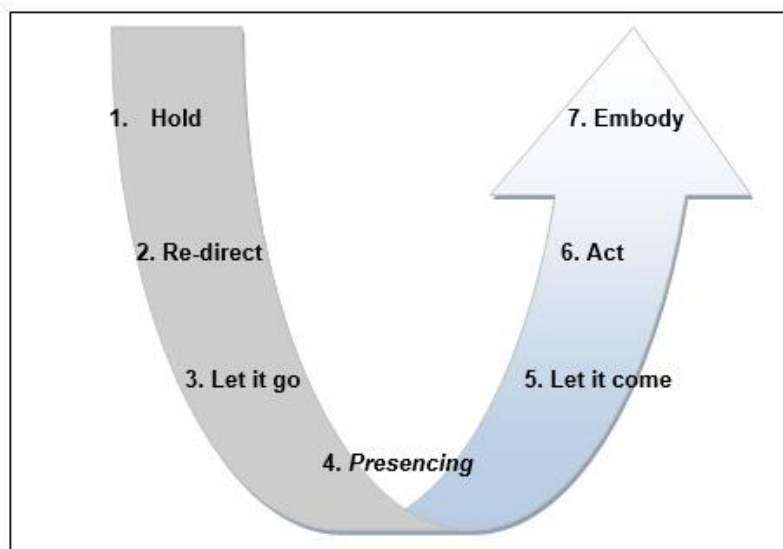


Figure. 1: Theory U focal points

Source: Adapted from Scharmer (2010)

Table 1: Description of Theory U inflexion points according to Figure 1

Points	Description
1. Hold	Suspend judgments so that it is possible to visualize the objective reality with which the individual is confronted, including basic facts and figures; in this paper, includes the sustainability status quo.
2. Re-direct	Paying attention from the object to the process in order to help the leaders see the system from a perspective that allows them to understand how their own actions contribute to the problem about to happen.
3. Let it GO	Identify the models used (which previously seemed to be caused purely by external forces) and perceive internal influences. Stage of letting go of the old model of capital, labor, society and sustainability; initiate the individual connection with higher order intentions.
4. Presencing	This stage, the lower point of the U, marks the movement of retreating and reflecting; which covers the stage of Presencing, where silence occurs to perceive the occurrence in the descent, allowing the inner knowledge to emerge for sustainability in its essence.
5. Let it come	The threshold of the ascending path leading to the space of crystallized vision and intention, which consists in anticipating the new from the future that seeks to emerge; new direction from the external mode to the inner mode of seeing, visualizing the triple capital, labor and society promote sustainability.

6. Act	The development of the inner mode of seeing transforms inner vision into outer action; a stage where living microcosms are prototyped to explore the future by doing - putting into practice the new. Plan the possible practice for sustainability.
7. Embody	Transform the new into actions, infrastructures and practices; incorporate the new in the context of larger co-development ecosystems.

Source: Adapted from Scharmer (2010)

IV. METHODOLOGY

This task is elaborated using Content Analysis Method techniques, recommended in Bardin and discussed in Silva and Fossá (2015). This method is characterized by the use and disclosure of research in Administration. It can provide valid and reliable results with an emphasis in texts analysis since they are cleaved and categorized in such a way as to aid in the understanding of the discourse.

Silva and Fossá (2015) indicate that the treatment of results, inference and interpretation, is to capture the manifest and latent contents contained in the captured documents. A comparative analysis is carried out by means of the juxtaposition of the several categories existing in each analysis, evidencing something similar and different. Figure 2 and Table 2 represents a systematic diagram of the application of the content analysis method, and its specification.

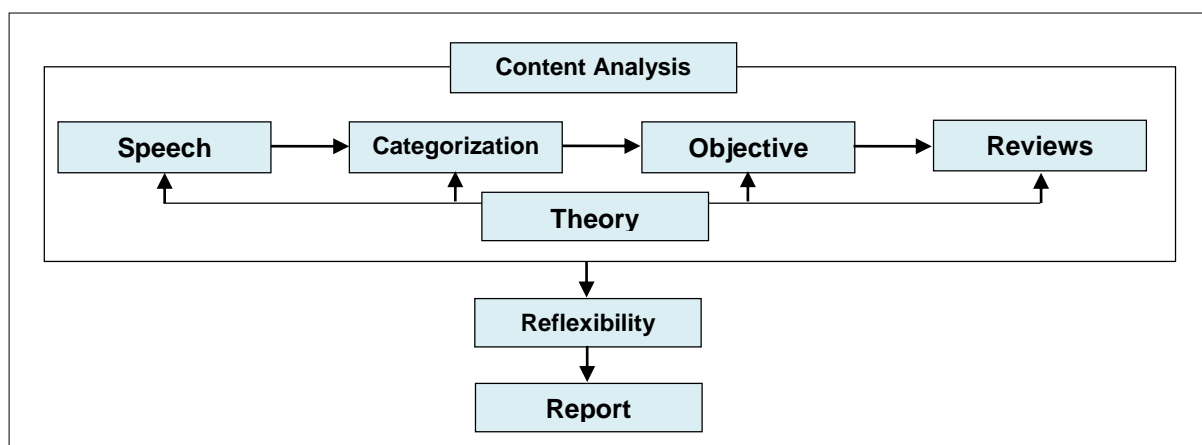


Figure 2: Content Analysis Method diagram, by categorization.

Source: Prepared by the authors.

Table.2: Figure 2 specification.

Elements	Concepts
Content Analysis	Set of message content decomposition techniques for reconstruction of meanings.
Theory	Paradigms, the study basis; Theory U was used in this essay.
Speech	Theoretical and conceptual referential. Table Represents the search of discourses for a theoretical conceptual revision, content analysis procedure.
Reviews	The qualitative research interpretive technique of the companies discourse analysis.
Categorization	Choice of categories, classification and aggregation; way of thinking by inferring the author's subjectivity.
Objective	Messages manipulation to confirm the indicators that allow you to infer about another reality, which is not a message.
Reflexibility	Analytical critical consideration of the discourses as representative for the results of the method of content analysis on capital, labor and society.
Report	Document that presents conclusions, contemplates as interpretations on the epistemological character of sustainability in relation to Theory U. It presents a proposal of action that refers to a socio-environmental strategic paradigm, changing as significations in the final considerations of content analysis.

Source: Prepared by the authors.

A study in Silva and Fossá (2015) indicates that the method of content analysis, when applicable a documentary analysis, comprises six phases: the first is a phase of reading selected documents; several authors published their speeches. However, some are interesting for textual search; this is the solution to your object-compatible and research approaches. The second phase is a formulation of categories of analysis, using the theoretical framework and as indications brought by the reading; a categorization assists in argumentative treatment, but requires a cleavage as cognitive providence without investigative process. The cleavage is a highlight to be categorized in investigative activity. The third step is to cut the material in comparable registry units; in this task, by means of author, and argument, maintaining a database and information according to the authorial part. The fourth phase refers raw data categorized and organized in an intellectual form being able to work. A fifth phase involves grouping by common categories, which is a complete task for each of the specific objectives proposed. That grouping has a

progressive character since it broadens the understanding of the parties that guide the result of the research. The sixth stage is inference with interpretation and report production.

V. STUDY OF THE EPISTEMOLOGICAL CHARACTER OF SUSTAINABILITY IN THE FACE OF U THEORY

The data interpretation was given through the analysis method, seeking to response, a contribution to awareness and an improvement of the relation of capital, labor, and society, from the study and analysis of the discourses contained in the theoretical-conceptual review. Through the categorical analysis, interpretation technique that consists of the division of the text into categories summarized by qualitative data, it is possible to understand the epistemological aspects of sustainability, which are a constancy in the interdisciplinary learning for the development of competences and decisions, sustainable responsibility, as shown in Figure 3.

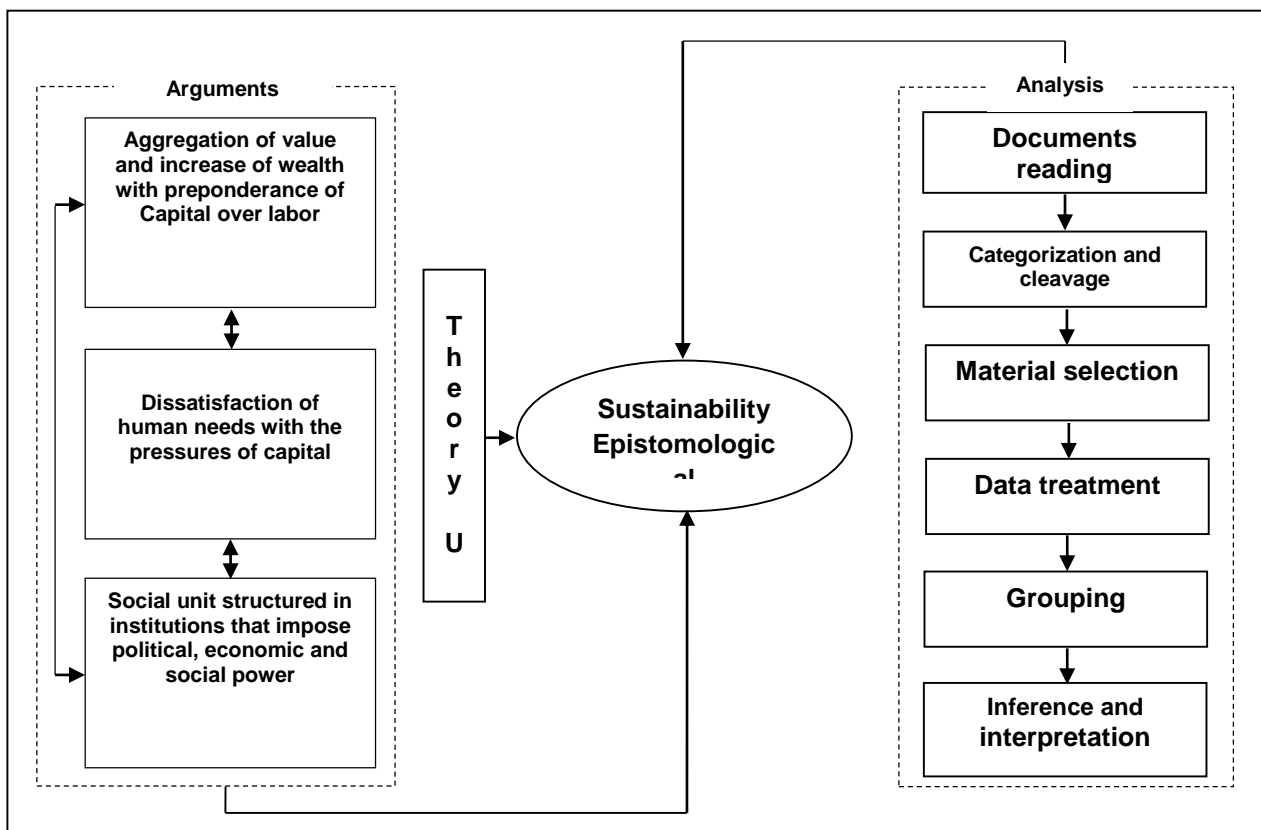


Figure 3: The epistemological character of sustainability in the face of Theory U.

Source: Prepared by the authors.

5.1 The survey of the theoretical-conceptual character of sustainability to explain its epistemological character

It explains the epistemological character of sustainability as a result of processes in organizations, which seek to minimize economic, social and environmental risks;

creating the opportunity to change in the organizational culture and quality of life for the people, through the dissemination of knowledge in a participatory and reflective way.

In fragile environments, such as in western Amazonia, there is a latent concern related to solid waste, deserving

emphasis from the conceptual point of view, where the origin of sustainability becomes the emergency that forces the behavior through recycling, destination of leftovers; so much so that Silva (2014) advocates the absence of residues. Reflection that returns a dialectical character between the generation of waste and the production of new goods with employment and income generation, in addition to the benefits that the task will bring in protecting nature.

5.2 Capital, labor and society relationship identification

Borges and Mourão (2013), Cassar (2013) and Brito (2013), identify in the development of the work the aggregation of value and generation of positive results, intervening in nature through a society structured in social institutions that promote changes in culture based on sustainable decision-making processes.

Cassar (2013) states that with the unity perception to reach common goals, arises the need for a work organization process; expanding human intervention on the environment and environmental impacts in a gradual and cumulative manner, culminating in the occupation of natural spaces

and destruction of areas, in an economic growth that affects humanity itself.

According to Philipi (2016), the mechanisms created by capital with domination over human labor make the worker passive in the society marked by capitalist hegemony. This implies that the holder of capital becomes the owner of the work and of the one who performs it, in a spurious vision of the relations that could be sustainable in themselves. In the view of the author, the historical reality is the maintenance of the "status quo" benefits only the capitalist, since the labor force is bought by the owner, who becomes its owner.

Institutions that integrate and impose political, economic and social power - constitutive factors of society - are capable of promoting sustainable development by investing in human interactions, changing the decaying socio-environmental structure to a powerful structure that promotes quality of life and sustainable results, consistent and perennial. Figure 4 refers to the relationship between capital, labor, and society, demonstrating the economics and sustainability feasibility.



Figure 4: Capital, labor, and society diagram

Source: Prepared by the authors.

5.3 Indication of the conceptual innovation required

Leading structural changes is an epistemological issue that happens in a pragmatic way, broadening the sensitive aspect of perception and consciousness; resulting in

innovations for sustainable development, providing learning where leaders promote changes in complex systems. In this context, the guiding concepts present a sustainable result, according to Figure 5.

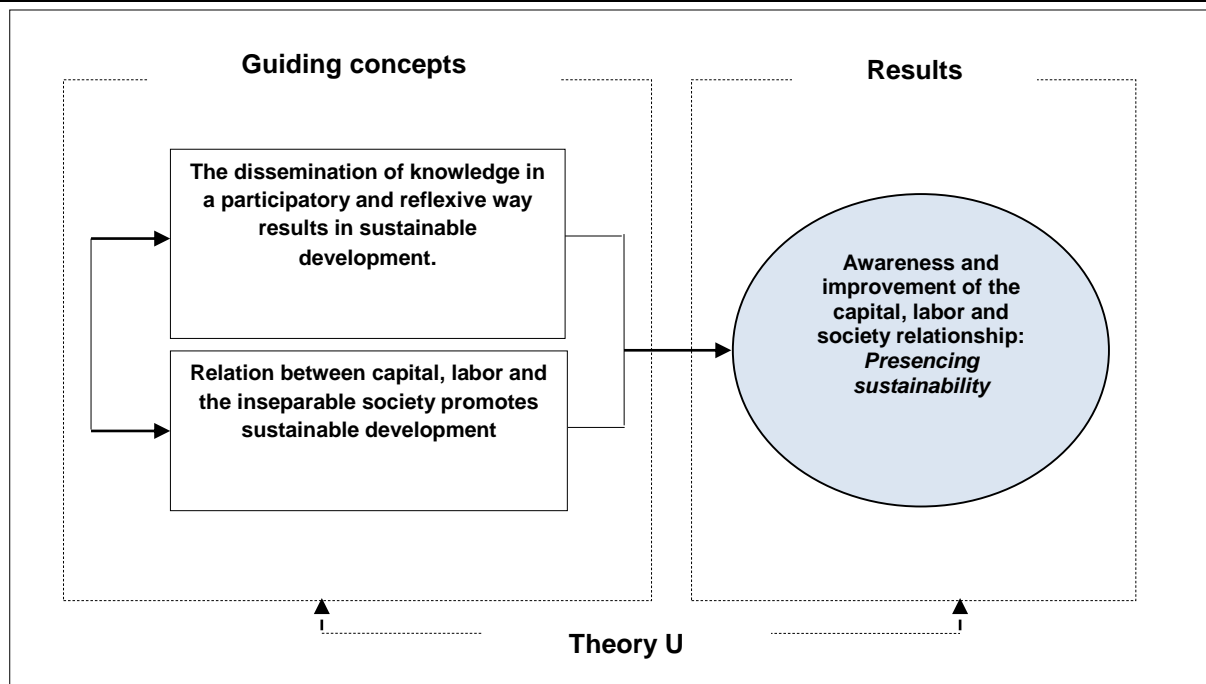


Figure 5: Analysis Process for Inference diagram.

Source: Prepared by the authors.

Presencing Sustainability results from a process of unlearning to change the minds of leaders capable of disseminating knowledge in a participatory and reflexive way, generating sustainable competence in the relation capital, labor and society.

VI. CONCLUSION

For the awareness and deconstruction of concepts that cause the reality of today's world in relation to sustainability, leadership is necessary to be able to connect with itself, depriving itself of paradigms aimed at gaining and increasing wealth with mechanisms of domination by predominance of capital. A leadership with the ability to influence, and generate new leaders with the same thoughts. Add to these open minds, specific actions and stages for new paradigms.

Rethinking the sustainability of ownership of the existing theoretical-conceptual framework is urgent for the emergence of effective actions that will contribute to the awareness and relation capital, labor, and social improvement, from *Presencing Sustainability*, using Theory U in all its stages, to achieve sustainable goals; resulting in implementation and effective change. These elements allow us to infer that joint action qualifies sustainable performance while guiding decision-making for improvement. This is the conceptual aspect that contributes to the awareness and improvement of the relation capital, labor and society.

The *Presencing Sustainability* limitations are focused on the human being, especially the leaders. They, with

genuine universal interest, will be able to change their minds and bring about changes in the environments in which they operate, fostering continuous and progressive learning. It is therefore recommended to measure results and continue the Theory U in a cyclical way, in order to become a personal goal in a constant learning process with aggregation perception of values that drive new learning. This work will serve as a contribution to the academy interested in economics and sustainability, to researchers and others involved in theoretical issues to delineate research in the axis of applied social sciences.

REFERENCES

- [1] Borges, L. O., & Mourão, L. (2013). *O Trabalho e as Organizações: Atuações a partir da Psicologia*. ArtMed. (pp. 55-56)
- [2] Brito, P. P. (2017, September 20). *O que é Trabalho – Suzana Albornoz*. Retrieved from <https://brito964.wordpress.com/2013/06/30/livro-o-que-e-trabalho-suzana-albornoz/>
- [3] Camargo, O. (2017, September 20). *Sociedade. Brasil Escola*. Retrieved from <http://brasilecola.uol.com.br/sociologia/sociedade-1.htm>
- [4] Cassar, M., Dias, R., & Zavaglia, T. (2013). *Introdução à Administração: da competitividade à sustentabilidade* (3rd ed.). Campinas, SP: Alínea. (pp. 190)

- [5] Comparato, F. K. (2014) *A civilização capitalista: para compreender o mundo em que vivemos* (2rd ed.). Saraiva. (pp. 56)
- [6] Jacomossi, R. R., & Demajorovic, J. (2017). Fatores Determinantes da Aprendizagem Organizacional para a Inovação Ambiental: Um Estudo Multicaso. *Revista de Administração Contemporânea*, 21(5), 685-709. doi:10.1590/19827849
- [7] Dias, R. (2015). *Sustentabilidade: Origem e Fundamentos; Educação e Governança Global; Modelo de Desenvolvimento*. São Paulo: Atlas
- [8] Fulgencio, P. C. (2007). *Glossário Vade Mecum: administração pública, ciências contábeis, direito, economia, meio ambiente*. Rio de Janeiro: Mauad.
- [9] Iamundo, E. (2012). *Sociologia e Antropologia do Direito*. (1rd ed.). São Paulo: Saraiva. (pp. 30-31)
- [10] Martins, C. B. (2013, june). Em defesa do conceito de sociedade. *Revista Brasileira de Ciências Sociais Online version ISSN 1806-9053*, Rev. Bras. Ci. Soc. 28 (82) São Paulo. Retrieved from <http://dx.doi.org/10.1590/S0102-69092013000200014>
- [11] Norris, C. (2007). *Epistemologia: Conceitos-Chave em Filosofia*. Porto Alegre: ArtMed
- [12] Philippi, A., Jr., Sampaio, C. C., & Fernandes, V. (eds.). (2016). *Gestão Empresarial e Sustentabilidade*. Manole.
- [13] Santos, F. M. (2012, may). Análise de conteúdo: a visão de Laurence Bardin. Resenha de: [BARDIN, L. Análise de conteúdo. São Paulo: Edições 70, 2011, 229p.] *Revista Eletrônica de Educação*. São Carlos, SP: UFSCar, 6(1), 383-387. Retrieved from <http://www.reveduc.ufscar.br>.
- [14] Silva, J. B. S., Pedro, F. S., F., & Silva Neto, J. M. (2014, april 2). *Deconstruction of the sanitary landfill concept and the management of solid waste in western amazon*. The 29th International Conference on Solid Waste Technology and Management.
- [15] Silva, A. H., & Fossá, M. I. T. (2015, may). Análise de conteúdo: exemplo de aplicação da técnica para análise de dados qualitativos. *Qualitas Revista Eletrônica*, [S.l.], 16(1). ISSN 1677-4280. Retrieved from <http://revista.uepb.edu.br/index.php/qualitas/article/view/2113>. doi: <http://dx.doi.org/10.18391/qualitas.v16i1.2113>.
- [16] Scharmer, O. (2010) *Teoria U como liderar pela percepção e realização do futuro emergente*. Rio de Janeiro. Elsevier.
- [17] Scharmer, O. (2017, september 4). Retrieved from http://www.ottoscharmer.com/sites/default/files/TheoryU_2nd_Figures.pdf

Reaction of Azo Dyes with Amino functionalized Multi walled carbon Nano Tubes.

Nasim Khoshlahjeh Motamed

Department of Chemistry, Tehran North Branch, Islamic Azad University, Tehran, Iran

Abstract— In this paper the synthesis of functionalized MWCNT Solution of multi-step reactions have been reported during carbonylated nanotubes is obtained with the desired amines. After purification of MWCNT oxidation with nitric acid and the formation of nanotubes carboxylated MWCNTS - CoCl obtained. The reaction product of aromatic amines and aliphatic several factors such as 1,4 phenylene diamine, 4-hydroxy- 1,3 phenylene diamine, 4-methyl -1,3 phenylene diamine, 1,3 phenylene diamine, 1,8 diamino-3,6 dioxo octane derivatives. Significant operating and nanotubes MWCNTS-CO-NH-R-NH₂ Was changed. Because of this structure, solubility in organic solvents can react with various functional groups and heavy metals ions in water is used. Each product at each stage of spectroscopic methods IR, RAMAN, ¹H NMR, ¹³ C NMR, SEM, TGA, were identified and analyzed. Then we make the dye, the dye composition of amino nano tubes and then deposited obtained by spectroscopic methods such as IR/TGA analysis was identified.

Keywords—Nano Tube, Azo Dyes, Amines.

I. INTRODUCTION

The carbon nanotubes are one of the most important structural blocks. The high power and the electrical conductivity of these materials are not comparable to the carbon nanotubes. The carbon nanotubes contain the thin cylindrical layers of graphite. Their electrical conductivity is similar to copper, but, they have the ability to transfer the higher currents. Generally, the carbon nanotubes are divided into two groups of the single-walled carbon nanotubes and the multi-walled carbon nanotubes [1,2]. The carbon nanotubes have a widespread application in the production of composite fibers. These fibers have a potential for use in the safety equipment, the anti-explosion coatings, and the protective shields of electromagnetic fields. Meanwhile, the buckypaper nano-sheets are more solid than the steel and harder than diamonds which can be used in the structures of automobiles and aircraft. The buckypaper is a very thin sheet which is made of a mass of carbon nanotubes [3]. The electrical conductivity of these materials is similar to copper or silicon and they transfer the heat very well like steel or brass. In fact, these nanotubes are the strongest

and most stiffness known fibers and also they are called the most conductive fiber which can also be used as the semiconductors. This material can be used as a wonderful material for manufacturing the aircraft and automobiles based on the unique properties [4].

In other words, the solar cells are photovoltaic systems which supply their photons from the sunlight. The solar cells can be divided into three generations. The first generation is mainly made of the single-junction silicon parts (p-n junction) with the very high purity. The second generation of solar cells uses the inorganic semiconductors which require the less preparation processes. These semiconductors usually are used as the crystalline films and the efficiency of these cells is much lower than the first generation. The third generation of solar cells consists of organic molecules. The cost of making these cells is lower than the other two generations. The methods of making them are simpler. However, the efficiency of these cells is still not acceptable and the efforts are continuing to increase it. The third generation consists of the dye-sensitized solar cell (DSSC), the polymer cells, and the small cells [4,5]. Generally, an organic pigment-sensitized semiconductor material is used as an optical electrode for the cells in this type of photochemical cells. The light radiation with the suitable wavelengths to the electrode causes the light to be absorbed by the pigment and consequently, the molecule is stimulated by the light. The electron-hole pair is separated from each other at the interface of the semiconductor pigment and the electron enters the external orbit through the semiconductor conduction level and leads to create a current. In this case, the organic pigment is reduced by the intermediate sample in the electrolyte of solar cells and the intermediate sample oxidized in the opposite electrode is reduced by the electrons passing through the external orbit. There are different methods for the preparation of azo dyes; but, generally, they are produced by the coupling reaction of the diazonium materials. These materials are produced from the diazotization reaction of the first-order aromatic amines. The diazotization reaction was discovered in 1862 by Grill and it caused a change in the painting industries [5]. Phenol, naphthol, and arylamines are used as a coupling agent in these reactions.

The carbon nanotubes are useful for making the non-organic moulds and preparing the modern hybrids. The carbon nanotube structure-based hybrids are used in the catalysis with the biosensors, the hydrogen storage, the drug delivery, the biomaterials, and the nanoelectronics fields. The challenge here is that use of nanotubes requires a functionalized surface to spread their dispersion and the ability to participate in the physical and chemical reactions. Many strategies have been used to functionalize the nanotubes, such as the oxidation of the strong acids, the covalent conversion with the organic molecules and the polymers. Other methods based on the functionalization of the nanotube have developed such as modulating and facilitating by benzyl mercaptan, the cationic polymers, and the polyelectrolyte surfactants [6,7]. The non-covalent functionalization may maintain the electronic structure as well as sp^2 and produced the metal particle hybrids of the carbon nanotubes under the gentle conditions and the evolution. The non-covalent functionalization of the nanotubes with biomolecules like DNA and proteins is an additional potential strategy to prepare the new bio-electronics nanomaterials [8,10]. It can benefit from the advantage of the recognized molecular properties in the biomolecules bond. For example, Bill et al. reported an easy strategy to modify and modulate the multi-walled nanotubes by poly-L-lysine, albumin bovine serum, bean-shaped seeds of Glycine max L. oxidase, and α^1 -acid glycoprotein [11-13]. They found that the absorbed proteins can be controlled the growth of nanoparticles of supported silver on multi-walled nanotubes. In this research, proteins should be selected which can directly modify and modulate the single-walled nanotubes through non-agricultural methods. The supported silver metallic nanoparticles were not synthesized in a gentle condition. The sub-products of the supported silver metallic nanoparticles with the hybrids of supported silver metallic nanoparticles of the multi-walled carbon nanotubes were together in the same conditions [14-16].

At the same time, Corpa et al. also found that the hydrophobic protein called HFB $^{\pm}$ can be used to control the non-covalent functionalization of the single-walled nanotubes and yet, it can also be planned to control the aggregation of the gold nanoparticles after the bond formation of these particles on the proteins [17-18]. Initially, they chose a specific protein to do the purpose, but, this protein was not readily available and their method can't be used which directly applied to the majority of proteins for the use of their attitude [19-20].

II. EXPERIMENTAL

Step 1

In the two neck round bottom flask pour 80mgr of nanotube carboxilate and 25cc of DMF was add, 30 min. over ultrasonic. After 30 min, put the mixture in the ice bath, containing acetone the 10mm of oxalic choloride, was added slowly, this reaction protected under nitrogen (atm) with stirring. Durring time temperature was under controlled.

The reaction minture was about $-13^{\circ}c$ with adding acetone with ice, then reaction mixture was kept for further 2hr at $0^{\circ}c$. left it for overnight at room tempereture for more drying, put it on the heater until temperature rise to $70^{\circ}c$

Step 2

7.5 gr (0.04 mol) of (b4) –phenylendiamine dissolved in 15cc of DMF was added in 0/5 gr of previous product (1 step) at 30 min. under ultrasonic. The mixture put in the microwave. (T. $110^{\circ}c$, P.70) for 2hr, evaporated solvent the residue was collected. This compound was reacted with 8gr of 4-hydroxy- 1,3 phenylene diamonium dichloride, 5 gr of 4-metyl 1,3- phenylene diamine, 4.5 gr of 1,3-phenylene diamine and 5 gr of 1,8 diamine – 3,6 – dioxaoctane respectively some of five drivatives added THF and then for 30 min. kept under ultrasonic. The percipitation was happened after 2 days and then 50ml of THF was added and seperated the residue by filtration and dry it. All product were confirme by IR / RAMAN / HNMR / $^{13}CNMR$ / and SEM, TGA spectroscopic

Preparation of DSSC

0.3 gr of each drivatives of nanotubes containing amines pour in the beaker and then some ice added, stirred slowly until nanotube desolved completely. 4cc Hydrogen choloride (5N) was added in the above beaker and reaction mixture was reached to ($0^{\circ}c$). In the other hand desolved onegr of Sodium Nitrite in 25cc of water and in an other beaker (0.4gr) blue azo dyes desolved in 10 ml of mixture of water and etanol, and then mixed the two beakers solution in the previous mixture, after filtration, purification, checked the product by IR / TGA respectively

III. RESULT AND DISCUSION

Derivative 1: 1,4 Phenylene diamine

IR (KBr, cm^{-1}) ν_{max} : 3400-3800 (OH), 3300-3500 (NH), 3000-3100 (CH, Ar), 2773-2973 (CH, Al), 1660-1760 (C=O), 1630-1690 (N-C=O), 1030-1230 (C-N), 548 (C-Cl) RAMAN: 3200-3600 (OH), 2500-3000(CH₃, CH₂, CH) (C=C), 1600-2000 (C=O, CoOH), 1600-1800 (C=C) 1Hnmr (DmSO, 300 MHZ) 8 ppm 3.3-4.5 (S, 1H), 3.5 (S, 2H, NH₂), 4.5-6.5 (S, 1H) 6.5-8 (m, 4H, Ar), 9.1 (1H, S, NH) $^{13}CNMR$ (DmSO, 300 MHZ) 8 ppm 200.0, 160.2,

135.1, 122.2, 420.1, 119.8, 118.2, 80.2, 65.4, 57.1, 40.5, 30.2

Derivative 2: 1.3 Phenylendiamonioum dicholoride

IR (KBr, cm^{-1}) ν_{max} : 3400-3800 (OH), 3500-3300 (NH), 3000-3100 (CH, Ar), 2773-2973 (CH, Al), 1660-1760 (C=O), 1630-1690 (N-C=O), 1030-1230 (CN), 548 (C-Cl) RAMAN: 1600-2000 (C=O, CoOH), 1600-1800 (C=C), 1200-1400 (CH, Ar) $^1\text{Hnmr}$ (DmSO, 300 MHZ) 8 ppm 3.3-4.5 (S, 1H), 6.5-8 (2Hm, Ar), 7.5 (S, 2H, NH₂), 9.1 (1H, S, NH), 10-12 (OH), $^{13}\text{CNMR}$ (DmSO, 300 MHZ) 8 ppm 160.2, 152.8, 125.2, 122.7, 120.1, 119.8, 118.2, 70.2, 55.1, 47.8, 40.5, 30.2

Derivative 3: 4 metyl – 1.3 Phenylendiamin

IR (KBr, cm^{-1}) ν_{max} : 3300-3500 (NH), 3421 (OH), 3000-3100 (CH-Ar), 2773-2972 (CH, Al), 1660-1760 (C=O), 1630-1690 (N-C=O), 1030-1230 (C-N), 548 (C-Cl) RAMAN: 1600-2000 (C=O, CoOH), 1600-1800 (C=C), 1200-1400 (CH, Ar) $^1\text{Hnmr}$ (DmSO, 300 MHZ) 8 ppm. 1.3-2.5 (3H, S, Ar), 3.3-4.5 (S, 1H), 4.5-5 (S, 2H, NH₂), 9.1 (1H, S, N), $^{13}\text{CNMR}$ (DMSO, 300 MHZ) 8 ppm 160.2, 135.2, 55.1, 47.8, 40.5, 30.2, 20.3

Derivative 4: 1.3 Phenylendiamine

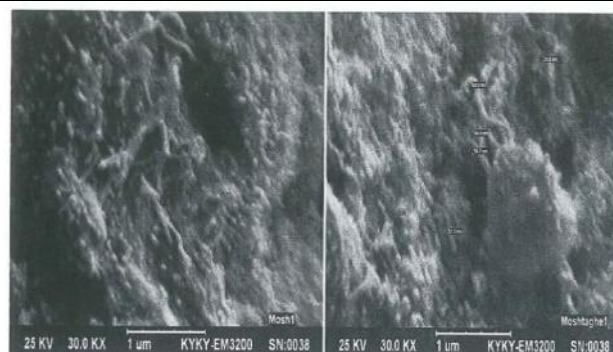
IR (KBr, cm^{-1}) ν_{max} : 3400-3800 (OH), 3300-3500 (NH), 3000-3100 (CH, Ar), 2773-2972 (CH, Al), 1660-1760 (C=O), 1630-1690 (N-C=O), 1030-1230 (C-N), 548 (C-Cl) RAMAN: 1600-2000 (C=O, CoOH), 1600-1800 (C=C), 1200-1400 (CH, Ar) $^1\text{Hnmr}$ (DMSO, 300 MHZ) 8 ppm 2.2 (S, 2H, NH₂), 2.82 (1H, S, Ar), 3.3-4.5 (S, 1, N), 4.5-6.5 (2H, S), 6.5-8 (4H, m, Ar), 9.1 (1H, S, NH) $^{13}\text{CNMR}$ (DMSO, 300 MHZ) 8 ppm 160.2, 135.2, 55.1, 47.8, 40.5, 30.2, 20.3

Derivative 5: 1.8 diamino, 3.6- dioxuocan

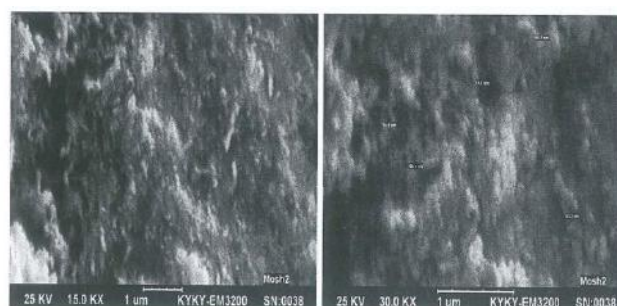
IR (KBr, cm^{-1}) ν_{max} : 3300-3500 (NH), 3421 (OH), 3000-3100 (CH, Ar), 2773-2972 (CH, Al), 1660-1760 (C=O), 1630-1690 (O=C-NH), 1030-1230 (C-N), 548 (C-Cl) RAMAN: 3200-3600 (OH), 2500-3000 (CH₃, CH₂, CH), 1600-2000 (C=O, CoOH), 1600-1800 (C=C), 400-700 (Cl) $^1\text{Hnmr}$ (DMSO, 300 MHZ) 8 ppm 2.83 (C=C-H), 4.26 (S, 1H), 4.94 (S, 1H), 5-7 (4H, m, C-C=H), 8.13 (1H, S), 4.1 (5CH₂ (10H, S)) $^{13}\text{CNMR}$ (DMSO, 300 MHZ) 8 ppm 160.2, 160.1, 158.7, 70.2, 65.2, 63.2, 62.1, 40.2, 40.1

SEM Spectroscopy:

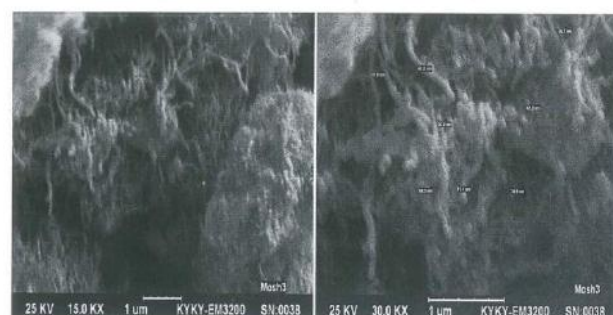
The same images of Carbon nanotubes Carboxilate are shown nanotubes groups are lied as in dependence chain beside of each other



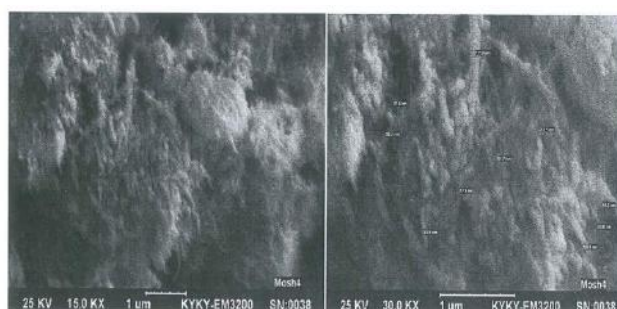
derivative 1



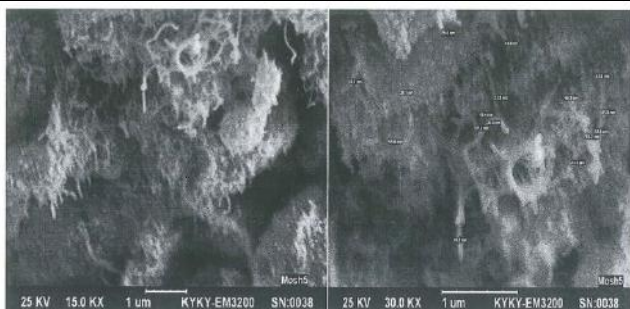
derivative 2



derivative 3

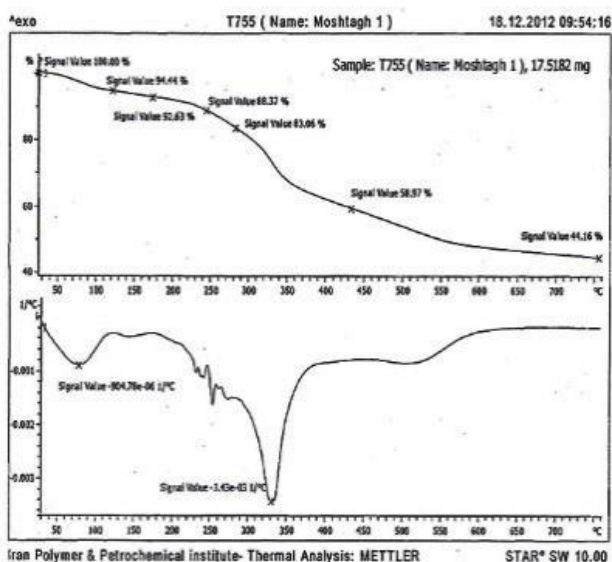


derivative 4



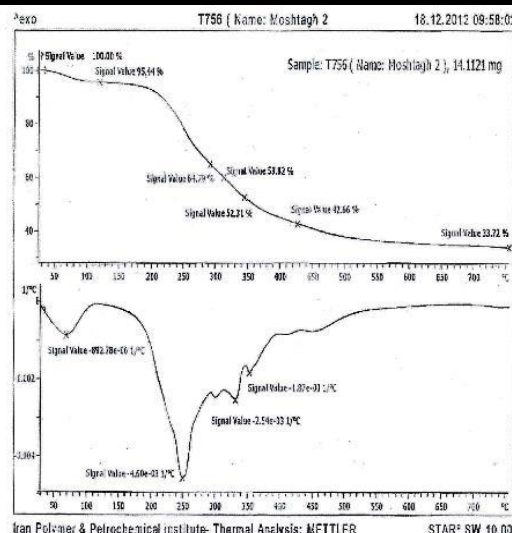
derivative 5

TGA Spectroscopy: (derivative 1) In above structure was shown decrease and increase of weight in 100°C because the sample was observe some water . In continue the Carboxile groups were destroyed in 170°C and maximom decrease of weight apear at 330°C and rised to 480°C for completing. Next peaks apear at 550°C that means the Oxidation of Carbon nanotubes was happened. The reason of Oxidation due of Carboxilic destruction which freedom Oxygen in TGA condition.



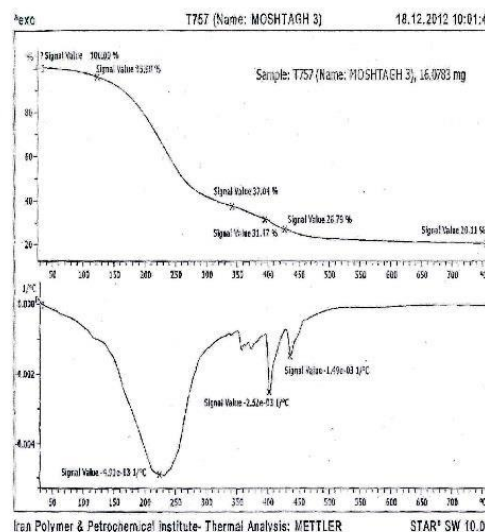
TGA Spectroscopy: (derivative 2)

In above structure was shown decrease and increase of weight in 70°C because the sampl was observe some water. In continue the Carboxile groups were destroyed in 170°C and maximom decrease of weight apear at 250°C and rised to 430°C for completing. Next peaks apear at 480°C that means the Oxidation of Carbon nanotubes was happened. The reason of Oxidation due of Carboxilic destruction which freedom Oxygen in TGA condition.



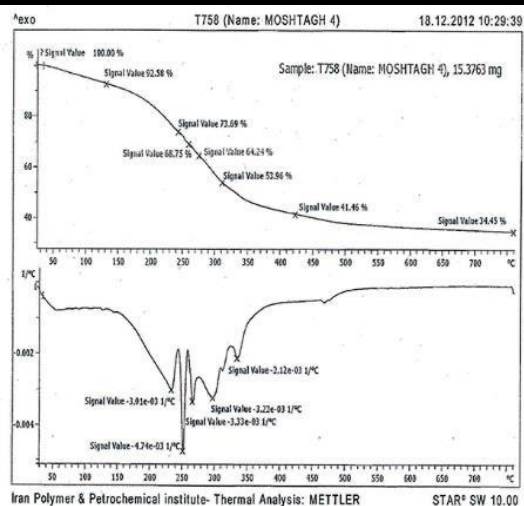
TGA Spectroscopy: (derivative3)

In above structure was shown decrease and increase of weight in 130°C because the sample was observe some water. In continue the Carboxile groups were destroyed in 150°C and maximom decrease of weight apear at 350°C and rised to 430°C for completing. Next peaks apear at 480°C that means the Oxidation of Carbon nanotubes was happened. The reason of Oxidation due of Carboxilic destruction which freedom Oxygen in TGA condition.



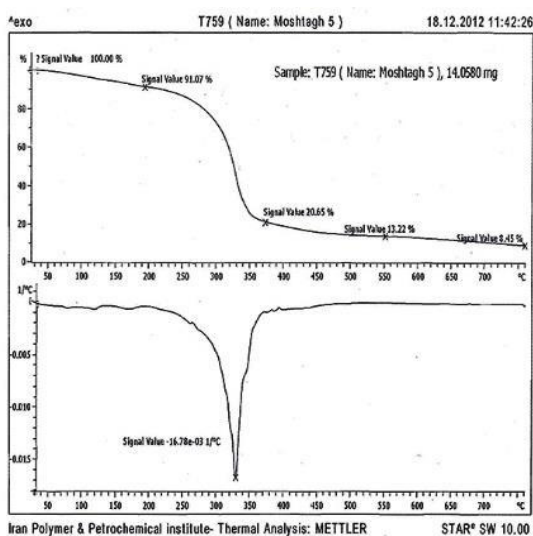
TGA Spectroscopy: (derivative 4)

In above structure was shown decrease and increase of weight in 130°C because the sample was observe some water. In continue the Carboxile groups were destroyed in 150°C and maximom decrease of weight apear at 250°C and rised to 480°C for completing. Next peaks apear at 530°C that means the Oxidation of Carbon nanotubes was happened. The reason of Oxidation due of Carboxilic destruction which freedom Oxygen in TGA condition.



TGA Spectroscopy: (derivative 5)

In above structure was shown decrease and increase of weight in 200°C because the sample was observe some water. In continue the Carboxile groups were destroyed in 250°C and maximom decrease of weight apear at 380°C and rised to 350°C for completing. Next peaks apear at 400°C that means the Oxidation of Carbon nanotubes was happened. The reason of Oxidation due of Carboxilic destroiton which freedom Oxygen in TGA condition.



IV. CONCLUSION

In this research we have alone several steps as below, Carboxilated, Colorination, Amination, Purification, and then run IR / RAMAN / ¹HNMR / ¹³CNMR / SEM / TGA. All structure established by spectroscopic method as above. In final deceision we would say functionalized these nanotubes Carbon by several of functional groups and then we can prepare several products of these functionlized nanotubes with respect of their properties which can used in new solar cells and percipitate them very simply.

REFERENCES

- [1] Shipway AN, Katz E, Willner I. (2000). Nanoparticle arrays on surfaces for electronic, optical, and sensor applications. *ChemPhysChem*;1:18-52.
- [2] El-Sayed MA. (2001). Some interesting properties of metals confined in time and nanometer space of different shapes. *Acc Chem Res*;34:257-64.
- [3] Burda C, Chen X, Narayanan R, El-Sayed MA. (2005). Chemistry and properties of nanocrystals of different shapes. *Chem Rev*;105:1025–102.
- [4] Zhang L, Sun X, Song Y, Jiang X, Dong S, Wang E. (2006) Didodecyldimethylammonium bromide lipid bilayerprotected gold nanoparticles: synthesis, characterization, and self-assembly. *Langmuir*; 22:2838—43
- [5] Kundu S, Wang K, Liang H. (2009). Size-controlled synthesis and selfassembly of silver nanoparticles within a minute using microwave irradiation. *J Phys Chem C*;113:134-41.
- [6] Tang Z, Kotov NA. (2005). One-dimensional assemblies of nanoparticles: preparation, properties and promise. *Adv Mater*;17:951–62.
- [7] Alivisatos AP. (1996). Semiconductor clusters, nanocrystals, and quantum dots. *Science*;271:933–
- [8] Hu J, Odom TW, Lieber CM. (1999). Chemistry and physics in one dimension: synthesis and properties of nanowires and nanotubes. *Acc Chem Res*;32:435–45.
- [9] Zubarev ER, Xu J, Sayyad A, Gibson JD. (2006). Amphiphilicity-driven organization of nanoparticles into discrete assemblies. *J Am Chem Soc*;128:15098—9.
- [10] DeVries GA, Brunnbauer M, Hu Y, Jackson AM, Long B, Neltner BT, et al. (2007). Divalent metal nanoparticles. *Science*;315:358–61.
- [11] Puchner EM, Kufer SK, Strackharn M, Stahl Sw, Gaub HE. (2008). Nanoparticle self-assembly on a DNA-scaffold written by single-molecule cut-and-paste. *Nano Lett*;8:3692-5.
- [12] Hulteen JC, Martin CR. (1997). A general template-based method for the preparation of nanomaterials. *J Mater Chem*;7:1075–87.
- [13] Huczko A. (2000). Template-based synthesis of nanomaterials. *Appl Phys A*;70:365–76.
- [14] Van Bommel KJC, Friggeri A, Shinkai S. (2003). Organic templates for the generation of inorganic materials. *Angew Chem, Int Ed*;42:980–99.
- [15] Xia Y, Yang P, Sun Y, Wu Y, Mayers B, Gates B, et al. (2003). Onedimensional nanostructures: synthesis, characterization, and applications. *Adv Mater*;15:353–89.

- [16] Asuri P, Bale SS, Karajanagi SS, Kane RS. (2006).
The protein- nanomaterial interface. *Curr Opin Biotech*;17:562–8.
- [17] M.F.Ldevoldev, S.H.Ray, H,Bau. (2013).
Science;339,535-539
- [18] N.Hiremath, J.Mays, G.Bhat. (2017). *Polymer Reviews*;27,Issues
- [19] N.Hiremath, G.Bhat. (2017). *Science Direct*;79-109
- [20] S.Mvosquerichian and Z.Bao. (2013). *NanoScale*;
Issues

Compressed Natural Gas Operated Two-Wheeler

Kini Rohit, Gharat Amey, Patil Abhishek, Sawant Rupesh, Choudhary Dipak*

Mechanical Engineering Department, Vidyavardhini's College of Engineering And Technology, Affiliated to the University of Mumbai, India

* Assistant Professor in Mechanical Engineering

Abstract— In this paper the results obtained on a 110cc two-wheeler S.I. engine using both petrol and CNG as fuel. Tests like Acceleration test, Emission test, Mileage test and Exhaust noise test were conducted at different operating condition. The basic petrol engine is converted into a bi-fuel engine and regulated by means of an electronically controlled Solenoid Actuated Valve system. On a comparative analysis CNG fuelled engine accelerated slower compared to petrol fuelled engine, but the CO and CO₂ emissions were lesser indicated that CNG when used as fuel accelerates at a faster rate, the emission of hazardous gases is comparatively far lower than petrol, fuel consumption of CNG is less and it is economical. The noise test shows that the exhaust of CNG is louder as compared to petrol.

Keywords— Acceleration, Bi-fuel, CNG, Mileage, Spark ignition engine.

I. INTRODUCTION

Compressed natural gas vehicles were first introduced to market in Italy in the mid-1930s and started to gain wider international attention during the oil crisis of 1970s and 80s.^[1] 'Alternative fuels vehicle' has become an essential field of research momentarily due to the scarcity of conventional fuels and increasing air pollution, thus endangering the species. According to the World Health Organization (WHO) the safe limit of dust particles in atmosphere is 40-80 mg also the estimates state 15-18 million children in developing countries suffers from permanent brain damage due to the hazardous environment.^[2] Therefore to ensure healthy environment CNG may play a vital role due to its advantages as high octane number, odourless, environment friendly and the limitations are low volumetric efficiency, low density, knocking at higher load.^[3] Various initiatives are launched and mostly focused over road transport. Although this programs are still not been hiked throughout. Therefore developing a non-conventional fuelling method for the vehicle is must to keep the machine working. Our project 'CNG operated two wheeler' contributes to the efforts made for the promotion of alternative fuels for such problem as petrol shows no sign of quitting the energy

scene. For the reasons such as its availability, environment friendly nature and most important is its compatibility with S.I. engine along with it CNG has higher octane number with respect to the petrol as it promotes better performance and longer life to engine.^[4] There is a huge potential in road, marine, railway and stationary engine applications to make use of CNG.^[5]

II. OBJECTIVE

- To make CNG operated two wheeler, for this we convert S.I. engine into the bi-fuel engine i.e. it can be operated on both CNG and petrol as fuel.
- To conduct Acceleration test and compare results of both fuels.
- To conduct Emission test on the S.I. engine and compare with both fuels.
- To conduct Mileage test and compare with the readings obtained with both fuels.
- To conduct Noise test to check the exhaust noise emission and relate values obtained with both fuels.

III. EXPERIMENTATION SET-UP

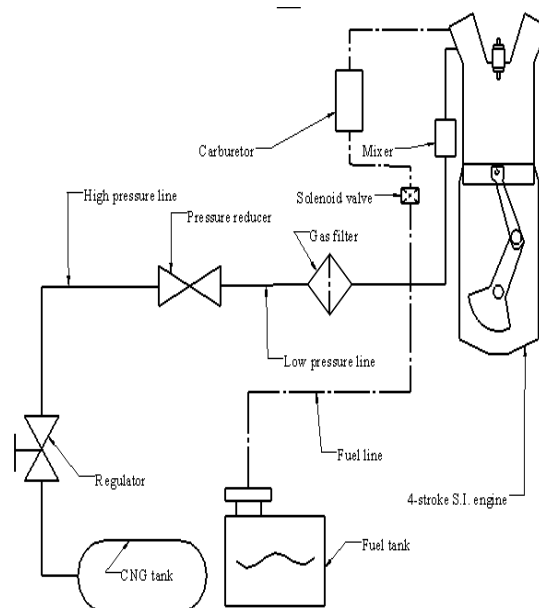


Fig 1. Working cycle

To convert an existing petrol fuelled two-wheeler engine into a bi-fuelled engine where the driver can switch from CNG to petrol easily whereas while switching from petrol to CNG it is necessary to burn out the left over petrol in the engine during operation.

The components required for the conversion are:

- Pressure Reducer
- Gas Mixer
- Main Shut-Off Valve
- CNG Filling Valve
- High- Pressure Lines
- CNG Tank and Filling Valve
- Gasoline/CNG Selector Switch
- Pressure Gauge
- Petrol Solenoid
- Low Pressure Pipe

IV. EXPERIMENTATION

4.1. Acceleration Measurement Test:

Test is conducted by measuring the time taken by the vehicle to accelerate 0-40 km/hr. with the change of load for both petrol and CNG fuelled engine. Load applied by the weight of riders and dead weight.

Table no-1

Reading No.	Load (Kg)	Time CNG (sec)	Time Petrol (sec)
1.	80	11.35	8.95
2.	140	17.20	10.35
3.	200	21.30	11.50

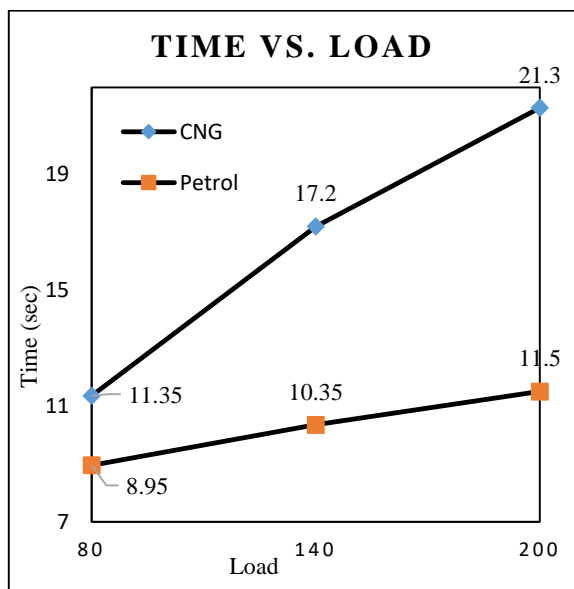


Fig No.-2

4.2. Emission test for petrol and CNG:

CNG reduces emissions of harmful gases like carbon monoxide (CO), carbon dioxide (CO₂) and nitrogen oxide (No_x). Burning gasoline on the other hand produces large

amounts of CO and CO₂ which leads to the greenhouse effect. Checking emission by means of gas analyser at different speeds by means of an optical tachometer.

For CNG-

Table no-2

Emission	Speed (RPM)			
	0	100	200	300
CO (%)	0.021	0.044	0.067	0.178
CO ₂ (%)	1.1	1.3	2	2.6
Non-methane HC(ppm)	0.0085	0.0346	0.0321	0.0281

For Petrol-

Table No-3

Emission	Speed (RPM)			
	0	100	200	300
CO (%)	0.395	1.146	2.116	2.625
CO ₂ (%)	2.3	3	3.82	4.8
HC(ppm)	218	120	146	298

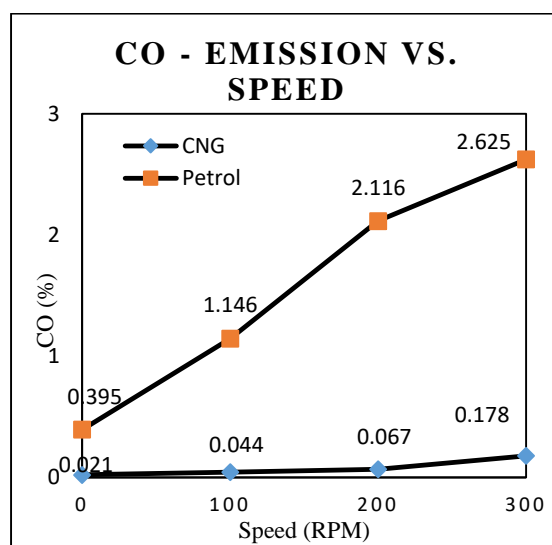


Fig No.-3

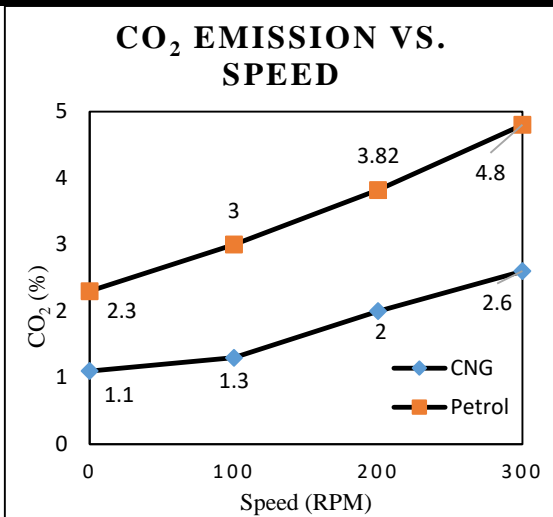


Fig No.-4

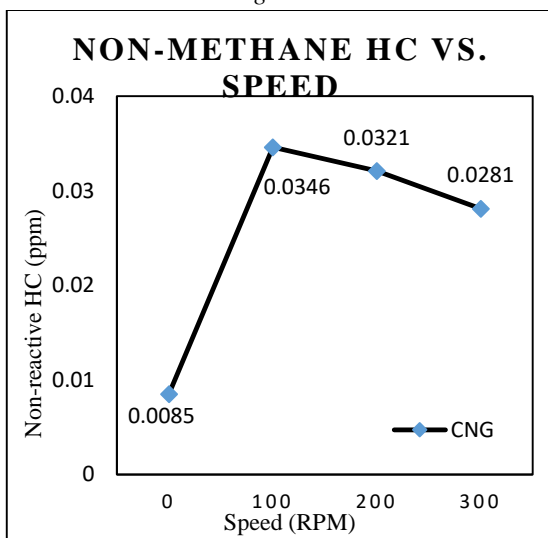


Fig No.-5

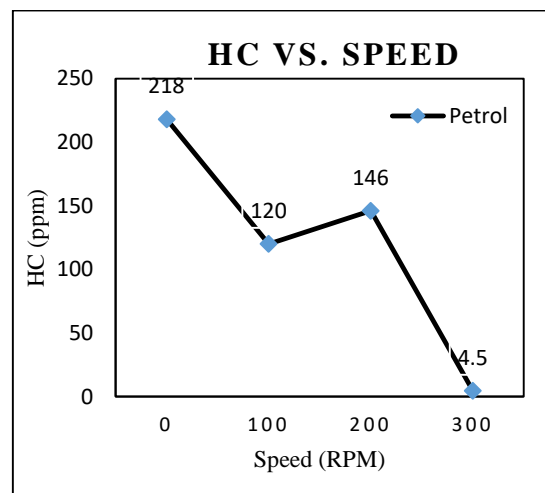


Fig No.-6

$$V = \frac{\pi}{4} \times 160^2 \times 320 + 2[0.5 \times 1.33 \times 75^2]$$

$$= 6996481.755\text{mm}^3 = 0.00699\text{m}^3 \sim 0.007\text{m}^3$$

For volume of CNG tanks = 0.014m³ and for varying pressure ranging from 3000 psi to 1000 psi, the density of CNG for each reading was calculated. Now by using both the pressure and density values, the mass of gas consumed was determined.

For CNG-

Table no-4

Sr. No.	Distance (Km)	Mass consumed (Kg)	Mileage (Km/kg)	Cost of fuel (₹)
1.	0	0	0	0
2.	38	0.442	87.6	19.02
3.	72	0.886	81.26	38.09
4.	110	1.32	83.33	56.76
5.	140	1.77	88	76.11

For Petrol-

Table no-5

Sr. No.	Distance (Km)	Mass consumed (Litres)	Mileage (Km/Lit)	Cost of fuel (₹)
1.	0	0	0	0
2.	38	0.9	42.22	72
3.	72	1.8	40	144
4.	110	2.5	44	200
5.	140	3.3	42	264

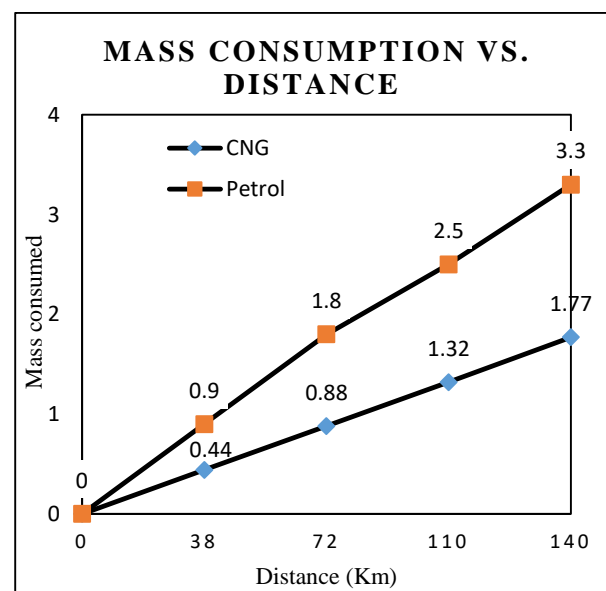


Fig No.-7

4.3. Mileage test:

Volume for a single CNG tank-

$$V = \frac{\pi}{4} \times d^2 \times h + 2 \left[\frac{1}{2} \times \frac{4}{3} \times r^3 \right]$$

Where, d = 160mm; h = 320mm; r = 75mm

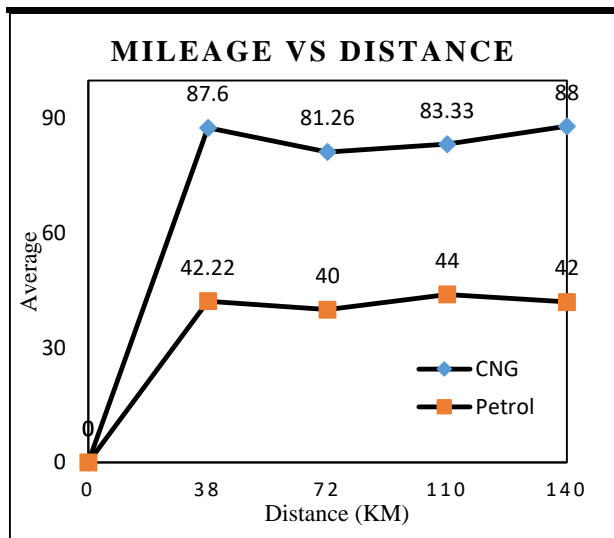


Fig No.-8

4.4 Noise test :

The motorcycle engine must be at normal running temperature during the test. The motorcycle must be in neutral gear during the test. The measurements between two verifications are valid if an adjustment of less than 0.5 dB_A is required. The microphone must be placed behind the exhaust pipe at a distance of 50 cm ±2 cm from the reference point of the exhaust pipe at the same height as the reference point ±2 cm. Perform the test with constant engine rpm measured with the help of an optical tachometer.

Table no-6

Sr. No.	Speed (RPM)	Exhaust sound CNG (dB _A)	Exhaust Sound Petrol (dB _A)
1.	0	60	65
2.	140	73	70
3.	250	76	74.2
4.	400	80	77.8

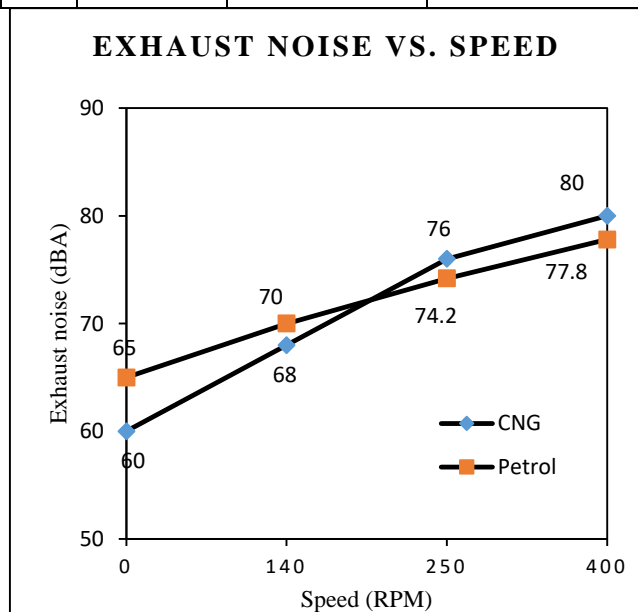


Fig No.-9

V. RESULT

- In acceleration test, time required to accelerate from 0-40 km/hr. during maximum load, CNG takes around 21.30 sec whereas petrol takes 11.50 sec to reach 40 km/hr.
- In emission test, CNG produce less CO, CO₂ gases as compared to the petrol and also HC is absent in CNG.
- In mileage test, the two-wheeler is driven for maximum distance of 140 Km where the mileage given by the CNG fuelled engine is 88 Km/Kg and for petrol fuelled engine for the same distance it is 42 Km/lit.
- In noise test, during idling CNG produces up to 60 dB_A but at 400 rpm the noise level rises to 80 dB_A and for petrol it is slight lower to 77.8 dB_A.

VI. CONCLUSION

From the results obtained it can be concluded that a bi-fuel (CNG) operated two-wheeler is more beneficial, economical and environment friendly as compared to the petrol operated two-wheeler.

REFERENCES

- [1] Yeh S., (2007), An Empirical Analysis on the Adoption of Alternative Fuel Vehicles: The case of NGV”, *Energy Policy*, 35, 5865-5875. doi:10.1016/j.enpol.2007.06.012
- [2] Tambori, S., Benjamin I., Daso, D., Sorbari, K., John, A., (2014), Evaluation of Comparative Analysis in the Use of Petrol and CNG as Vehicular Fuel, *IOSR-JMCE (e-ISSN: 2278-1684)*, 11, 46-54,
- [3] Ganesan V., (2007). Internal Combustion Engine, 3rd Edition, *TMH (ISBN 978-1259006190)*, New Delhi.
- [4] Munde G., and Dr. Dalu R. S., (2012). Compressed Natural Gas as an Alternative Fuel for Spark Ignition Engine: A Review, *IJEIT (ISSN: 2277-3754)*, 2, 92-96.
- [5] Paul, J., Hossain, M. A., Das, S. K., Rahman, R., (2013), Studies of performance and emission characteristics of Compressed Natural Gas fuelled S.I. engine and developing CNG conversion kit, *IOSR-JMCE, (e-ISSN: 2278-1684)*, 9, 23-29.
- [6] M.T. Abu Seman, M.F. Abdul Hamid, A.K. Ismail (2016). Green Application: Electric Charge Generated From Any High Temperature Heat Source. *International Journal of Advanced Engineering, Management and Science (ISSN: 2454-1311)*, 2(7), 1160-1162.

The Importance of Water use under Climate Change effects in Semi-Arid Agricultural Areas

Ayşe Güneş

Harran University, Agriculture Faculty, Field Crops Department.63000.Şanlıurfa, Turkey

Abstract— Irresponsible use of water resources, hunger, drought, extinction of species, vegetation and soil destruction, pollution, global warming and climate change, the thinning of the ozone layer, the negative effects of greenhouse gases was the beginning of the process of global warming. Almost 90 percent of the irrigated agricultural production in our country is carried out by so-called wild irrigation flood irrigation method. To obtain abundant and high-quality forage from pastures, irrigation of this area is to solve the drainage problems, fertilization, weed the war and the various maintenance jobs are dependent on properly. With surface irrigation practices, fertile agricultural land becomes barren in the Southeastern Anatolian region. These lands are becoming agricultural production cannot be done in the future. Therefore, soil and agricultural production to continue in a healthy manner and informed water management practices must be done to protect the soil. The use of wastewater for this purpose irrigation, directing the arid areas of runoff, evaluating and storing rainwater farmers to promote modern irrigation methods, practices that save water and farmer training with consideration should be given to applications involving studies as to ensure its dissemination. We have to use irrigation water in our region with low rainfall. We must look for ways to benefit from rainwater.

In this study, in order to ensure sustainable water management in our country under the influence of climate change on agricultural production, land and water use and it has consciously explored in agriculture.

Keywords— Drought, climate change, water management, irrigation, water conservation.

I. INTRODUCTION

In order to ensure sustainability in agricultural production, water resources must be well protected and used rationally. Turkey is not a water-rich country, a country faced with water. All our regions have been affected by the agricultural drought that has been experienced with global warming. It is inevitable that the agricultural drought is the result of low agricultural productivity, economic losses, deterioration of ecological balance and social life. As a result of global warming Turkey influenced by ecological degradation and

desertification linked to them in terms of the potential impact of global warming, and water resources decreases, forest fires, droughts, thus has been among the risk group of countries. According to the climate change scenarios and the expectations expressed by these scenarios, the amount of water available in the world, such as warming in the atmosphere, increasing evaporation, decreasing snowfall, degradation of existing distribution in the rainfall season, and changes affecting agricultural production negatively. The amount of rainfall has decreased in our country under the influence of climate change. It is necessary to evaluate the small amount of rainfall in situ and use it in agricultural production. (Kuzucu 2017), informed that rainwater harvesting studies could supply the water needed in arid regions and pointed out that rainwater harvesting practices are an easy and economical method to gain water to the soil. For this reason, drought and flood should be considered together and evaluated, based on these climate events. Water, which is gradually decreasing due to global warming and climate change, is an indispensable necessity of living life. Drinkable water resources in the world; irregular urbanization, excessive population growth, increase in greenhouse gases and excessive industrialization. In this context, methods for reducing water consumption rates need to be defined and water conservation models for sustainable water and wastewater management should be developed (Anonymous, 2014). Researchers worked on water management in the process of climate change (Kılıç, 2008) and the solution of a global problem of water scarcity (Sahin, 2016). According to these studies, "conservation of water resources" should be one of the priority targets. (Monirul 2003) and (Huang 2014), it is important to note that the adaptation of the two varieties to agricultural activities is important. (Kuzucu 2017) reports that organic fertilizers in the production of pistachio conserved soil and water at dry conditions and increase yields at the same time. Water-conscious techniques involving the collection and storage of surface runoff and rainwater, and water-saving practices to promote farmers to modern irrigation methods such as drip and drip irrigation, should be given importance in order to achieve conscious water consumption in agriculture in agricultural irrigation. In countries affected

by climate change, FAO also conducts various surveys and emphasizes that all measures necessary for food safety and agricultural sustainability are taken according to the studies (Anonymous, 2016).

Global warming and climate change effects in Turkey.

Drought, which is the result of global warming and climate change, is a climate event that occurs when precipitation occurs less than the average for many years. The effects of the drought, the duration and the time and the difficulty of predicting it are also closely related to human activities. With the increase in the amount of greenhouse-influencing gases released to the atmosphere after the industrial revolution, the world entered an artificial climate change process. Globally, the average temperature of earth and water bodies has increased since 1861. This increase was at 0.8 ° C during the 20th century. Diminishing the amount of water in some lakes in Turkey visualized (Figure 1).

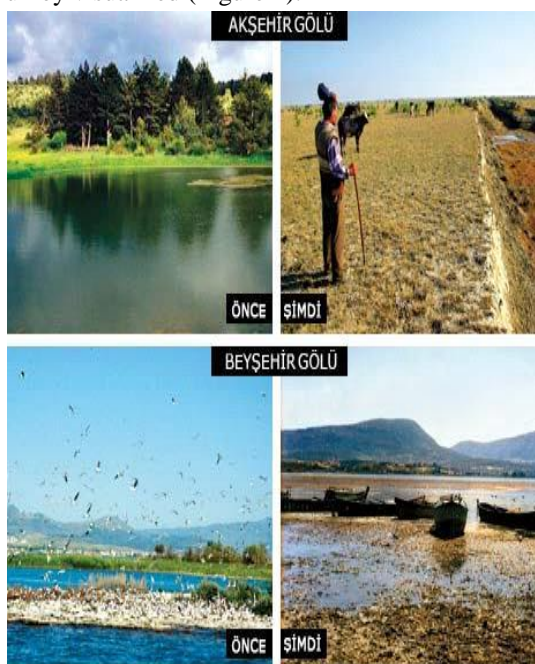


Fig.1: Effects of global warming in some lakes in Turkey

Market share is given that affect global warming in Turkey in Figure 2. Global warming the most affects was the energy sector with 26%. This is followed by industrial forestry and agriculture sectors respectively. Impact of the agricultural sector on global warming was set at 14%.



Fig.2: Sector share in global warming in Turkey.

Population increasing, especially farmers in agricultural areas in Turkey, increased industrialization and prosperity that took place in the cities also increases the need for water. Turkey, especially the increase in the major cities in the amount of water used for industrial and residential, which means a reduction in the amount of water used in agriculture and growing population with the greater number of waste water and has led to more water pollution. For this reason, the water used in agricultural areas has to be used more effectively (Anonymus, 2005). The effect of global warming is to extract the water from the small farm ponds used in agriculture and to damage the area as shown in Figure 3.



Fig.3: Evaporation and water withdrawn from agricultural land under dry condition in Turkey.

In the 2070 general of Turkey 6 0C temperature will rise until thoroughly rainfall will decrease in other areas outside the Black Sea region and ecosystem changed, it is also expected to be faced with extinction of many species. Especially in our country where our global warming has started to be felt, our fields are driven by wrong edition techniques. The biggest mistake is a very deep field version. Very deep field crops cause drought and soil cracking and plant capillary roots to be destroyed by temperature effect. As is known, the humus layer of the soil is a layer thickness of 3-5 cm on the surface. This 3-5 cm humus layer in the uppermost layer is pushed deeply

and is exposed to the surface of the layer which is in the deep and the amount of humus and organic matter is extremely weak. The deep part is not pushed into the humus wherein the deep drilling down to the groundwater. From this point of view, the deep driving of the fields is wrong. Climate change and the scarcity of rainfall caused limited agricultural production in Turkey. Particularly, in the southeastern region of Anatolia, agricultural production has been hampered by the droughts in 2008 and 2010. The average of 30 years rainfall was 344.1 mm in this semi-arid region. Between 1982 and 2011, the lowest rainfall measured was 227.3 mm in 2008, while the highest rainfall measured was 573.1 mm in 1996. Agricultural production's products are very difficult circumstances under rain-fed conditions (Kuzucu et al. 2016).



Fig.4: Water harvesting practices for collecting rainwater in arid areas.

Some of our farmers are tillage their fields for inclination because this application is easier. In this case, the humus layer disappears of the soil with rain and wind erosion. In this respect, the sloping fields must be driven perpendicular to the slope. Though it is difficult in this regard, sloping land should be driven upright. Water shortage is one of the main problems in agricultural production for Southeast Anatolia Region. The organic fertilizers used in this study increased the amount of organic matter in the soil and thus the water absorption capacity, thereby preventing the stress conditions of the plant in the arid summer season. It is also supplied with the applied water harvest and the winter rainfall of the water needed by the plant (Fig 4.). The best plant water consumption was obtained by application of farm grab with water harvesting of soil with an average of 380mm. water harvesting and organic fertilization are recommended for plant growth and yield enhancement in dry farming areas (Kuzucu et al. 2013). In the last years when global warming has occupied our agenda and drought is felt more every day, 30% - 70% of irrigation water is evaporating with daytime field irrigation. In addition, the water droplets remaining on the leaves in

daytime irrigation show a lens effect, burning 12 times as much as their own area. This means that the area of photosynthesis of the plant is shrinking. The plant has to constantly defeat this situation, which leads to a decrease in fruit yield of the plant. Another drawback of daytime watering is the formation of miniature ponds in the pit areas of the fields. These ponds cause the plant roots in this part to decay. Irrigation should be done whatever method is absolutely night soil cold (Çakmak et al., 2005).

II. RESULTS AND DISCUSSION

In-situ development work such as leveling, consolidation and drainage should be built in conjunction with irrigation systems to ensure sustainable water management in agriculture. It should not be forgotten that the success of irrigation projects depends on the arrangement of soil-water-human relations in the physical infrastructure project area. Agricultural water user sector is in first place as the most water-use sectors in Turkey. For this reason, the use of tools and techniques that provide effective water use in agriculture should be among the priority targets of our country. With advanced irrigation technologies it is possible to produce the same amount or more of products with less irrigation water and work power without harming the environment. The selection and projecting of the most appropriate irrigation method for the vegetation pattern to be selected according to the characteristics of the land in our country and application of a suitable irrigation program will ensure that our natural resources are transferred to the next generation in the best way. The application of pressure irrigation systems will reduce water losses and minimize the harmful effects of excessive watering. Under the pressure of the Agricultural Drought, the decrease in agricultural production becomes more effective with the future population increases, and the increase of the food need makes the struggle with the agricultural drought even more important. Completion of surface storage facilities and completion of work to ensure that groundwater reservoirs are kept at the highest levels with maximum nutrition, application of appropriate water harvesting methods according to land use types and effective methods of water use should be improved. Rainfall should be stored in soil or other area in rainfall-less areas. Farmers should benefit from this water during the arid periods. It is necessary to prevent excessive watering in flat land and to spread the application of drip irrigation. Priority should be given to informing and educating farmers in order to improve performance and ensure effective water use in the irrigation system.

REFERENCES

- [1] Anonim (2004). 1995-2004 50.Yılında DSİ. Enerji ve Tabii Kaynaklar Bakanlığı DSİ Genel Müdürlüğü, DSİ İdarive Mali İşler Daire Başkanlığı, Basım ve Fotofilm Şb.Md.84s. Ankara.
- [2] Anonim (2005). 2004 yılı DSİ'ce İşletilen ve Devredilen Sulama Tesisleri Değerlendirme Raporu. DSİ Genel Müdürlüğü, İşletme ve Bakım Dairesi Başkanlığı, Ankara.
- [3] Anonim (2016). <http://www.fao.org/climate-change> (Erişim: 25/10/2016, FAO 2016)
- [4] Çakmak B, Kendirli B, Yıldırım M (2005). Türkiye'de Sulama Uygulamaları ve Basınçlı Sulama Uygulama Olanakları. II. Ulusal Sulama Sistemleri Sempozyumu 9-11 Kasım 2005, DSİ Gn.Md., s.25-37, Ankara.
- [5] Huang Ji-Kum (2014). Climate Change and Agriculture: Impact and Adaptation. *Journal of Integrative Agriculture (Elsevier)*, 13 (4): 657-659.
- [6] Kılıç S (2008). Küresel İklim Değişikliği Sürecinde Su Yönetimi. İ.Ü., Siyasal Bilgiler Fakültesi Dergisi, No:39 (Ekim 2008), s. 161-186, İstanbul.
- [7] Koçak M, Zayıf YA (2005). Yüzey ve Basınçlı Sulama Sistemlerinin Karşılaştırılması ve İşletme Hizmetleri Yönünden Değerlendirilmesi. II. Ulusal Sulama Sistemleri Sempozyumu 9-11 Kasım 2005, DSİ Gn.Md., s.193-207, Ankara.
- [8] Kuzucu, M., Gözel H., Şahan A. 2013. Effects of Water Harvesting Practices and Organic Fertilization on Growth, Yield and Quality in Pistachio Orchards. *Soil and Water Journal* ISSN: 2146-7072 Special Issue for AGRICASIA' 2013. Vol.2 Number 2 (1) page 381-386.
- [9] Kuzucu, M., Dökmen, F., Güneş A. 2016. Effects of Climate Change on Agriculture Production Under Rain-Fed Condition. *International Journal Of Electronics, Mechanical And Mechatronics Engineering* Vol.6 Num.1 - 2016 (1057-1065).
- [10] Kuzucu, M. (2017). The Economic Evaluation Of Water Harvesting Techniques In Dry Agricultural Areas. *Journal of Multidisciplinary Engineering Science and Technology*. ISSN: 2458-9403 Vol. 4 Issue 9, p.8267-8270. September – 2017.
- [11] Kuzucu, M. (2017). Effects Of Water Harvesting Techniques And Using Humic Acid On Soil Moisture, Plant Evaporation, Growth And Yield In Pistachio Orchards In Southeastern Of Turkey. *Fresenius Environmental Bulletin*. Volume 26 – No. 12/2017 pages 7521-7528.
- [12] Monirul M, Mirza Q (2003). Climate Change and Extreme Weather Events: can Developing Countries Adapt. *Climate Policy (Elsevier)* 3(2003), 233-248.
- [13] Şahin B (2016). Küresel Bir Sorun: Su Kıtlığı ve Sanal Su Ticareti. T.C. Hitit Üniversitesi, Sosyal Bilimler Enstitüsü, İktisat Ana Bilim Dalı, Yüksek Lisans Tezi, 2016, Çorum.
- [14] Öztürk A (2004). Tuzluluk ve Sodyumluluğun Oluşumu, Bitki ve Toprağa Etkileri, Sulanan Alanlarda Tuzluluk Yönetimi Sempozyumu Bildirileri, s.1-16, 20-21 Mayıs 2004, Ankara.

Phosphoric Acid Increases the Porosity and Extends the Contact Area of Dental Osseo integrated Implants

Fernando Luzia França¹, Aline do Carmo França Botelho^{2*}, Fernando Gabriel Souza Araújo³

¹PhD Federal Center of Technological Education of Minas Gerais - Sector Dental Medical. Av Minister Olavo Drummond, 25 Zip Code: 38180-084. Araxá, Minas Gerais, Brazil.

²PhD Professor in University Center of Araxá Plateau. Av Minister Olavo Drummond, 5. Zip Code: 38180-084. Araxá, Minas Gerais, Brazil.

³PhD Professor Department of Physics Institute of Mathematical Sciences and Biological / University of Ouro Preto Federal (UFOP) Campus Morro do Cruzeiro. Zip code: 35400,000. Ouro Preto, Minas Gerais; Brazil.

* Corresponding author: alinefb@terra.edu.br

Abstract— *The surface treatments are performed in dental implants in order to increase the chemical and mechanical connection between the implant and bone, favoring the stability of implant-supported prostheses. The aim of this study was to characterize dental implant surfaces treated with 37% phosphoric acid. Implant surfaces were evaluated divided into groups of fifty samples being distributed in: porcelain samples without treatment; metal samples without treatment; porcelain samples with treatment with 37% phosphoric acid for 30 seconds; metal samples treatment with phosphoric acid at 37% for 30 seconds; porcelain samples with treatment with 37% phosphoric acid for 60 seconds; metal samples with treatment with 37% phosphoric acid for 60 seconds. The samples were characterized by Scanning Electron Microscopy. After the phosphoric acid treatment porosity changes were observed and expanding the contact area. The results show benefits of using phosphoric acid, as a surface with increased roughness; this is desired to occur matrix deposition and growth of bone tissue and facilitates the fixation of implant-supported prostheses.*

Keywords— *Dental implants, phosphoric acid, porosity.*

I. INTRODUCTION

A dental implant is a treatment to replace missing teeth has become an integral treatment modality in Odontology. Dental implants have several advantages in relation to conventional fixed partial denture. Among them it is possible to highlight: high success rate (over 97% for 10 years); reducing the risk of cavities and endodontic problems of adjacent teeth; best bone maintenance in edentulous site and decreased sensitivity of the adjacent teeth. It is a structure located in the tissues under the oral mucosa and / or the periosteum and / or within or through

the bone to provide support and retention for a dental prosthesis (Gupta; Weber, 2017).

For biocompatibility and implant success determining factors are considered: the geometry, surface condition, the general state of health of the host, the surgical technique and control of the mechanical load after installation of the implant. Several studies have sought to compare different surface treatment methods and their influence on the mechanisms involved in the acceptance or rejection of the implant, as well as the cellular response and intensity of inflammation (Brandão, 2010; Fugazzoto; Vlassis, 2007; Kang, 2009).

The increased contact area between bone and implant can be obtained by changing the topography or by increasing the surface roughness of the implant (Anselme et al., 2000). The relationship between the success of the implant and the cement used for fixation of the prosthesis is still not fully understood. Despite the stage of cementing is one of the stages of the clinical protocol indirect restorative, which was modified in the transition from the use of conventional systems for so-called aesthetic-adhesive systems or metal-free, in the literature, there are few works related to mechanical and each adhesive system, as well as the properties and limitations of adhesives and cementing systems that can lead to early failure of implant-supported prostheses (Garofolo, 2005). Thus, surface treatment process can be an alternative to the success of the implant. Such treatments may be added through methods where the material added to the implant surface, or subtracting, when removing part of the surface layer (Groismam et al., 2005).

One method of surface treatment by subtracting is the acid attack (Hsu et al., 2007), with the machined metal implants are immersed in an acid, in pure form or in

solution, and maintained for a given time interval, with small ridges or retention surfaces (Nagem Filho, 2007). The aim of the study was to characterize surfaces of dental implants of different materials, treated with 37% phosphoric acid by volume.

II. MATERIALS AND METHODS

For the treatment effect was considered the inner surface of the prosthetic implant and the implant external metal. The concentration of phosphoric acid used was 37% and treatments were performed two times, 30 seconds and 60 seconds. A control was also performed without the treatment with phosphoric acid.

Three hundred samples were prepared, divided into six groups, with fifty units in each sample. Where: Group 1: porcelain samples without treatment with phosphoric acid at 37%; Group 2 metal samples without treatment with phosphoric acid at 37%; Group 3: porcelain samples treatment with phosphoric acid at 37% for 30 seconds; Group 4 metal samples treatment with phosphoric acid at 37% for 30 seconds. Group 5: porcelain samples with treatment with 37% phosphoric acid for 60 seconds; Group 6 metal samples with treatment with 37% phosphoric acid for 60 seconds.

The porcelain samples were prepared mimicking the buccal surface of the upper incisor teeth, having its inner surface received etching with phosphoric acid at 37% for 60 seconds, leaving an area not in contact with the acid to indicate the difference in opacity between the treated area and the untreated area.

The metal inner surface received etching with 37% phosphoric acid for 60 seconds, leaving an area not in contact with acid, to indicate the difference in opacity of treated area and untreated area.

Using scanning electron microscopy the surface was mapped and the data registered in photomicrographs.

III. RESULTS

After treatment of the samples with phosphoric acid application at 37% were observed on the surface changes as a function of time. The exposure to phosphoric acid made more opaque surface. Figure 1 shows the differences between the samples without attack on the inner surface of the prosthetic implant and the external surface of the implant, in the presence or absence of phosphoric acid treatment.

What is observed is that surfaces of both porcelain and metal before the treatment with 37% phosphoric acid are smoother and therefore more homogeneous (A), where these surfaces are exposed to the treatment with phosphoric acid 37% for 30 seconds characteristics of surfaces are becoming opaque and therefore less bright (B), however the images in (C) after the surfaces were exposed to treatment with phosphoric acid at 37%, for 60 seconds, the surfaces have much more opaque and less bright, suggesting that the higher the greater exposure to acid changes in their structure.

It is observed that after 60 seconds of treatment with phosphoric acid the surfaces of both porcelain and metal feature are changed, as indicated by arrows in Figure 1.

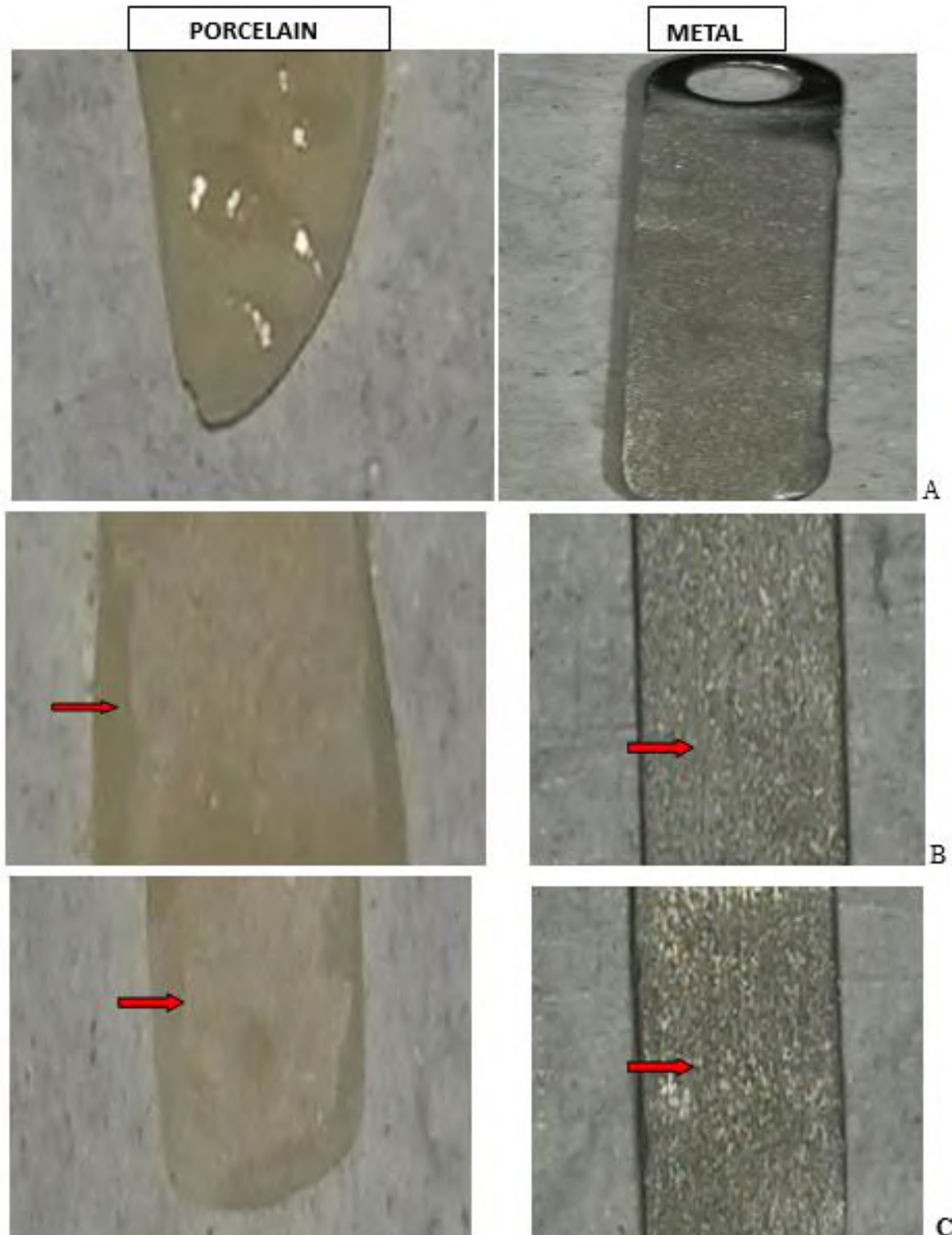


Fig. 1 -1: Visual appearance of porcelain and metal samples without treatment with phosphoric acid attack (A) with phosphoric acid treatment for 30 seconds (B) and treatment with phosphoric acid for 60 seconds (C).

In Figure 2 is the analysis of the porcelain surfaces treated and not treated by phosphoric acid at 37% in the scanning electron microscope, there is an area treated with strong porosity.

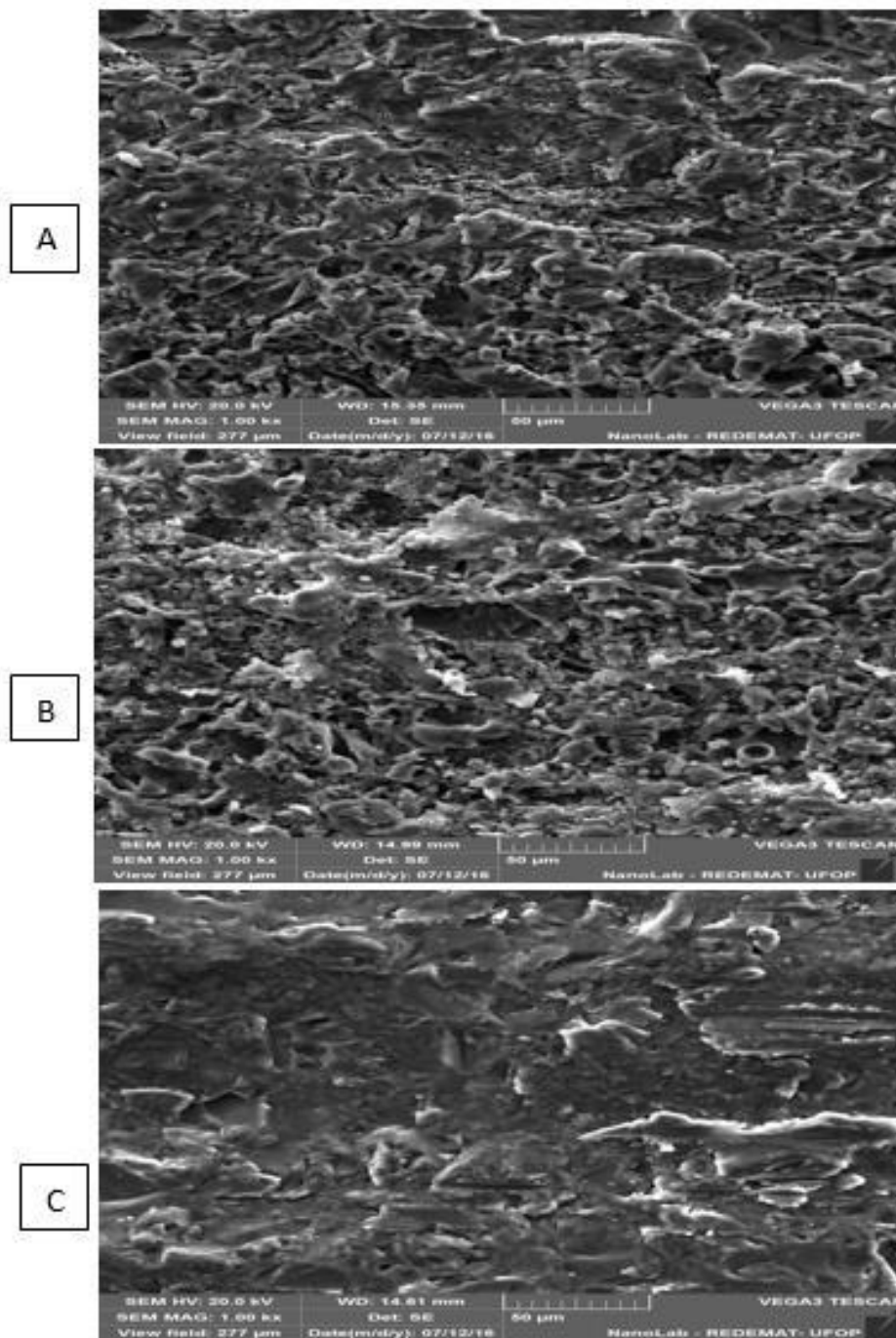


Fig.2: Photomicrograph of porcelain surfaces; in A the untreated, in B treated with phosphoric acid and after 30 seconds and in C treated with phosphoric acid after 60 seconds (SEM image at 1000x magnification).

Figure 3 refers to the photomicrographs of untreated and treated metal surfaces with phosphoric acid. It is noted that the treatment in metal was effective for increasing the contact area with cement, which may improve the attachment the prosthesis.

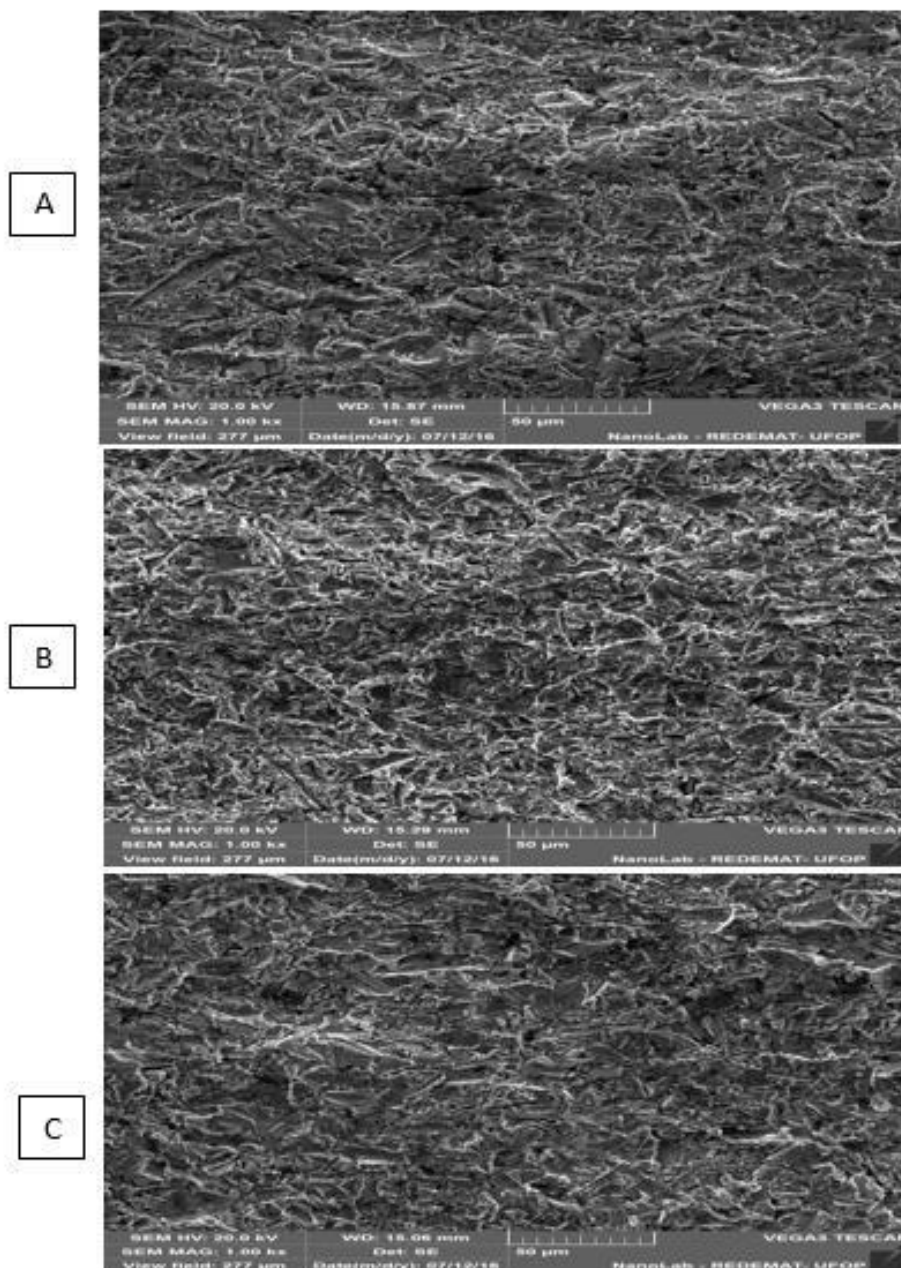


Fig.3: Photomicrograph of metal surfaces; in A the untreated, in B treated with phosphoric acid and after 30 seconds and in C treated with phosphoric acid after 60 seconds (SEM image at 1000x magnification).

IV. DISCUSSION

The need for development of dental treatments to supply the missing teeth stimulated the search for studies of the production of prosthetics they need to have a restraint system that provides retention and stability of the prosthetic element, which allows the patient to use with functionality and aesthetics.

The treatment of the internal surfaces of the prosthetic implant can directly influence the physical and mechanical properties of the joint prosthesis / implant, culminating in a reduced line of cementation and better fixation of prosthetic implants for dental use.

According to the data obtained, the implant surfaces treated with phosphoric acid undergo structural changes which can influence the success of the dental implant. Scanning electron microscopy analysis revealed that the surfaces of both metal and porcelain implants have undergone considerable surface changes with increased porosity. The breakage caused by phosphoric acid on the surface suggests an increase in porosity, expansion of the contact area of the cement fixer and imbrication of the favored cement, which may increase the anchorage of the prosthesis over the implant.

The different surface pretreatment (chemical, mechanical, or both) to the surfaces that make up the cementing line are proposed in the literature (Lohbauer et al, 2008;

Kitayama et al, 2009; Amaral et al, 2014; Bottino et al, 2014; Rippe et al, 2015).

Studies on the resistance of cemented crowns with different roughness after treatment with aluminum oxide showed that on smooth surfaces cemented crowns had a lower resistance drift as compared surfaces with grooves. The rugosity after treatment with acids can generate increased resistance in cemented crowns (Campos et al., 2010).

The treatment with phosphoric acid of the surface which the implant can increase the offset resistance and the acid solution can clean the surface and create micro roughness on the surface, improving adhesion to cement.

It is noteworthy that the pretreatment of surface enhances the retention of the implant crowns for dental use. Thus, preparation of surfaces that were in contact with the zinc phosphate cement can result in significantly increased retentive strength values when compared to untreated surface.

In the clinical monitoring of patients rehabilitated with cemented and screwed prostheses on implants showed clinical success and prosthetic these types of prostheses. The success rate of treatment was 96.4%, with no differences between patients rehabilitated with cemented prostheses and rehabilitated patients with screwed prosthesis (Sherif et al, 2011).

On the other hand, another study reported clinical complications associated with cemented prostheses on dental implants use, requiring rigorous clinical controls, to check for changes in the peri-implant tissue. The main cause of the observed problems is excess cement and suggest that it is necessary rigorous clinical controls, so that they can examine the changes in the peri-implant tissue in their early and act quickly to avoid a major complication (Pauletto et al, 1999).

V. CONCLUSION

The results obtained allow us to conclude that there is a beneficial action of phosphoric acid when applied to implant surfaces, causing porosity changes and expansion of the contact area of the surface, which may have important clinical implications.

REFERENCES

- [1] Amaral R. Rippe M. P. Oliveira B. G. Cesar P. F. Bottino M. A. Valandro L. F. (2014). Evaluation of tensile retention of YTZP crowns after long-term aging: Effect of the abutment substrate and Y-TZP surface conditioning. *Operative Dentistry*. 39(6): 619-626.
- [2] Anselme K. Bigerelle M. Noel B. Dufresne E. Judas D. Iost A. Hardouin P. (2000). Qualitative and quantitative study of human osteoblast adhesion on materials with various surface roughnesses. *Journal of Biomedical Materials Research*. 49(2): 155-166.
- [3] Bottino M. A. Bergoli C. Lima E. G. Marocho S. M. Souza R. O. Valandro L. F. (2014). Bonding of Y-TZP to dentin: Effects of Y-TZP surface conditioning, resin cement type, and aging. *Operative Dentistry*. 39(3): 291-300.
- [4] Brandão M. L. Esposti T. B. D. Bisognin E. D. Haran N. D. Vidigal G. M. Conz M. B. (2010). Superfície dos implantes osseointegrados x resposta biológica. *Implantnews*. 7(1): 95-101
- [5] Campos T. N. Adachi L. K. Miashiro K. Yoshida H. Shinkai R. S. Neto P. T. et al. (2010). Effect of surface topography of implant abutments on retention of cemented single-tooth crowns. *International Journal of Periodontics & Restorative Dentistry*. 30: 409-413.
- [6] Fugazzotto P. A. Vlassis J. (2007). Report of 1,633 implants in 814 augmented sinus areas in function for up to 180 months. *Implant Dentistry*. 16: 369-378.
- [7] Garófolo J. C. (2005). Desvendando a Cimentação Adesiva (parte 1). *Alianews, Informativo interno do Laboratório Aliança N. 03- Set*.
- [8] Groisman M. E. Vidigal Junior G.M. (2005). Tipos de superfícies de implantes. *Periodontia e Implantodontia - Atuação clínica baseada em evidências científicas. Sobrape*. 14: 1-14.
- [9] Gupta R. Weber K. K. (2017). *Dental Implants. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing*.
- [10] Hsu S. H. Liu B. S. Lin W. H. Chiang H. C. Huang S. C. Cheng S. S. (2007). Characterization and biocompatibility of a titanium dental implant with a laser irradiated and dual-acid etched surface. *Biomedical Material Engineering*. 17: 53-68.
- [11] Kang B. S. Sul Y. T. Oh S. J. Lee H. J. Albrektsson T. (2009). XPS, AES and SEM analysis of recent dental implants. *Acta Biomaterialia*. 5: 2222-2229.
- [12] Kitayama S. Nikaido T. Maruoka R. Zhu L. Ikeda M. Watanabe A. Foxton R. M. Miura H. Tagami J. (2009). Effect of an internal coating technique on tensile bond strengths of resin cements to zirconia ceramics. *Dental Materials Journal*. 28: 446-453.
- [13] Lohbauer U. Zipperle M. Rischka K. Petschelt A. Müller F. A. (2008). Hydroxylation of dental zirconia surfaces: characterization and bonding potential. *Journal of Biomedical Materials Research Part B Applied Biomaterials*. 87(2): 461-467.

- [14] Nagem Filho H. Francisconi P. A. S. Campi Júnior L. Fares N. H. (2007). Influência da textura superficial dos implantes. *Odonto Ciência*. 22(5): 82-86.
- [15] Pauletto N. Lahiffe B. J. Walton J. N. (1999). Complications associated with excess cement around crowns on osseointegrated implants: a clinical report. *International Journal of Oral and Maxillofacial Implants*. 14(6): 865-868.
- [16] Rippe M. P. Amaral R. Oliveira F. S. Cesar P. F. Scotti R. Valandro L. F. Bottino M. A. (2015). Evaluation of tensile retention of Y-TZP crowns cemented on resin composite cores: Effect of the cement and Y-TZP surface conditioning. *Operative Dentistry*. 40(1): E1-E10.
- [17] Sherif S. Susarla S. M. Hwang J. W. Weber H. P. Wright R. F. (2011). Clinician- and patient-reported long-term evaluation of screw- and cement-retained implant restorations: a 5-year prospective study. *Clinical Oral Investigations*. 15: 993-999.

Condor: a reflection on a company's history, memory, and leadership

Mário Neneve, Miguel Nenevé

Universidade de Joinville – Univille – Brazil

email: mneneve@uol.com.br

Universidade Federal De Rondonia – UNIR - Brazil

email: neneve@unir.br

Abstract— *In this article we propose to discuss the importance of authentic leadership for the success of a company. We focus our study on CONDOR, a company from São Bento do Sul, Santa Catarina, Brazil. We explore the history of the company since its foundation and the importance of the founder's leadership. In addition to this, we show how the leadership of founder's successors, especially during the transformation process was essential to the company's success. Our study is based on scholars such Avolio and Gardner, (2005) among others who discuss changes in companies which start as family companies. Besides, we explore the history of Condor company based mainly on the work developed by Baumgarten (2015). Our research leads us to a conclusion that in the transformation process from a family company into a joint-stock company the leader who conducts the changes plays a very important role.*

Keywords— *History, Company, Condor, Transformation, Success.*

I. INTRODUCTION

What is the relevance of studying History of a company in southern Brazil to administration students and businessmen? Why does it matter to get to know what happened years ago to a company and its founder? What does the study of a company's history have to contribute to issues of leadership? We believe that History is inescapable when we want to investigate the success of a company and its fruitful leadership as an enterprise that started small and became a leader in the production of certain items in Brazil. So, in this article we want to connect the history of the founder, some memories of people who shared part of his work for the company, to issues of leadership. Our aim is to encourage entrepreneurs and students of administration to pay attention to history of a leader and founder of a successful company when they want to have a broad view of leadership. It is relevant to know how the founder's successors in the enterprise took over the function of leader and how they succeeded to lead the company towards success. Like Augusto Klimmek, the company's

founder, his successors and the company itself have living histories which can help us understand the growing of the company. The adaptation to the new is very important. As we study the history of an immigrant we have to remember that he had to be creative in adapting to new and complex cultures in Brazil, with traditions and religions that had been different from his country of origin. Further on, adaptation to the use of technologies, new ways of looking at the market, everything is related to adjustment and perception of the world: qualities of a leader.

Therefore, we believe that it is important to understand the linkages between past and present of a company such as CONDOR, in order to learn about the importance of an effective leadership. By understanding history we will understand roots and changes upon secure conditions. If the company's history matters, individual history involved in the company matters too. Having this in mind we propose to study the history of CONDOR - a company which started as a family company.

II. CONDOR: A FAMILY COMPANY

Most businesses are born small and become familiar as soon as the heirs of the founder become capable of occupying functions within the organization. It is natural that at this stage the company is larger than at its foundation, so the number of family members within the organization increases as well, this occurs at all hierarchical levels, according to Chrisman et al. (2005); Bammens (2008); Westhead & Howorth (2006), functions are often created within the companies to be able to allocate the people of the family who are wanting to join, this ends up swelling all sectors.

However, Condor, although inserted in this context, reveals a different attitude that deserves to be investigated, coming from its founder, Mr. Augusto Klimmek, who, unlike the other immigrants to Brazilian lands, had a trajectory built through a separate and independent migration. It deserves emphasis, from the very beginning, that the Condor, then, that Klimmek, was founded when the immigrant Augusto Klimmek, was 50

years of age. Another aspect: His company was a pioneering industry, which demanded more technology at the time it was founded. Besides, it was in a small town with no more than 10,000 inhabitants. The insertion of this intrepid entrepreneurial man's trajectory shows the challenges faced by him: hard work and determination was necessary. Family company, recognized for its peculiar values and culture, endowed with an organizational culture, may be reflecting what Vries (2001) discusses when referring to Organizations and authentic leadership. A company with an organizational team in which its leaders stand out in the business environment is always recognized as a differentiated organization.

The current CEO is one of the examples of opportunities for personal growth within the organization. He joined the company at the age of 15, today, at the age of 35, does not belong to the proprietary family and has gone throughout his career through the challenges of the areas in which he acted, being chosen on his merits for the position he now competently exercises. His history shows that his evolution in time, gave a strong contribution to the company adding much to the fiber and the values cultivated by its founder. Determination, persistence in the pursuit of ideals, ethics, human vision, are characteristics that we will see in the profile of the company's founder.

Values of the founder remain in the company, talents cultivated in the company, willingness to win, united generations, love of work, commitment are attributes among others, that can be extracted from the essence of this message. We believe it is necessary, therefore, to refer to the history of the Condor company.

III. BRIEF HISTORY OF THE COMPANY'S FOUNDER

As an authentic organization presupposes a positive atmosphere in the company, this aspect intertwines with the capacity of Authentic Leadership. According to AVOLIO and GARDNER, 2005 Authentic leadership converges to the fact that the Authentic Leaders have their balance of authenticity, through their life trajectory so that, when facing difficulties overcome them. The individuals can achieve a self-awareness and self-esteem that make them act genuinely. Below we describe a little of the history of the founder of Condor, and we will see that his life trajectory is an example of overcoming obstacles..

Mr. Augusto Klimmek was born in 1889, in a small town in the interior of Western Prussia, near Berlin. We used as a source for the trajectory of this character, the book "O Jeito Condor de Ser ("The Condor way"), written by Christina Elisa Baumgarten, (2015). The introductory

message of the grandson of the founder, Mr. Heinz Engel also translates the values of this current leader, based on values that were his grandfather's. Heinz Engel affirms that:

"[...] A company that was built based on the talent of the people who know how to do well, who commit themselves, who have a vision for the future ... I remember the teachings of my grandfather, the founder Augusto Klimmek, who older 50 years old, decided to make brushes. His entrepreneurial spirit, his enthusiasm and his will to work is what gave rise to the company of which, today, with pride, we are part. His values remain alive and give life to Condor. Because it is the love of work, the challenge of facing new projects and the willingness to develop that move the company. It is gratifying to see people growing, evolving and building their life stories linked to Condor. Equally rewarding is to see the generations united, working strategically for the future of the company [...]" (BAUMGARTEN, 2015).

Augusto Klimmek, who lends the name to the main street which provides access to the premises of this company, created the company in 1929, in a totally innovative initiative. A totally new fact in the environment where it was founded. The founder, with a unique personality, was born in 1889, in the countryside, in Gross Olschau, a town with no more than 40 inhabitants, in West Prussia, known as the Land of a Thousand Lakes, not far from Berlin. From an early age he was bound to face challenges. The first one was the hardness of confronting a stepmother who was rude to him, as Baumgarten (2016) reports. In addition, to take his technical studies of mechanics he had to go 6 km from where he lived, in the selling cooperative of agricultural implements in Neidenburg.

Baumgarten (2015) also emphasizes the rudeness received in his childhood that coined his structure of bitterness that accompanied his early in life. It should be noted, however, that in founding Condor when he was 50 years old, with his lived experience of overcoming, his strong personality, he had already learned to approach people who were committed to great moral value.

Besides, it is important to mention, in the beginnings of his studies, he excelled in his vocational course as one of the best students. At the end of the course, at the age of seventeen, he left his family and departed for Berlin, which had become the capital of the German Empire, a town familiar to the Prussians. Baumgarten (2015, p.31) confirms: "firmness of character, already developed mechanical training, and the appearance of a strong young man." He worked in Berlin as an apprentice in a foundry

and improved his knowledge of mechanics in a specific course. He served the army of German Empire. "His rigid complexion, the wholeness of character which showed in his firm and frank gaze, all contributed to his acceptance into the body of the Emperor's Honor Guard." (BAUMGARTEN, op cit, p.36). In another passage, the author emphasizes: "The intense and rigid training he received helped to forge even more discipline, order and character that accompanied him ..." (BAUMGARTEN, op cit, p.37).

In the environment of the Emperor's Honor Guard, he attended many banquets as a servant. The commanders did not allow him to feed on the remains of the food. His character of seeking justice made him revolted against that: the servants had an inadequate food while the others had banquets. He left the army at the age of 21 in 1900. At the suggestion of a friend, he contacted the existing colonizing societies, intending to emigrate to Brazil, referred to as a country full of opportunities and already possessing countless Germanic colonies formed decades ago. He then bought two tickets and departed, he and his friend Harald, in the year 1902, in the steam Halle to the south of Brazil. Unlike other immigrants of the 19th century, the intention in Brazil, was to develop their professional activity. In December of 1902 they disembarked in São Francisco do Sul, in the state of Santa Catarina.

With his entrepreneurial spirit, soon after his arrival in Brazil, he tried a business focused on power generation through a water turbine at a waterfall in Joinville. He was not successful in this endeavor, but he did not get discouraged. Gifted with a determined personality, unlike his friend immigrant, who was expelling moanings with respect to the land in which he had immigrated, he showed a strong will to stay and overcome obstacles. Demonstrating personal commitment and a just heart, he bought the tickets for his friend to return to his origins. Baumgarten tells us: "Augusto was not a man of many words, always sober and somewhat serious in his relations. As his friend who had immigrated together proved weak in the face of the challenges, he paid his way back to his country of origin "(BAUMGARTEN, op.cit., 55).

In 1903, the young Augusto was employed by the Otto Bennack Foundry, in the center of Joinville, as chief mechanic. The author points out that the young Augusto Klimmek always went to work impeccably dressed. In 1905 he married Emma Carolina Mayer, a woman from Joinville. He took over a new professional function, such as the company's master of works. He was responsible for the construction of the railroad between Joinville and São Francisco do Sul. In 1905, the first daughter was born,

and, in the following years, the other children came. The only son was born in 1911.

Returning to his entrepreneurial nature, in 1905 he joined a repair shop, Bierckholz and Klimmek. In 1913, the partners transformed this workshop into a foundry. It is worth noting that this foundry was the embryo of the Tupy Foundry, recognized at the time as the pioneer and largest foundry company in South America. In 1920 Augusto Klimek moved to Curitiba and acted as a minority partner, forming a partnership with Carlos Schmidlin in the Iguacu Foundry . Faced with the crisis of 1929, he negotiated his withdrawal from this company. He had met a professional, Germano Trempel, who worked in a toothbrush factory, at the time a restricted and promising market. This fact stimulated him to know São Bento do Sul, a German colonization, at that time with 10 thousand inhabitants, very promising.

IV. THE COMPANY ORGANIZATION AND ITS EVOLUTION

On July 1, 1929, at the age of 50, Augusto acquired an initial structure for the new company: the company "Klimmek & Cia. Ltda" the industry was prepared to produce tooth brushes to the market. Mr. Augusto Klimmek came in with the capital and Mr. Trempel with the knowledge. They imported machinery for the manufacture of brushes, in addition to all the necessary raw material. With the knowledge already dominated by Mr. Klimmek, the partner Trempel retired and left the enterprise. In the succession process, one of the important personages who married one of Mr. Augusto Klimmek's daughters, is Mr. Theodoro Engel, father of the leader who is focused on this research, Mr. Heinz Engel.

Theodore Engel was one of the descendants of the German immigrants who had come to Sao Bento do Sul in 1873. Baumgarten (op.cit.) reports that Theodore was a shy and gentle boy, who by his nature, had hardly ever left Sao Bento. The company, with only 90 days of production, already manufactured 160 dozen toothbrushes per day. Five months later, in addition to the whole family, there were already 8 employees. Baumgarten quotes: "working at Klimmek came to mean status, salary and social ascension." The crisis of 29 generated high prices for the importation of the raw material. One innovation for the solution of the crisis was to use pig bristles to make brushes. Worthy of record to understand a little of the culture that was beginning to build is that a 15 year old boy, João Roberto Mayer Behring, entered the company in 1930. João was a person of extreme trust of Mr. Augusto and worked for life in the company. In addition, many other professionals had the Condor company as the unique employer in the city, as Baumgarten informs. Mr. Theodore Engel, as stepchild of

Mr. Augusto, has always worked in the production area. His son, Alfredo, worked in the administration area. Baumgarten reports that Augusto had difficulty relying on one of the sons-in-law who acted in the sales area because he was very expansive, perhaps too much. Augusto had affection for people of a more reserved and respectful spirit. While Augusto valued according to the production and though, his son-in-law saw in the commercial sector the development of the company. There was, therefore, disagreements and his son-in-law left the company.

These positions well demonstrate Mr. Augusto Klimmek's strong genius. On the other hand, there were circumstances where the heart spoke louder. One example: on one of Mr. Augusto's trips to Germany, he met his cousin Adolf Tallareckand brought him to the company for him to work as a mechanic in the company. AugustoKilmek gave a participation to the same and his friend remained in the company until his death. These facts reveal his austerity, silence, zealous for discipline, but on the other hand, also an enormous heart towards those people w

ho he perceived as endowed with values that coincided with his conception of the world.

In 1935, the company created a voluntary fire company. In that same year, the company became a corporation, having as Chief Executive Officer Augusto Emilio Klimmek (founder, 1st generation). Directors-Managers: his son Alfredo Klimmek, and his son-in-law Theodoro Engel as second. Mr. Heinz Engel, as a child, was very attached to his grandfather. Baumgarten points out that Mr. Augusto had a black Oldsmobile - one of the five cars in the entire city of São Bento do Sul - and took Mr. Heinz, his firstborn grandson, on a tour. Mr. Heinz Engel, on the other hand, as his father was most closely connected with production, established a lot of contact with the settlers of São Bento do Sul; this must have shaped a humility and a human vision, characteristic of authentic leaders. Baumgarten (2015) states that Mr. AugustoKlimmek was endowed with a committed spirit, who had a mission in his business. Fiber and character, respect and rigor were identified in his profile, reflected in the nicknames of company employees, such as, "Big gray bear"; "Big boss"; "Der starke August - August the Strong".

As a result of the war, which was confronted by Germany, the company suffered persecution, mistrust and injustice in Brazil, from 1942 to 1943. The rationing of energy during this period obliged it to use its own generation by means of a truck, demonstrating creativity and overcoming of obstacles. It is important to point out that his son, Alfredo Klimmek, was a more malleable, political subject, and he became friends with politicians such as the governor of Santa Catarina at the time, Nereu

Ramos. A fact in the difficult time of obtaining, after the second war, it awarded Brazilian citizenship to Mr. Augusto Klimmek, which gave him a relief. The pioneering and enterprising spirit of the family is also visible through the fact that, in 1946, it had installed a cinema with the importation of all necessary equipment in the city, which was then inexpressive. Denoting, likewise, entrepreneurial skills, he acquired a refrigerator and a cold store as a source of bristles for the manufacture of brushes; these ventures were inactivated when new machines arrived for the purpose. Augusto Klimmek's son, Alfredo being more expansive and communicative was elected to the city council for São Bento do Sul. Theodore Engel, with a more closed profile, was the man of the wood,sawmill and timber production, as Baumgarten (2015) lets us know.

V. THE IMPORTANCE OF A LEADER IN THE CHANGING PROCESS

In Condor's historical context Condo it is important to emphasize that Heinz Engel played a decisive role in this important change for the professionalization of the company. Because of his vision and perception of the future, he hired the Consultancy of the Dom Cabral Foundation, whose prominence, mentioned by Baumgarten ,was Professor Elismar Alvarez. The idea was to deal with the professionalization, in view of the diversity of family members who were imprisoning management in the sense of achieving results for its sustainability. Thus, in 1996, the professionalization process began. Corporate governance was implemented. The owners migrated to the Board of Directors.

On 17 April 1997 a Belgian market CEO Jean Luc Pierre Jadoul was hired. In this year's Exame Magazine, Condor was ranked 14th Company in Brazil in the hygiene and cleaning sector. In 1999, it was elected as the Best Company to Work for. (Exame magazine).

In 1999, the CEO who took all the cutting actions with the past was replaced by a new director, Paulo Iserhard, from the Rio Grande do Sul market. He remained in the company from 1999 to 2003; in 2003 he joined the new CEO, Ernoe Eger, who kept in the job until 2006. In the same year of 2006, Vicente Donini, from the General Directorate of Marisol SA, joined the Board of Directors as a generation owner, the Advisory Board. In addition, this year OsmarMuehlbauer was elected General Director, the first CEO, to be a family member and a career professional in his own company. Baumgarten (2015) affirms that he had the wisdom to start replacement in the company with total success. The changes that needed to be madewas achieved and the results were positive. There were sequels from previous managements of market professionals and needed to reunite the team. Important

points were mentioned by Baumgarten: she states that in 2009, with the management of a professional coming from the company's own professional body, the company had the best result in 15 years. The company's motto was: "do more with less; empowering the employees; committed team. The years worked as administrative and financial director gave him the bases so that, knowing the company, he could obtain the adhesion for a commitment with the goals conquered with the engaged leaderships.

In 2010 the occupant of the post of CEO, Osmar Muhlbauer suffers a stroke accident and is removed. Two fundamental facts of organizational commitment: the management of the company was shared through a Group called G7, whose strategies and actions were discussed weekly. Thus, even with the sudden departure of its CEO, the continuity of actions is not impaired. But, for a reorganization plan, a new CEO from the market, Luiz Affonso Vidal Guardia (Venezuelan), who has been in business for 1 year and 7 months, In 2011, a new professional formed in the company Alexandre Wiggers is elected General Director, who with a competence and all dynamics with expertise in the company, molded by permanent contacts with the market through professional courses leads the company successfully giving him the condition the market in which it operates. In 2011, in the development of family governance, the Board of Shareholders

It should be noted that Mr. Heinz Engel, who is the subject of this study, came to be the leader, and the grandson of Mr. Augusto Klimmek. It is therefore to be supposed that Mr. Heinz Engel has mingled the harshness, discipline, and authority of his grandfather, Augustus, with the simplicity allied to the submissive nature of Mr. Theodore Engel, his father. Above all, however, he held the family values: honesty, commitment, human respect, dedication to their mission of overcoming, through people committed to the greater goal of the company. Baumgarten cites two people who have remained in the company for more than 50 years: Helmuth Knop from the commercial area and Élvio Becker from the industrial area. According to both workers, Mr. Klimmek and the company's culture differentiated by nurturing commitment based on organizational values. In addition, in this sense, the book also contemplates other employees who made the company a second home. An example of this is that, already in 1961, those who had worked for 25 years were honored, with 12 employees being considered. In that year of 1961, Theodore Engel retired and is succeeded in the company by his son Heinz Engel. Commitment, innovation and passion animated the young man who had studied in Germany from 1953 to 1958. He came back from Europe full of new propositions and

ideas, including bringing about a concrete negotiation of a new machine for the company.

In 1966, he returned to the company, at the invitation of his 85-year-old grandfather; which also expresses not only a human vision but also a commitment to the company and its vision of people's potential. The management of the company is thus constituted: President: Alfredo Klimmek; Industrial Director: Heinz Engel. Thus, different life-styles naturally blended. Heinz Engel, with a vision of business control, and Mr. Alfredo Klimmek, with a more liberal behavior, diplomat, who was well suited to business issues and community relations. Augustus had died in the year 1970; Mr. Alfredo Klimmek passed away in 1994, and as of this year Mr. Heinz Engel became the company leader.

VI. CHANGES IN THE COMPANY: THE IMPORTANCE OF A LEADER

The second generation in the company disappeared. Condor was always guided, according to Baumgarten (2015), by guidelines of honest personal conduct, family, health, financial, vocational training and political preparation of trade union. It is important to emphasize that, in the present day, we find employees who were admitted in 1973, as quoted by Baumgarten (2015). As highlights, Mr. Osmar Muhlbauer, who was Managing Director of the company, was admitted in 1984; Elzo Dudda, current Industrial Director, admitted in 1986; Alexandre Wiggers, Chief Executive Officer (CEO), admitted in 1988.

The identity of the Klimmek Condor, so lavishly elaborated, stoned generations of employees, whose families were conforming to that style, also managed to transfer to the whole community an image of a correct, fair and good company in every way.

In this historical context of Condor, it is important to emphasize that Heinz Engel played a decisive role in the important change for the professionalization of the company. Through her vision and perception of the future, she hired the consultancy of the Dom Cabral Foundation, whose main point, mentioned by Baumgarten, was Professor Elismar Alvarez, in 1995, to deal with professionalization, considering the diversity of family members who were imprisoning management in order to obtain results for its sustainability. Thus, in 1996, the process of professionalization began. Corporate governance was implemented.

The owners migrated to the Board of Directors. On 17 April 1997 a Belgian market CEO Jean Luc Pierre Jadoul was sworn in. In the same year of 1997, the magazine Exame considered Condor to be 14^o place of the country, if we compare it to the companies of the hygiene and cleaning sector. In 1999 she was elected, through Exame,

the best company to work for. In 1999, the CEO who took all the cutting actions with the past, was replaced by a new director, Paulo Iserhard, of Rio Grande do Sul market, who remained in the company from 1999 to 2003; in 2003 he joined the new CEO Ernoe Eger, who stayed until 2006. In the same year of 2006, he joined the Board of Directors, Vicente Donini, who came from the General Directorate of Marisol SA. In 2006, the Consulting Board was created, and Osmar Muhlbauer was elected the first General Director (CEO), a stranger to the family and having professional career in his own company. Baumgarten (2015) writes that he had the wisdom to promote changes in the company, with total success. There were consequences from previous managements of market so that professionals needed to be reunited as a team. It is important to highlight that Baumgarten states that in 2009, the company had the best result in 15 years. Muelbauer stayed nine years as Chief Financial and Administrative Officer. By getting to know the company, he would achieve adherence to a commitment to the goals achieved with the committed leaderships. In 2009 the composition of the Board of Directors underwent a renovation with family members and external ones: Vicente Donini, Rolf Buddemeyer, Marion Klimmek, Christian Meyer and Thomas Engel. In 2010, the occupant of the CEO's post, Osmar Muhlbauer, suffered a stroke and was removed. Two fundamental facts of organizational commitment: the management of the company was shared through a Group called G7, whose strategies and actions were discussed weekly. Thus, even with the sudden departure of its CEO, the continuity of actions was not impaired. But for a rearrangement planning, a new CEO from the market, Luiz Affonso Vidal Guardia (Venezuelan), was hired again. He remained for 1 year and 7 months.

In 2011, a new professional trained in the company, Alexandre Wiggers, was elected Director General, who with a complete competence and dynamics with expertise in the company, molded by permanent contacts with the market through professional courses. He led the company successfully, giving it the status of prominence in the market in which it operates. In 2011, in the development of family governance, the Board of Shareholders was created.

In 2013, Board Member Jaime Richter joins the Board of Directors. According to Baumgarten (2015) Richter states that:

"In the beginning my perception was that part of the legacy of beliefs and values are worth forever as a discipline and will to work, which could be lost due to the carelessness of the relationship between the members, motivated by their lack of preparation to be partners. In time: this fact

began to be corrected with the creation of the Family Council, whose main objective is the formation of successors partners of the heritage of values and patrimony, different from what would be with the Council, since the partners would be only heirs. In this conception, the Successor is one who preserves the legacy; even heirs do not care, because their own interests would prevail. On January 1, 2014, Condor completed 85 years of age, with 1,500 professionals.

VII. WHAT SOME MANAGERS SAY ABOUT THE LEADER AND THE CHANGES IN THE COMPANY

We conducted some interviews in order to have a broad view of the company and its leaders. The interview with the managers of the company Condor SA, for example was very relevant. The data presented are linked to the leadership exercised by Mr. Heinz, who through the interviews confirmed that he was responsible for conducting the process of succession of the company, and also contributes to conflict management among family members who were in the company at the time.

Four interviews were carried out with some Condor managers, who were present at the time the professionalization and succession process. These interviews also contributed to our understanding of the way leadership played an important role in the company. We are identified in the dialogues as researchers and the other interviewees as interviewee 1, 2, 3 and 4, in order to maintain the confidentiality of these people. The following are the results obtained in the questions made to these people.

Asked about the importance of Heinz's leadership in the process of succession and professionalization of the company, the interviewee 2 stated that Heinz's presence was fundamental at this stage, he said "for the family, having to leave the company provokes a great impact. The management of the business reaffirms what had already been verified in the theoretical support. Respondent 4 also contributes in this sense, "the family business did not have this definition very clear perhaps", at this point the interviewee refers to the delegation of tasks among the family: there was a clear definition of the role of each family member in the company and the direction which the company wanted to follow.

The interviewee 2 reaffirms what we have read as theoretical support regarding the choice of qualified professionals for the vacancy. In addition to this, in relation to the management structure of the company he also confirms the theory by mentioning that not always the person was qualified to occupy a position, "[...] Also

in the sense of preparation I think, the person who belongs to the family and is occupying a position within the company, maybe s/he is there because of the family, but not because s/he is the best person to fill that position. ", In this case, it is important for the family to pay attention to the skilled professional to occupy a certain position, instead of simply employing someone who has family ties.

In this way a change was necessary : a change in the company was needed. The interviewee 2 was questioned if it was really important for Heinz to take the lead and to gradually carry out the professionalization of the company. He affirms "exactly, today Condor is' where it is because of the change in 1997, which was the decision to professionalize the company, ".This demonstrates the assertiveness of the leader in wanting to transform it.

According to interviewee 2, Heinz was primarily responsible for realizing that Condor needed to be professionalized, and he was responsible for conducting this process effectively, "it was the leadership of Mr. Heinz Engel that promoted this. He saw that it was necessary to change in order for the business to grow and walk in a healthy way, he realized this, [...]". And he goes on: " he was stitching it up with families, and constructing this perception by alerting families that it was healthier for the business to be done the way it was made". So he contends that Engel's leadership was fundamental for the company's success: "It is clear that there was a firm leadership role in the succession of the company, both in the organization of the company and in the management of conflicts between family members."

Respondent 2 further emphasizes Heinz's importance in conducting this process, and what could have happened if there was no such leadership, "if one of the shareholders does not have the attitude of referring the company to it, it probably does not happen, conflict installs and arrives at an almost unsustainable point." He concludes: The change was fundamental, especially after the family went to the council, the board must have a president who can manage conflicts, who can create a consensus that can converge interests. "

The process of professionalization is not always easy, the interviewee 4 provided important information about Heinz's attitude at the time, "[...] Heinz always fitted with the administration that was below him at the time. Certainly that administration has contributed and supported a lot for this change to take place, because it was a paradigm change within the company, and often the families go against it, because it implies the exit of these people from the positions that they are occupying in the company.

Today there is an agreement among shareholders that no person of the family can work for the company: " neither

grandson nor son, nobody, have grandchildren of shareholders who work in other companies, maybe in the past would work here, then it is a change of culture and strategy. "

With the creation of the board of directors and with this breakdown of paradigms many things had to change, and many conflicts had to be managed by Heinz, who stood out as leader of this process, as mentioned before. He was the one who made the decisions, but supported by the others Members of the Board.

As Heinz's leadership also remained on the board, on the issue of minimizing conflicts, interviewee 4 was also questioned about the role of the council and the council chairman in the management of conflicts caused by professionalization. The interviewee contributed in this sense, " we can see that today the committee boards are much closer to the board than in the past, with this professionalization, with the coming of these external advisors, [...]". He then concludes that "this all makes management closer to the board, and absorbs a little more of the needs that the board and shareholders have, I think this is very clear. Today condor has 6 counselors. And there are three outsiders, who have no direct connection to the family. "

Asked about the transition process and the first moments of a professionalized company, Interviewee 1 also emphasized the importance of Heinz Engel as a leader: "the transition of this process was quite serious, because in the early years there was still one or the other of the family within the corporation as well , then it did not have a "sudden" migration". The he explains: " this was not the decision taken, the decision was made in the sense that there was a certain transition and I think this made the company succeed in the process". He argues that there were people of the family leaving the company. People who had been working for years for Condor, but the presence of the leader was necessary to remove them.

The interviewee further states that, "the fact that they created the board and removed all family members from the company's operation makes the work of the managers, both the directors, the chairman and the managers, a more professional job. " He explains then that " having a clear goal, to have a definite clear objective is impo'rtant and this was the goal designed by the board of directors." He then concludes that

when you have an executive board as it happens today, we have a well-defined hierarchy so I have someone to report to me, so my work is tied to this board, which will consequently be tied to the board of the presidency, which is going to respond to the advice. So the day-to-day work facilitates a lot, who is in the operation the fact that you do not have the family inside, it

facilitates a lot of work and understanding and makes us able to develop the work very well, with which we achieve these objectives with great clarity, and with as much dedication and commitment as ever.

The process of transition and succession in the company was difficult, but with the figure of a leader things were well underway, according to the interviewee 2, "[...] as Heinz began the professionalization process of the company, he was the captain and was the ambassador of this whole process." According to the interviewer, when Heinz learned about some difficulties in the process of professionalization, he would come and ask the managers, what was happening and if the workers and managers were satisfied. He interfered in the process when the something was not very good, he made this connection between the directors and managers and clarified the situation to both sides. In other words, Heinz Engel knew to act as a mediator between the parties. In conclusion, Heinz was a born leader and the ambassador of this process of professionalization, I would say he was the key person for the professionalization of the condor.

Considering the importance of a leader in Condor's process of succession we also asked the interviewee 3 to list the main characteristics of Heinz Engel's leadership. According to him, Engel was a different leader because, being a born leader "he was important for his seriousness, objectivity, courage and decision maker." He took over his responsibilities in the decision making in the company. As a resilient leader he could recognize the suggestions of other people. He was clear transparent and accepted the things proposed by the other hierarchical levels, he questioned much the things that were being done. These were the main characteristics listed by the interviewee, who worked on managing the changes that took place at Condor.

In addition to these characteristics, respondent 3 points out that a leader like Heinz "[...] has a passion for the company, that makes all the difference in the company." Heinz Engel was able to transfer part of these characteristics also to the internal CEO. We consider that it is very important part in a succession process that the company does not lose its main characteristics during the adaptation to new ways of administration.

Heinz's leadership becomes important because it is in the company to this day, and it continues to influence people. Today Heinz Engel has a family representative, who is his son and who has a chair on the board. But the decisions are taken by the board, it is the board that takes care of the business, managing the business for the shareholders.

Heinz is no longer in the company's daily life but his leadership is still perceived by the people in the company. All the interviewed people agree that he has a true passion

for the company and people who know him respect him a lot, as well as he respects these people: workers, supervisors, directors and managers.

VIII. SOME PRELIMINARY CONCLUSION: DISCUSSING THE RESULTS

After conducting the interviews and demonstrating the main findings, we start with the discussion of the results, in this chapter we will address questions related to the findings made in the interviews conducted at Condor S.A. We observed that there was a fundamental leadership role in Condor Company. This leadership was performed by Heinz, mainly regarding the issues of conducting the succession process.

It was also confirmed what had been researched in the theoretical support, that often family matters end up having a strong impact on the company's decisions. Through the statements of the interviewees we could verify that often the family member did not have the necessary skills to occupy certain positions, which might have harmed the organization. Another problem that can be caused by a lack of professionalization is the lack of direction of the company, as there are several people within the company there is no exact direction to be followed, there are many people who are in charge of the company.

One of the outputs for the company is to professionalize, that is take people from the family out of the management and hire professionals to run the business. These is also what scholars in the area of administration agree. However this can not be applied in all enterprises, because of some resources necessary for this transition, which may be insufficient in the case of smaller companies. In this case study the company was able to professionalize and did so.

Once again the issue of leadership appears, at the moment when the decision is made for professionalization. In this case, it is necessary that all the people who are involved with the company, especially the family members. They are the ones who need agree with the changes that will be made.

We could found from the study that this is one of the most difficult steps. This difficulty had already been verified in theory, and could be proven through the study: people are emotionally attached to the company, so it becomes difficult to leave a company. The role played by Heinz Engel in this sense was very importantly, he took responsibility and was able to carry out this process very well, reducing the conflicts that could arise due to this professionalization.

Another point verified in the research was that Heinz was responsible for thinking about the professionalization of the company and conducting this process to the end, if he

had not fulfilled this task until the end, the company would not be able to execute it, this leadership already existed prior to the creation of a council, and after Heinz took over the chairmanship of the council, this leadership role became even clearer, important decisions were made, all the family members left the management of the company, and in addition pacts were signed which determined that no person with family connection could manage the company, all these conflicts were managed with firm wrist and brought good results to the company. With the creation of the firm's profession and professionalism, it was noted that directors and managers were able to unpack their roles within the company more efficiently, there was no longer a family bond between the people who were working in the organization, and this more effective management, which also resulted in a decrease in managerial positions. Just as there was a reduction in the number of people in the council, there are now 1 representative of each family and 3 people from outside, in the council this also directs the decisions more, these reductions that were realized were also thought by Heinz, who always looked for the best both for families and for the company.

It was emphasized that this process of succession and professionalization of Condor was not easy to manage, people were very attached to the company to simply leave their functions, but Heinz was successful and always managed to soften the conflicts that arose in this process. He knew how to negotiate with both sides and kept things under control.

Heinz Engel was also responsible for managing the conflicts between the professional management and the people who were already in the company. Managers coming from other companies have a different culture, and this in a first moment may cause a conflict with the organization. This leader was responsible in managing these conflicts of culture that arose in this process of professionalization, he prized in maintaining the culture of the company.

From our study we could also observe that Condor company owned some unique characteristics, these characteristics and behaviors also influenced in the progress of the decisions and led the changes. These characteristics were grounded on: seriousness; objectivity; courage; conviction; decision-making; resilience, transparency; macro vision and above all passion for the company.

After some CEOs who came from other companies, Condor started to promote people from the company to high-impact positions, so-called "house tarps". These people have characteristics similar to the characteristics of Heinz and have a direct link with the way he led these changes in the company. Bringing people from the

company to higher positions allows the strengthening of the culture, as well as maintains the characteristics of one of the great leaders who have passed through Condor S.A. This ends up bringing the board of directors together and reduces the conflicts that may occur.

Based on the research carried out and data processed and analyzed, we can argue that there was an effective family leadership in the professionalization process of Condor SA.. Leadership was very effective in mitigating the conflicts that could have arisen in this process of changes. We can also observe that the process of professionalization of a company is not a simple process, the organization must be well prepared for this process to work without generating conflicts between the company and the family.

REFERENCES

- [1] Alchian, A. A.; DEMSETZ (1972) H. Production, information costs, and economic organization. *The American Economic Review*, p. 777-795,
- [2] Andrade, A.; Rsetti (2006), J. P. *Corporative Governance: fundamentos, desenvolvimento e pendências*. 2. ed. São Paulo: Atlas
- [3] Baumgarten (2015), C.E. *The Condor Way [O jeito Condor de Ser]*. IVH8 Editores.
- [4] Bass, B. M (1990). From transactional to transformational leadership: Learning to share the vision. *Organizational Dynamics*, v.8, Issue 3, p. 19–31,
- [5] Benevides V.L (2016). *Leadership Styles and the main influences used by Brazilian leaders.[Os Estilos de Liderança e as principais influências utilizadas pelos líderes brasileiros]*. Fundação Getúlio Vargas – FGVescola. availableat:///F/LIDERANCA, acesso em 20.01.2016
- [6] Begaminini C. W. (1994.) *Leadership: Administration of senses [Liderança:A administração do sentido]*. *Revista de Administração de Empresa*. São Paulo, v. 34, n. 3, p. 102-114,
- [7] Berle, A.; Means, G , (1932). *The Modern Corporation and private property* .New York: McMillan.
- [8] Berhoeft (1989), R. *Family Enterprise: professional succession or committed survival. [Empresa familiar: sucessão profissionalizada ou sobrevivência comprometida]*. São Paulo: Nobel,
- [9] Bammens, Y., Voordeckers, W., & Van Gils, A. (2008).Boards of directors in family firms: A generational perspective. *Small Business Economics*, 31 (2), 163.
- [10] Casilas, José Carlos; Sanchez, Adolfo Vázquez; Fernandez (, 2007), Carmen Diaz. *Family enterprise*

- Management/Gestão da empresa familiar: conceitos, casos e soluções. Tradução de Vértice Translate. São Paulo: Thomson Learning. p. 4, 27-28, 32, 71, 78 e 119.
- [11] Cohn (1991), M. Passando a tocha, como conduzir e resolver os problemas de sucessão familiar. São Paulo: Makron Books Editora do Brasil Ltda.,.
- [12] CREMER (2017). Histórico. Disponível em: <http://200.247.161.241/cremer/ml_empresa/ml_tem_p_historia.html>. Acesso em: 20 abr.
- [13] De Massis, A.; Chua J. H.; , J.J(2008),. Fatores que impedem Sucessão Intra-Familiar. Family Business Review.Vol.21 Edição 2 . May 2008.
- [14] Döhler (2017). Available at: <<http://www.dohler.com.br/site/institucional.html>>. Accessed on: 20 April .2017
- [15] Donnelly, Robert. G. (1964) Family enterprise. Revista de administração de empresas. Junho de 1967. (Publicado originalmente na Harvard Business Reviewem 1964.)
- [16] Ecco, I. L.; Ribeiro, R.; Kock, K. F.; Marcon, R.; Alberton (2010), A. Teoria de agência em uma organização sem fins lucrativos.Estratégia e Negócios, Florianópolis, v. 3, n. 1, jan./jun. 2 010.
- [17] Eisenhardt, K. M. (1989) Agency theory: an assessment and review. Academy of Management Review, v. 14, n. 1, p. 57-74.,
- [18] FAMA, E. F(1980). Agency problems and the theory of the firm.Journal of Political Economy, v. 88, n. 2, p. 288-307, abr.,.
- [19] Fama, E. F.; Jensen, M. C. (1983.) Separation of ownership and control. Journal of Law and Economics, v. 26, p. 301-325, 1983.
- [20] Ferreira , O. T.; (2012) The influence of Germanic Culture in the development of Santa Catarina; Univali, Itajaí; Fial paper.
- [21] Gersick, K. E.(1997.) et al. De geração para geração. (Tradução de Montingelli Jr.) São Paulo: Negócio Editora Ltda.
- [22] Hemmer (2017) Quem somos. Disponível em: <<http://www.hemmer.com.br/>>. Acesso em: 20 abr.2017
- [23] Herring (2017). Sobre a Cia Hering. Disponível em: <<http://ciahering.com.br/site/ptbr/>>
- [24] Empresa/Sobre+a+Cia+Hering>. Accessed on: 20 apr..2017
- [25] Hunter, James C (2006). Como se tornar um líder servidor: Os princípios de liderança de O monge e o Executivo. Rio de Janeiro: Editora Sextante.
- [26] German Immigration to Santa Catarina. Destaque Magazine .Herança na prática. Available: <<http://www.imigracaoalemasc.com.br/conteudo.php?&sys=1&id=1154>>. Acesso em: 20 abr.2017
- [27] <<http://www.imigracaoalemasc.com.br/conteudo.php?&sys=1&id=1154>>. Acesso em: 20 abr.2017
- [28] Jensen, M. C.; Meckling, W. H.(1976) theory of the firm: managerial behavior, agency costs and ownership structure. Journal of Financial Economics, v. 3, n. 4, p. 305-60.
- [29] Klug, João. (1992.) Imigração e Luteranismo em Santa Catarina: a comunidade
- [30] Kouzes, James M. e Posner, Barry Z. (1991) O desafio da Liderança. Rio de Janeiro: Campus. p. 31-255
- [31] Leone, N. M. C. P. G. (1992.) A sucessão em pequena e média empresa comercial na região de João Pessoa. Revista de Administração, São Paulo: Fundação Instituto de Administração, v. 27, n. 3, jul./set. 1992.
- [32] Lodi, B. A. O (1989). Empowering Family enterprise/ fortalecimento da empresa familiar. São Paulo: Pioneira
- [33] Mauch, Cláudia. Vasconcelos, N. (1994) Os alemães no sul do Brasil: cultura, etnicidade e história. Canoas: Ulbra.
- [34] Oliveira D.P R. (2006) Empresa familiar: como fortalecer o empreendimento e otimizar o processo sucessório.2.ed. São Paulo: Atlas.
- [35] Shein, E. (1985) Organization cultures and leadership : a dynamic view. San Francisco: Jossey-Bass,. p.1-26; 70-96.
- [36] _____. Guia de sobrevivência da cultura corporativa. Rio de Janeiro: José Olympio. 1999. 191p.
- [37] Seyferth, Giralda (1981). Nacionalismo e identidade étnica: A ideologia germanista e o grupo étnico teuto-brasileiro numa comunidade do Vale do Itajaí. Florianópolis: Fundação Catarinense de Cultura,
- [38] Senge, P et al. (2009), A Revolução decisiva : como indivíduos e organizações trabalham em parceria para criar um mundo sustentável. Tradução Afonso Celso da Cunha Serra. Rio de Janeiro: Campus Elsevier, .
- [39] Sobral, F.; Peci, A (2008). Administração: teoria e prática no contexto brasileiro. São Paulo: Prentice Hall.
- [40] Tigre. (2017) Available on: <<http://www.tigre.com.br>>. Acesso em: 20 abr.2017
- [41] Tupy (2017). History. Available at: <http://www.tupy.com.br/portugues/empresa/historia.php>>. Accessed on: 20 abr.2017
- [42] Westhead, P., & Howorth, C. (2006) .Ownership and management issues associated with family firm performance and company objectives.Family Business Review, 19 (4), 301-316.

Prevalent Leadership Profile: A Research on Management of Innovation in the Military Organization

Sued Santos Rocha de Souza¹, Flávio de São Pedro Filho², Miguel Nenevé³, Jose Moreira da Silva Neto⁴, Thiago Pacife de Lima⁵

¹Captain of Fire Department Military of Rondônia – CBMRO, Director of Military School Tiradentes VII; Master in Management (UNIR-2017), graduated in Law (Inter-American College of Rondônia). Is Member of Research Group on Management of Innovation and Technology (GEITEC / UNIR / CNPq), Brazil. E-mail: sued_s@yahoo.com

²Post-Doctor in Management and Economic at the University of Beira Interior (UBI) – Portugal. PhD in Administration from the University of São Paulo (USP), Brazil. Doctor in Management of Enterprise from the Universidad Autónoma de Asunción (UAA), Paraguay. Is Professor of the Graduate Program of Management at the Federal University of Rondônia (UNIR). Is Coordinator of the Research Group on Management of Innovation and Technology (GEITEC / UNIR / CNPq), Brazil. E-mail: flavio1954@gmail.com

³Conducted postdoctoral studies in Caribbean Literature at the University of Guyana and Translation Studies at York University – Canada; Holds a PhD in Literatures in English – University of Santa Catarina (1996) CNPq researcher, Full Professor at the Federal University of Rondônia-mail, leader of the Group Research Literature, Education and Culture: Alternative ways.: nenevemi@gmail.com

⁴PhD in Production Engineering at Federal University of Santa Catarina– UFSC. Full professor of Management at the Federal University of Rondônia; coordinator of the Research group on Organizations – GepOrg- UNIR.e-mail: msilva@unir.br

⁵Professor of Basic, Technical and Technological Education at the Federal Institute of Rondônia - IFRO. Master's degree in Management and graduated in Mathematics from Federal University of Rondônia - UNIR. Member of the Amazon Innovation and Sustainability Research Group. e-mail:thiago.lima@ifro.edu.br

Abstract—*In this work we investigate prevailing leadership in a military organization. Our study has a multi-disciplinary nature as it focuses on Organizational Innovation and the profile of a leader as well as a little investigation on history of the development of a military organization Our main objective is to identify the profile of a strategic prevalent leadership at the Firemen Corporation in Porto Velho, Rondonia – Northern Brazil. We propose to describe the process of nomination for someone to exercise the role of a leader used in the military structure. In this context, we make a survey of the prevalent elements considering the profile of leadership in the face of organizational innovation having in mind the expectation of the people involved in the process of research. At the end we conduct a critical analysis comparing the prevalent elements identified in our study with the expectation of innovation revealed by the military structure investigated. We apply the method of content analysis through convenient procedures. As a result, we present the elements which show prevalence for the definition of the leadership profile of the investigated military structure. We hope our research can contribute to the studies in the field of leadership, as we still have few references in the area of knowledge.*

Keywords— *Leadership, Public Security, Prevalence, Military Management.*

I. INTRODUCTION

An initial study on leadership points out that the various forms of the definition of leading have as a consequence the belief that one individual commands and the other obeys. Over the years a new concept has been observed, which translates into the innovation of the art of leading. This innovation generates the shifting of the paradigms presented by several authors as the human need for evolution and, thus, maintains the order of a dynamic society flowing through the understanding, balance and mutual cooperation between individuals.

This research points out the results of the study on innovation and leadership, alongside the Master's Program of Business Administration of the Federal University of Rondônia, having Organizational Innovation as a theme and focusing on the strategic leadership profile. The principles of Trait Theory for defining the characteristics of leadership and the counterpoint between the Institutionalism Theory and the Theory of Domination, presented by Max Weber, as well as the paradigm shift

occurred from New Public Management Theory, guide this investigative process.

II. OBJECTIVES

This study aims to analyze the prevalence of leadership for organizational innovation, focusing on the leadership profile of managers in the Military Fire Brigade of the State of Rondônia. According to Abbade and Brenner (2009), the characteristics of the management sectors, such as human resource management, planning, operations and the observation of the behavioral elements, should be examined for better results. The general objective is to identify the prevalent leadership profile, through management of innovation in the Military Fire Brigade and, for that reason, the work has as its specific objectives: to describe the designation process used in the military structure for the exercise of the leadership role (1); to survey the predominant elements in the leadership profile in face of organizational innovation contained in the expectation of those involved in the researched process (2); to perform a critical analysis among the prevalent elements identified in view of the need for innovation in the studied military structure and in the perception of current managers (3).

III. METHODOLOGY

This study follows a qualitative approach through the interpretation of observed phenomena and the contemplation of these results found in the military organization which we have studied. For Creswell (2014), the qualitative research is established by means of the criteria derived from a survey project by which the purpose of the research is defined.

Our research seeks to identify the prevalent elements of leadership in the management of the Military Fire Corporation of the State of Rondônia and in some institutions academically linked to the Fire Department through the Officers Training Course, analyzing the participation of officers who perform managerial functions and their personnel in obtaining results and in decision-making.

A questionnaire was applied to the students of the course, based on the Likert scale, with five options and values assigned to them, allowing the formulation of graphs. The use of tools such as Microsoft Excel assisted in the formulation of these results, observing variables in order to produce the reliability of the presented data.

The form provided for the sergeants training course was made available on the distance-learning platform of the course; the student, upon accessing the system, was instructed to respond to the form anonymously. The results were stored in the server of the Corporation, the Military Fire Brigade of the State of Rondônia, and the report was made available to this researcher.

The form aimed to find the 5 (five) most predominant leadership characteristics indicated by the respondents, as well as the 5 (five) less predominant. In order to evaluate the degree of occurrence of these characteristics, a questionnaire was included to measure this data that is common to all military personnel.

IV. THEORETICAL-EMPIRICAL REFERENCE

This study has the Institutionalism Theory as its basis and doctrinal foundation and it observes the characteristics which are peculiar or pertinent to the military regiments, sculpted in the practice of leadership in the daily life of this type of corporation. It is important to consider the legitimacy of actions, which is the reason we seek to present valid propositions in the transformation of new administrative practices, and their logical arguments, based on the Theory of Domination and the New Public Management Theory, in the search for the explanation that meets the facts, clarity and logical argumentative conciseness of this investigative work.

To the students in the training course, a questionnaire was applied based on the Likert scale, with five options and values assigned to them, allowing the formulation of graphs. The use of tools such as Microsoft Excel assisted in the presentation of these results, observing variables in order to produce the reliability of the presented data. The presented data was demonstrated through tables, graphs or figures in order to allow a visualization of the results found.

V. IDENTIFYING THE PREVALENT LEADERSHIP PROFILE

The result of this study is based on theoretical and conceptual principles, on the methodology of the preparation and on the data collected in the military organization subject to management of innovation. The relationship between the leader and those who are led is summed up in the way leadership is exercised within this military body. The corpus dealt with in the literature raised points to the corroboration of how social transformations directly influence the achievement of the objectives. However, the measurement of systematized prevalence may offer the most appropriate means to answer the research question, from which the arguments contained in the following sub-topics should be considered:

5.1 Description of the Designation Process used in the military structure to exercise leadership roles

The spheres of action that separate the hierarchical rank in the Military Corporations are fundamental to configure levels of command and subordination. Examples are the operational activities performed by the military categorized as officers and those categorized as enlisted rank/soldiers, who are subordinate to the officers. Both

functions are essential for the accomplishment of the missions of the corporation to which they are all associated. As provided in the Federal Constitution of Brazil in force in its Article 144, the Military Police and Fire Brigade of the States are military organizations called auxiliary forces, treated as a reserve of the armed forces, and a specific law is authorized to discipline their organization and their functioning. Shaped in the statutes and legislations of the Armed Forces, the Military Fire Brigade of the State of Rondônia, which had its emancipation from the Military Police in 1998, instituted the continuity of the posts and graduations originating from militarism, such as those between enlisted rank/soldiers and Officers.

For the management positions characterized in the corporation, such as: Commander of Military Unit, Barracks, or Administrative Sections, the Coordination or Boards, which are functions foreseen for Officers, although some highlighted sections may be commanded by Lieutenants or Sergeants, according to the necessity of service. The posts to the military in the corporation are granted respecting the meritocracy regarding the classification in their courses, from which the planned positions are offered and they choose where they wish to act after the course ends. Another form of designation is after the completion of specialization courses, such as: operational courses or technical courses, in which the

military is placed in a specific section, consistent with the investment made by the State in that military. The current command carried out a study on the competencies of each officer of the corporation and assigned its officers with managerial functions, based on the precepts of *New Public Management*, which corroborates the theory presented by Matos (2015), according to which the new managerial model commits to efficiency and effectiveness, shifting from traditionalist bureaucracy to participatory management.

5.2 Survey of the Elements of Prevalence in the Leadership Profile in face of the expectation of Organizational Innovation

The leadership vision in any organization can be viewed down or up from the hierarchical scale. The present research carried out a study at all levels of the corporation. This way, the perception of the 2016 class of the sergeants training course was evaluated through a form. In this environment, 20 (twenty) structured assertions were submitted from the theoretical focus contained in this document in order to obtain the respondents' perception. On fundamental aspects related to leadership, both subordinate and command were categorized. Table 1 presents the questions of the questionnaire applied and the answers are synthesized in Table 2, summarizing the performance of the respondents in this *in situ* consultation.

Table.1: Questions about concepts and leadership for the Sergeants Training Course

ELEMENT	DESCRIPTION
P1	Age group of the person consulted
P2	Sex of the person consulted
P3	Degree of education of the person consulted
P4	Time working for any of the Public Security Bodies
P5	Position within the corporation
P6	Exercises Management, Leadership or Director function
P7	I am fit for my the function I have
P8	I feel I am an important member in the organization.
P9	I exercise a function because of my technical knowledge or because of a specific vacancy, proven by professional curriculum.
P10	The function that I exercise requires specific technical knowledge
P11	I possess specific technical knowledge for the function that I exercise
P12	In my perception, my immediate superiors are fit for the function they exercise
P13	My superiors perceive my needs and aspirations within the organization.
P14	I have my superiors as an example to be followed in the organization.
P15	In my perception, my hierarchical subordinates are fit for their functions.
P16	My superiors care about my opinions and well-being within the organization.
P17	In my perception, there is a need for new training courses for the functions performed.
P18	My position/function is by appointment.
P19	I give opinions that are discussed in planning meetings.
P20	I participate in meetings that discuss the methods and procedures performed.

Source: Elaborated by the authors.

Table.2: Questionnaire answers about Training and Leadership

	p7	p8	p9	p10	p11	p12	p13	p14	p15	p16	p17	p18	p19	p20
Totally Agree	63	73	40	75	38	60	39	40	34	42	96	14	33	34
Partially Agree	42	27	32	28	59	35	44	34	52	33	12	17	35	32
Indifferent	3	9	20	6	6	6	9	14	11	12	4	17	24	21
Partially Disagree	2	2	6	2	6	7	14	10	12	14	0	7	9	7
Totally Disagree	2	1	14	1	3	4	6	14	3	11	0	57	11	18

Source: Elaborated by the authors.

The criticism of Table 1 and Table 2 above makes it possible to consider the significant numbers resulting from the positioning of the respondents. Thus, for variable p17 in Table 6 above, which addresses the need of training for the performance of new functions, indicating the 112 (one hundred and twelve) respondents, 96 (ninety-six) fully agree with such need. This position corroborates with Oliveira (2012), as this researcher indicates self-improvement as one of the training factors for leadership. In recognizing the importance of this need it is assumed that the individuals are conscious to assume positions of command in the corporation. In addition, in relation to the evidence indicated above, 59 (fifty-nine) individuals indicate that they have specific technical knowledge for the functions they perform; however, 59 (fifty-nine) respondents state that they do not hold positions or functions by appointment, which confirms that they have real technical expertise. This fact corroborates the prescription of Vieira (2002), who points out the technical

expertise before the subordinate ones. The result of the questionnaire applied asserts that 76% of respondents, most of whom are between 26 and 39 years of age, are male, have finished High School, with a service time of more than 5 (five) years, and are considered able to perform the function of a military firefighter. Among the respondents, 21% correspond to officers and 79% are enlisted rank/soldiers.

5.2.1 Characterization of the leadership in the military command in the organization studied in this research

According to Martins (2015), Institutional Theory versus *New Public Management* points to the adaptation of the private sector in public administration, being shaped according to the pillars of militarism indicated by Abreu (2015), as the hierarchy, which is one of the sources of leadership that comes to be shaped as new elements of leadership. Table 3 presents the explanation about this comparison in the organization studied by this research.

Table.3: Leadership: Theoretical framework

THEORETICAL SUPPORT	DOCTRINAL PRINCIPLE	PRACTICE IN MILITARY ORGANIZATION
INSTITUTIONAL THEORY Carvalho, Vieira and Silva, (2012); Pereira (2012).	Exercise of Leadership through the position occupied.	Functions occupied based on military hierarchy.
NEW PUBLIC MANAGEMENT THEORY Carneiro and Menicucci (2011); Martins (2015)	Ability to generate meaning for the community, motivating people to act for the common good.	Functions by technical-professional qualification.
DESIGN THINKING Lima and De Carvalho, 2013); Vianna et al., (2012); Biscaia (2013).	Development of creative skills, such as imagination, ideation and prototyping.	Functions by qualification.

Source: Elaborated by the authors.

The Institutionalism Theory itself, according to Pereira (2012), deals with the organization through norms and regulations, and empirically in the military hierarchy it is one of the precepts that keeps the institution intact, although over the years it has shown a need for change in external factors that come to satisfy the primary needs of military institutions, such as the corporation under study, www.ijaers.com

becoming, thus, transforming elements in these organizations.

Leadership innovation has been observed as the implementation of a new or significantly improved solution, aiming to strengthen the competitive position and to improve performance and knowledge; therefore, it is possible to interweave the innovation with the participation

of the leadership demonstrated in coordinating works that involve the need for improvements and the capacity to make decisions, through productive practices not previously thought, which is pointed out in the literature, according to Torquato, Willerding and Lapolli (2015), who describe the process of innovation through participation. Participation in corporate decision-making is also evaluated; in this regard, 58% evaluate that they totally or partially agree with participation in the meetings regarding

the methods and procedures of the corporation, also combined with the evaluation of 67% who inform that they wish to be observed by their superiors.

This analysis is shown in Figure 1, where the synthesis of this relationship of qualification and leadership is found, being referenced in the literature as pointed out by Vieira (2002). The author indicates characteristics that involve competence, discernment and tact, placing the intellectual skills above political influences or patronage.

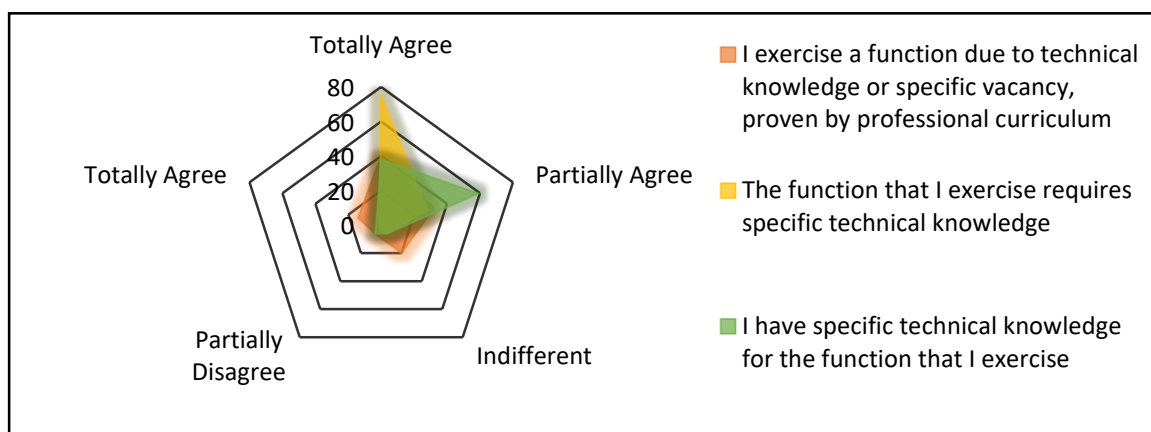


Fig.1: Professional training of respondents

Source: Elaborated by the authors.

5.2.2 Characterization of the prevalent leadership

The structured form points to the most present view of leadership from the point of view of the characteristics

identified in Hunter (2014) and Posner and Kouzes (2011), prevailing the five (5) most visible characteristics of the respondents, as identified in Figure 2.

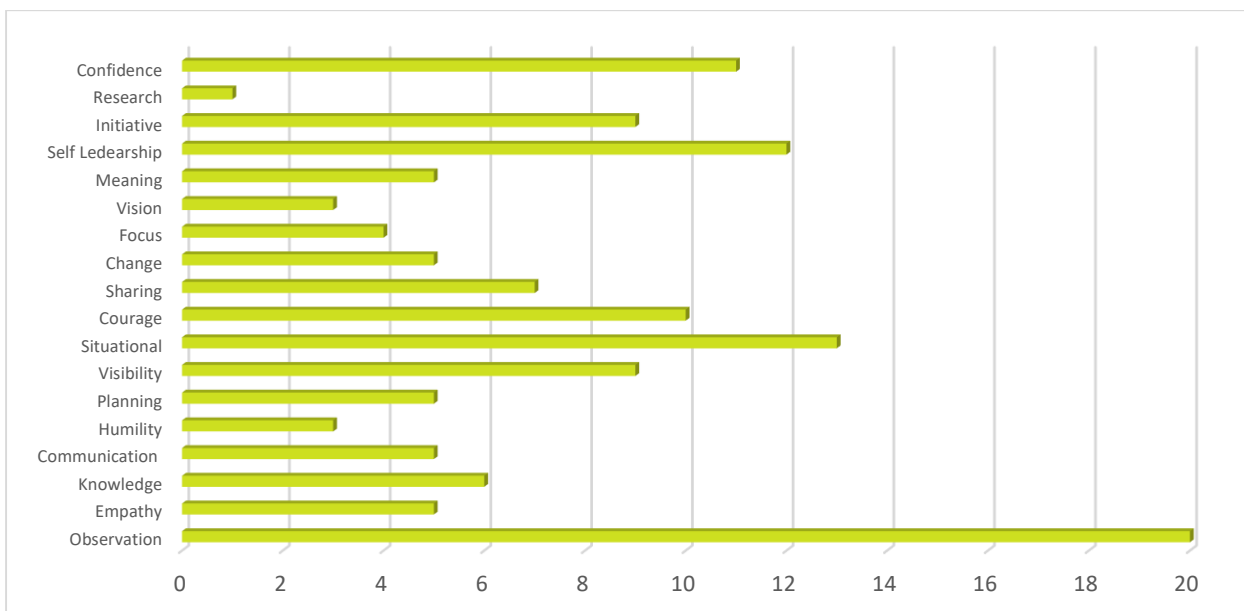


Fig.2: Characteristics of Leadership that are most present in Managers in Military organization.

Source: Elaborated by the authors.

The figure above contemplates the characteristics presented in the literature pointed out by Maxwell (2013). In order to develop skills capable of influencing a modern leadership, a view is taken within a point of the

organizational structure, also presented by Ferreira (2012) as the very characteristic of influencing people. The prevalent Leadership is pointed out in this study as the one that presents the most predominant characteristics in face

of the vision of the military towards its managers and hierarchical superiors. According to Collins (2017), four characteristics stand out as most prevalent, being: self-confidence, humility and ambition. The respondents understand that observation is the characteristic that prevails among the others, because it represents the analysis of the organizational environment in search of effective solutions for each problem. This characteristic represents the need to innovate, always aiming to evolve, reaching the objectives of the organization. This corroborates the study of De Oliveira (2012), contemplated by the notes necessary in the act of observing to plan, and listed in the study on Principle of Leadership, according to the Army manual. The designation of competent officers who are able to listen to their subordinates through participatory leadership demonstrates that this characteristic becomes prevalent nowadays as a solution, generating respect and trust for other members of the military in all hierarchical ranks.

The second most present characteristic pointed out by the respondents, is the situational one, which according to Gustavo (2016), is a characteristic that involves integrity with solution targeting, which complements the first, since it represents the ability to direct the team to obtain better results, observing the problem and seeking intelligent and sustainable solutions for the corporation. Such is a fact that was observed during the analysis of the corporation of the Military Fire Brigade of the State of Rondônia.

The respondents put self-leadership as the third prevalent characteristic in leadership and it represents similarity with those listed in the literature we used in our work. Self-leadership represents the ability to lead themselves, creating possibilities for success for the organization. Allied to one's self-leadership, there is confidence. It is the result of the capacity to coordinate actions for the effective solution to the organization's objectives, receiving endorsement for the credibility of the actions, as presented by Vieira (2002), in the personal development by the responsibility of his subordinates and the knowledge of himself leading to the perception of his own characteristics and its limits.

The fifth characteristic most evidenced by the respondents is courage, resulting from the ability to make decisions in the face of the events of the organization, knowing how to take risks with wisdom in the actions assigned to him in pursuit of the objective of the corporation. This finds similarity with Maxwell (2013), in his note to the law of victory and of the great impulse, which shows the steps from starting from scratch and moving on to making decisions on the way to victory.

5.3 Critical analysis of the prevalent elements identified in face of the expectation of innovation in the studied military structure

www.ijaers.com

The corporation under study, whose existence corresponds to just under two decades, presents an administrative maturity that is a result of several corporations with secular traditions, as in the case of the Military Fire Brigade of the State of Rio de Janeiro and Brasília. The Military Fire Brigade of the State of Rondônia - CBMRO has existed for 19 (nineteen) years and presents an index of innovation in several sectors, being nationally recognized. This fact is verified through the recognition of the National Fire Brigade – the deliberative body and representative of all National Fire Brigade bodies, which highlights the direction of the Council through the presidency of the General Commander of the Military Fire Brigade of the State of Rondônia. In the period of 2012-2014, stand out: the Civil Defense operations triggered in the State during the flood of 2014, with zero deaths; the recognition of the Government of the State and the optimization of the public resources raised through the Fund of Re-Equipment of the Fire Department – FUNESBOM; and the technological modernization and improvement of the military, with specialization courses for several areas.

The corporation under study had through the Law 2699/12 (RONDÔNIA - 2012) the creation of the Air Operations Group, which demonstrates the innovation exercised by the leadership of its General Commander, in order to offer new services for the noble mission of saving lives. Allied to this fact, we identify the prevalence of innovative characteristics of leadership in the CBMRO, finding the 5 (five) characteristics pointed out by the respondents, leading to the determination of the creation of a new tool capable of reaching the goal of the corporation. This fact goes back to what the aspiring sergeant students point out as necessary for the recognition of leadership, for which it was provided the training of human resources to operate this type of service. Management was also the target of this reflection of participatory leadership; through meritocracy, some fundamental functions of financial and administrative management were occupied by professionals with knowledge and who were better trained in courses funded by the Corporation.

A survey conducted by the newspaper O Globo (2017), which interviewed about 300 (three hundred) presidents, superintendents, directors and managers of medium and large companies in Brazil, points out three main qualities of a good leader: inspiring others, have ethics and having decision-making skills.

VI. CONCLUSIONS AND SUGGESTIONS

The prevalent leadership in the organization studied reflects a paradigm shift to existing models within the militarism present in military manuals and legislation. The existing isomorphism between civil organizations and public organizations, more specifically the Military Fire Brigade Corporation of the State of Rondônia, admits the

understanding that the new public management within a military organization has new notorious characteristics related to leadership, and the results point to the mastery of management over those it leads. The confidence in the technical qualification is one of the observed factors in the present study as a primordial fruit for the new model of leadership. It also results in a conclusive analysis, according to the sample, which exists besides the concern with the qualification of intellectual capital, the concern for the welfare of all of those involved in exercising a participatory leadership.

The innovation visualized in this research points directly to the internal services of the organization, which allows the study of ideas and the prototyping for practice when viable. For this work, the innovation in military organizations is characterized by the transition from institutionalist theory to New Public Management, observing the clear principles of Design Thinking involving these transformations and exercising a paradigm shift. Thus, the characteristics pointed out in the literature studied and presented by Collins, Hunter, Posner and Kouzes highlight the prevalent elements presented by the studied organism: observing and providing confidence for problem solving or the generation of new management models, which are natural characteristics to confirm leadership.

In summary, the research presented results visible in the observation of the respondents and the documentary analysis of the publications in general bulletins, minutes of meetings and reports. We can see convergent points in the evaluation between the hierarchical subordinates and the managers of management functions which are listed. A primordial characteristic listed in the literature and ratified by the respondents is that the ideal leadership in a military organization has, in evidence, characteristics of participatory leadership, from which the leader observes the environment, performs an analysis and through his technical knowledge proposes measures to obtain effective results.

The prevailing leadership profile identified in the study reveals that it is necessary to promote professional valorization of all of those involved in the corporation. However, one can observe that it is not yet at the level desired by the respondents, according to the perception pointed out by the need for new training and recognition of the work developed. Concomitant to this fact, we observed that the corporation attends part of this professional valorization with the fomentation of technical qualification through the several courses to the military. At this point, we can see the presence of the Design Thinking tool, which is emerging in the corporation when it comes to the innovation model allied to the listening of ideas and creativity carried out daily by those involved. It is also presented in documents for innovation in improvements in daily relief services; leading the organization to innovate

with acquisition of materials to support the activities of firefighters.

As a suggestion for the organism studied, we encourage a management through participatory leadership, which results in a constant learning, aiming at the strengthening of the servant leadership, demonstrating that the prevalent characteristics highlighted in the study allow innovations in the way the organization is managed. The prevalent characteristics can be used for a proposal of isomorphism of civil organizations and military organizations, creating through the points raised here a favorable environment for the achievement of new Leaders and the improvement of management in organizations. For the academy, the present study can be used as a laboratory of indicators to elaborate new studies in the face of leadership, whether in a public or private body.

REFERENCES

- [1] ABREU, J. L. N. De. (2015). **Military and Administrative Law**. São Paulo: MÉTODO.
- [2] BISCAIA, H. G. (2013). **Design Thinking and Sustainability: Study of the Mandalla DHSA system in the struggle against hunger and misery**. Paraná: Dissertação (Mestrado em Administração) - Universidade Federal do Paraná, 5 jun.
- [3] BRASIL. **Brazilian National Constitution (1998)** Brasília, DF: Senado Federal: Centro Gráfico.
- [4] CARNEIRO, R.; MENICUCCI, T. M. G. (2011). **Political and Public management: Pending reforms**. Brasília: IPEA.
- [5] CARVALHO, C. A.; VIEIRA, M. M. F.; SILVA, S. M. G. (2012). The conservative trajectory of institutional theory **GESTÃO. Electronic journal**, v. 10, n. 03.
- [6] COLLINS, J. (2017). **Good to great**. Vienna: Business Books.
- [7] CRESWELL, J. W. (2014). **Investigação Qualitativa e Projeto de Pesquisa: Escolhendo entre Cinco Abordagens**. Porto Alegre: Penso Editora.
- [8] DE OLIVEIRA, G. E. A. ALVADOR. **LIDERANÇA MILITAR**, 2012. Disponível em: <http://www.coter.eb.mil.br/images/noticias_principial/Artigo_Gen_Salvador.pdf>. Acesso em: 28 ago.
- [9] FERREIRA, E. L. O. S. B. (2012). A influência da relação líder – liderado no clima organizacional. **REVISTA DE ADMINISTRAÇÃO DE RORAIMA (RARR)**, v. 2, n. 2, p. 29–50, 21 dez.
- [10] GLOBO, J. (2017). **Líder por natureza e paixão**. Disponível em: <<https://oglobo.globo.com/economia/emprego/lider-por-natureza-paixao-4520191>>. Acesso em: 28 ago.
- [11] GUSTAVO, L. (2016). **A Teoria dos Traços - Produção acadêmica**. Disponível em: <<http://www.administradores.com.br/producao->

- academica/a-teoria-dos-tracos/5265/>.2013. Acesso em: 3 jul.
- [12] HUNTER, J. C. (2006). **De volta ao mosteiro: O monge e o executivo falam de liderança e trabalho em equipe**. Rio de Janeiro: Sextante.
- [13] HUNTER, J. C. (2014). **Como se tornar um líder servidor: Os princípios de liderança de o monge e o executivo**. Rio de Janeiro: Sextante.
- [14] LIMA, G. B.; DE CARVALHO, D. T. (2013). **Design Thinking: um olhar estratégico sobre o pensamento abduativo**. In: X CONGRESSO VIRTUAL BRASILEIRO - ADMINISTRAÇÃO COVIBRA, 2013. Disponível em: <<http://www.convibra.com.br/artigo.asp?ev=23&id=7485>>. Acesso em: 10 jun. 2016
- [15] MARTINS, C. A. F. (2015). **Contratação Pública na Administração Pública Local no quadro da Nova Gestão Pública**. Dissertação de Mestrado em Construção Cívica—Guarda: Instituto Politécnico da Guarda.
- [16] MATOS, J. C. (2015). ADMINISTRAÇÃO PÚBLICA GERENCIAL. *ANAIS DO ENIC*, v. 1, n. 4, 27 out.
- [17] MAXWELL, J. C. (2013). **As 21 irrefutáveis leis da liderança: Uma receita comprovada para desenvolver o líder que existe em você**. Thomas Nelson Brasil.
- [18] MAXWELL, J. C. (2013). **O Líder 360: Como desenvolver seu poder de influência a partir de qualquer ponto da estrutura corporativa**. Thomas Nelson Brasil, 2013b.
- [19] PEREIRA, F. A. M. (2012). A Evolução da Teoria Institucional nos Estudos Organizacionais: Um Campo de Pesquisa a Ser Explorado. *Revista Organizações em Contexto*, v. 8, n. 16, p. 275–295, 31 dez.
- [20] POSNER, B.; KOUZES, J. (2011). **O que precisamos saber sobre liderança?: Verdades fundamentais sobre a natureza do líder**. Rio de Janeiro: Elsevier Brasil.
- [21] ROBBINS, S. P.; JUDGE, T. A. (2014). **Fundamentos do comportamento organizacional**. São Paulo: Pearson Prentice Hall.
- [22] RONDÔNIA. (2012). **Lei n 2699/12 - ALTERA OS ARTIGOS 47 E 48, DA LEI N° 2.204, DE 18 DE DEZEMBRO DE 2009, QUE DISPÕE SOBRE A LEI ORGÂNICA E FIXAÇÃO DO EFETIVO DO CORPO DE BOMBEIROS MILITAR DO ESTADO DE RONDÔNIA**. Assembléia Legislativa.
- [23] TORQUATO, M.; WILLERDING, I. A. V.; LAPOLLI, É. M. (2015). **A ferramenta Design Thinking: uma estratégia da gestão empreendedora da inovação para o despertar criativo em organizações**. In: ALTEC 2015. Porto Alegre, 2015. Disponível em: <<http://www.altec2015.org/anais/altec/papers/56.pdf>>. Acesso em: 10 jun. 2016
- [24] VIANNA, M. et al. (2012). **Design Thinking: inovação em negócios**. Rio de Janeiro: MJV Press.
- [25] VIEIRA, B. (2002). **Liderança Militar**. Lisboa: Academia Militar, 2002.
- [26] WEBER, M. (2012). **O que é a burocracia**. Brasília: Conselho Federal de Administração.

Determination of Optical Energy Gap for Copper oxide at Different Temperatures

Wasil Abdalgader Abdalla Alhassan¹, Ismael. A. Wadi²

¹(Basic Science Units, Preparatory Year Deanship, Prince Sattam Bin Abdulaziz University, Ksa, wasil8899@gmail.com).

²(Physics Department, Faculty of Education, University of Nyala, Sudan, Basic Science Units, Preparatory Year Deanship, Prince Sattam Bin Abdulaziz University, Saudi Arabia, iawadi@yahoo.com).

Abstract— In this work, thin films of copper oxide (CuO) have been prepared using spraypyrolysis technique. The energy gap was determined for samples of the copper oxide (CuO) at different temperatures ranging from (150 to 330) °C. The absorption and transmission spectra, shows the energy gap for (CuO) in the range from (2.44- 2.19) eV. These values are comparable to the actual values.

Keywords— Optical Energy Gap, Copper oxide, semiconductors.

I. INTRODUCTION

Determination of the band gap energy of semiconductors and specially semiconductor nanostructures is of great interest since it is directly related to the nanometer sized particles. Therefore, many efforts have been focused on the evaluation of the band gap energy to investigate the optical properties. Semiconductor nano particles produced by various methods constituting different sizes, thereby particles size distribution introduces many consequences on the optical properties due to the corresponding band gap. Therefore studying the particle size and their size distribution could be considered an crucial point.

Copper oxides CuO are the main semiconductor phases of copper oxides. CuO has monoclinic crystal structure and indirect band gap of 1.4eV, CuO also been reported [2,3].

Due to copper oxides potential applications, such as, in solar cells [4], catalysis [5], and magnetic devices [6], much attention has been attracted. Recently, extraordinary efforts have been made to investigate the optical properties of Cu₂O. Mishinia et al have studied the structure of Cu/Cu₂O multilayer preparation using non-linear electrochemical deposition with high precision in control thicknesses and number of layers. Their results lead to significant changes in the linear and nonlinear optical properties of Cu₂O and CuO multilayer structure [7]. Liu et al reported the structural and optical properties of film select rods deposited on different substrates. Their results illustrate that, the kind

of substrate strongly affect film morphology, crystal structure and optical properties [8]. Prevot et al studied the near infrared optical and photoelectric properties of Cu₂O under oxygen atmosphere. The absorption near the fundamental edge was characterized by several absorption bands with peak position at 0.65μm, 0.75μm, 0.88μm, 1.1μm with strongest one at 1.28μm, The aim of this work is to find an appropriate theoretical consideration to obtain the value of the optical energy gap at the different temperatures [9].

II. THEORETICAL BACKGROUND OF OPTICAL BAND

A common and simple method for determining whether a band gap is direct or indirect uses absorption spectroscopy. By plotting certain powers of the absorption coefficient against photon energy, one can normally tell both what value the band gap has, and whether or not it is direct. For a direct band gap, the absorption coefficient is related to light frequency according to the following formula [10].

$$\alpha \approx A^* \sqrt{hf - E_g} \quad (1)$$

$$A^* = \frac{q^2 x_{vc}^2 (2m_r)^{\frac{3}{2}}}{\lambda_o \epsilon_o \hbar^3 n} \quad (2)$$

Where: α is the absorption coefficient, f is light frequency, h is Planck's constant, \hbar is reduced Planck's constant

n is the (real) index of refraction, E_g is the band gap energy, q is the elementary charge, ϵ_o is the vacuum permittivity

A^* is a certain frequency-independent constant, with formula above, Type equation here is a "matrix element", with units of length and typical value the same order of magnitude as the lattice constant [11].

$$m_r = \frac{m_h^* m_e^*}{m_h^* + m_e^*} \quad (3)$$

Where: m_e^* and m_h^* are the effective masses of the electron and hole, respectively, (m_r is called a "reduced mass")

This formula is valid only for light with photon energy larger, but not too much larger, than the band gap (more specifically, this formula assumes the bands are approximately parabolic), and ignores all other sources of absorption other than the band-to-band absorption in question, as well as the electrical attraction between the newly created electron and hole. It is also invalid in the case that the direct transition is forbidden, or in the case that many of the valence band states are empty or conduction band states are full [12].

On the other hand, for an indirect band gap, the formula is:

$$\alpha \propto \frac{(hf - E_g + E_p)^2}{\exp\left(\frac{E_p}{KT}\right) - 1} + \frac{(hf - E_g - E_p)^2}{1 - \exp\left(\frac{-E_p}{KT}\right)} \quad (4)$$

Where: E_p is the energy of the phonon that assists in the transition, K is Boltzmann's constant,

T is the thermodynamic temperature, (This formula involves the same approximations mentioned above.)

Therefore, if a plot of hf versus α forms a straight line, it can normally be inferred that there is a direct band gap, measurable by extrapolating the straight line to the $\alpha = 0$ axis. On the other hand, if a plot of hf versus $\alpha^{\frac{1}{2}}$ forms a straight line, it can normally be inferred that there is an indirect band gap, measurable by extrapolating the straight line to the $\alpha = 0$ axis (assuming $E_p \approx 0$) we get [13].

$$(\alpha hf) = A(hf - E_g)^{\frac{1}{2}} \quad (5)$$

The photon energy (hf) for y-axis can be calculated using Eq. (6).

$$hf = E = \frac{hc}{\lambda} \quad (6)$$

Where h is Planck's constant (6.626×10^{-34} J/s), c is speed of light (3×10^8 m/s) and λ is the wavelength.

Band gap obtained from Eq(5) where

$$(\alpha hf)^2 = A(hf - E_g) \quad (7)$$

Setting $y = \alpha hf, x = hf$ (8)

One gets $y = A(x - E_g)$ (9)

The tangent is given by $\frac{dy}{dx} = A$ (10)

It is important to note according to eq (9) at $y = 0$

$$x = E_g \quad (11)$$

Thus the tangent eq is given by

$$y = ax + b \quad (12)$$

The slope is given according to Eq (2.10)

$$a = \frac{dy}{dx} = A \quad (13)$$

Thus substituting eq (13) in eq (11) yields

$$y = Ax + b \quad (14)$$

The straight line of eq (9) and tangential (13) are the same.

Thus

$$y = Ax + E_g \quad (15)$$

In general if even eq (9) to be generalized to be in the form

$$y = A(x - E_g)^n \quad (16)$$

The equation of tangent is $y = ax + b$ (17)

The slope of the tangent at $x=x_0$ is given by

$$a = \left. \frac{dy}{dx} \right|_{x_0} = nA(x_0 - E_g)^{n-1} \quad (18)$$

The tangent intersect with x-axis, when

$$y = 0, ax = -b, x = \frac{-b}{a} \quad (19)$$

It is clear that for $x < E_g$:

$$y_{real} + y_{imag} = (x - E_g)^n = (-1)^n (E_g - x)^n$$

$$= \left[(-1)^{\frac{1}{2}} \right]^{\frac{n}{2}} (E_g - x)^n = i^{\frac{n}{2}} (E_g - x)^n \quad (20)$$

Thus: $y_{real} = 0, \dots, y_{imag} = i^{\frac{n}{2}} (E_g - x)^n$ (21)

But since $y = y_{real}$ hence $y=0$ $x \leq E_g$ (22)

Thus one can for a good approximation requires that

$$y=0 \quad x = E_g \quad (23)$$

Sub this relation in eq(17) to get $0 = aE_g + b$, $b = -aE_g$ (25)

Substance eq (25) in eq (16) to get

$$y = a(x - E_g) \quad (24)$$

Which is the equation of the tangent of the curve described by Eq (15).

To see the intercept of this tangent with the x-axis, substance $y = 0$ in Eq (25) to get

$$0 = a(x - E_g) \quad , \quad \text{Thus intercept exists at}$$

$$x = E_g \quad (25)$$

Thus the energy gap is the value of x at the point where the tangent of the curve (16) intersect meet the x -axis.

III. EXPERIMENTAL METHOD

Work method summarized in the following steps:

1. 0.2M solution of Copper acetate dehydrate (Cu (CH₃COO) 2.2H₂O) diluted in methanol and deionized water (3:1) was used for all the films. A few drops of acetic acid were added to improve the clarity of solution.
2. Nitrogen was used as the carrier gas, The nozzle to substrate distance was 30 cm and during deposition, solution flow rate was held constant at 4ml.min⁻¹.
3. The CuO films were deposited onto glass slices, chemically cleaned, using the spray pyrolysis method at different substrate temperature.
4. The optical measurements of CuO films were carried out at room temperature using Shimadzu UV-VIS-1240 scanning spectrophotometer in the wavelength range from 190 to 1100 nm. The substrate absorption is corrected by introducing an uncoated cleaned glass substrate in the reference beam. Energy Band Gap: According to the curve obtained from UV-absorption, the energy band gaps can be measured experimentally. These curve explain the connection between the determined energy E_g from Eqs. (5) and (28) and the square of absorption $(\alpha E)^2$.

IV. RESULTS BAND GAP OF COPPER OXIDE (CuO)

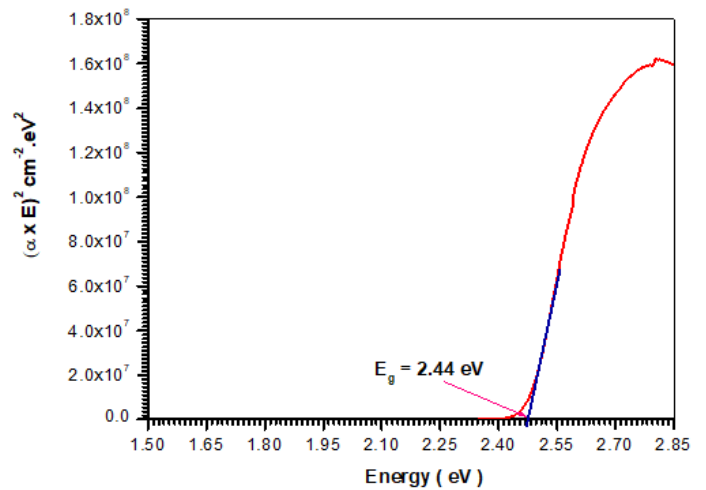


Fig.1: Band gap measurement of CuO at 150°C

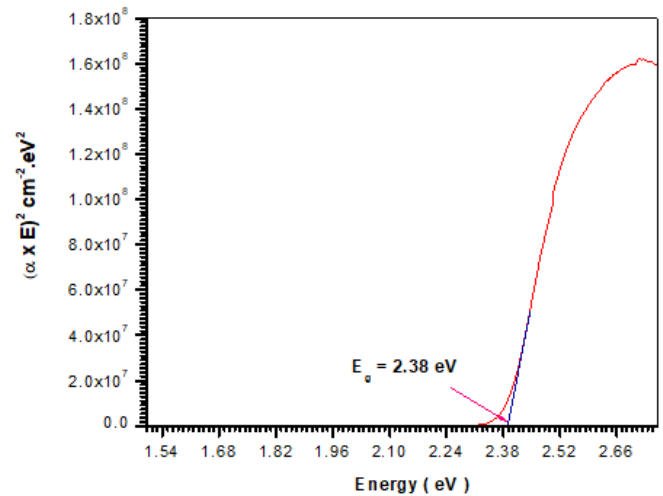


Fig.2: Band gap measurement of CuO at 190°C

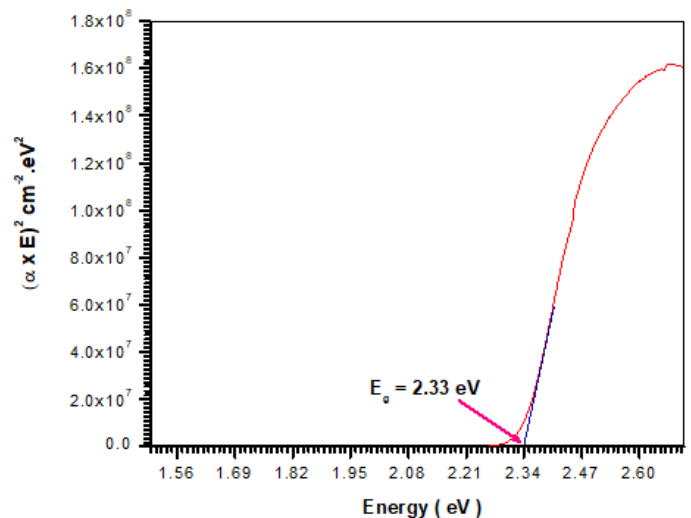


Fig.3: Band gap measurement of CuO at 230°C

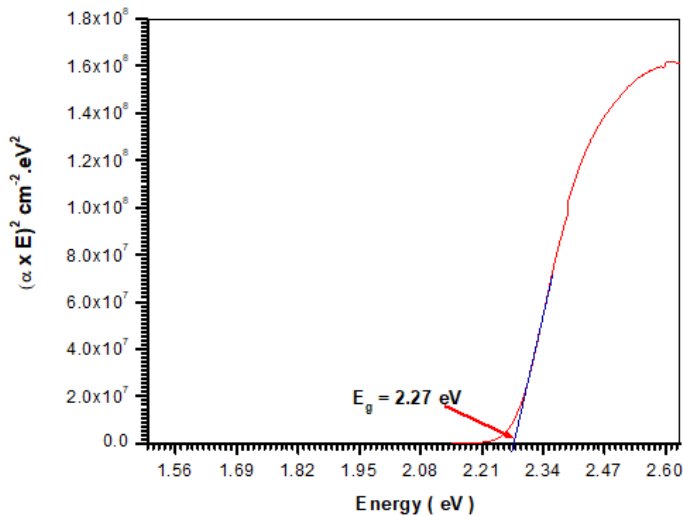


Fig.4: Band gap measurement of CuO at 270°C

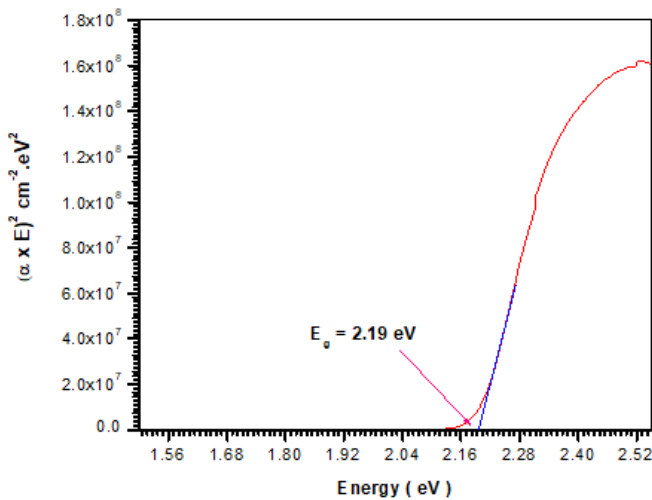


Fig.5: Band gap measurement of CuO at 330°C

Table.1: Variation energy gap with temperature (UV-VIS spectrophotometer)

No	Temperature (T °C)	Copper oxide E _g
1.	150	2.44
2.	190	2.38
3.	230	2.33
4.	270	2.27
5.	330	2.19

V. DISCUSSION

The determined optical band gap values for copper oxide are shown in Table (1). The band gaps of films were obtained at different temperatures ranging from 150°C to 330°C. The values of band gap decrease as temperature increase. It is very striking to note that this result agrees with equation (2.1) and Fig (5.1). The lower band gap of the copper oxide samples are at high temperature 330°C where

they reached 2.16 eV, 3.31eV respectively. The transmittance is min at $\lambda \approx 500 \text{ nm}$ or $500 \times 10^{-9} \text{ m}$ corresponding to photon energy for copper oxide

$$E = \frac{hc}{\lambda} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{500 \times 10^{-9} \times 1.6 \times 10^{-19}} \text{ eV}, E = \frac{hc}{\lambda} = \frac{19.8 \times 10^{-26}}{8 \times 10^{-26}} = 2.475 \text{ eV} \quad (26)$$

It is very clear that photons of energy having this value are absorbed. This is not surprising as for as the energy of this photons is just greater than the band gap. Those having energy less than the band gap E_g , i.e $E < 2.38 \text{ eV}$ for copper oxide

VI. CONCLUSION

From previous results one can conclude that the chemical spray pyrolysis method that has been used to perform the experimental measurements required for this investigation was found to work fairly successfully.

REFERENCES

[1] Z. Gan et al., J. Phys. D. Appl. Phys., 37 (2004) 81.
 [2] J. Li, G. Vizketlethy, P. Revesz and J. Mayer, J. Appl. Phys., 69 (1991) 1020.
 [3] A. Rkhshani, Solid State Electron., 29 (1986)7.
 [4] K. Borgohain et al., Phy. Rev. B, 61 (2002) 11093.
 [5] R. Borzi et al., J. Magn. Mater., 226-230 (2001) 1513.
 [6] D.E. Mishina, K. Nagai, S. Nakabayashi, Nano. Lett., 1 (2001) 401.
 [7] Y.L. Liu et al., Semicond. Sci. Technol., 20 (2005) 44.
 [8] B. Prevot, C. Carabatos and M. Sieskind, physcia status solidi (a), 10C21 (2006) 455. [50] Pankove, J.I. Optical Processes in Semiconductors. Dover, (1971).
 [9] J.I Pankove,. Optical Processes in Semiconductors. Dover, (1971).
 [10] C. R Sekhar,. Solar Energy Mater., 68 (2001) 307.
 [11] A. Neamen , Donald, semiconductor physics & devices, second edition (1997).
 [12] S. David, Perloff, J. Electrochem ,Four-point probe correction factors for use in measuring large diameter doped semiconductor wafers, Soc. 123, 1745 (1976).
 [13] Asia Hussein Kahdim, Nahida B. Hasan, Huda Bukheet Hasan(2018).Optical and Electrical Properties of TiO2 Doped Fe2O3 Thin Film Prepared by Spray Paralysis Technique. *International Journal of Advanced Engineering, Management and Science* (ISSN: 2454-1311),4(3), 189-195.
<http://dx.doi.org/10.22161/ijaems.4.3.9>

Hydric balance and climatic classification of the city of Porto Nacional, state of Tocantins, inserted in the Legal Amazon, Brazil

Angelo Ricardo Balduino¹, Márcio Galdino dos Santos², Lucas Barbosa e Souza³, Diogo Pedreira Lima⁴, Aurean de Paula Carvalho⁵.

¹Department of Environmental Sciences, Federal University of Tocantins, Palmas, BRA
Email: angelo.balduino@uft.edu.br

²Department of Environmental Sciences, Federal University of Tocantins, Palmas, BRA
Email: galdino@uft.edu.br

³Department of Environmental Sciences, Federal University of Tocantins, Palmas, BRA
Email: lbsgeo@uft.edu.br

⁴Department of Civil and Environmental Engineering, Tocantinense Institute President Antonio Carlos, Porto Nacional, BRA
Email: diopli@gmail.com

⁵Department of Civil and Environmental Engineering, Federal Institute of Education, Science and Technology of Tocantins, Porto Nacional, BRA
Email: auren@ifto.edu.br

Abstract— *The objective of this study was to carry out the Climatological Water Balance in conjunction with the climatic characterization, using precipitation and air temperature data in the municipality of Porto Nacional, belonging to the Legal Amazon, Tocantins state, by Thornthwaite and Mather (1955) for 20 years, from 1997 to 2016. From the results of potential evapotranspiration, real evapotranspiration, water surplus and water deficit, the water, aridity and humidity indices were established based on the number of continuous data from the conventional meteorological station, of WMO Code 83064, of the National Institute of Meteorology, located in the district Setor Aeroporto, municipality of Porto Nacional. The climatic formula obtained for the municipality of Porto Nacional was $C2wa'a'$, which characterized the climate in wet subhumid, with two well defined seasons, rainy and dry, being the dry season in the winter season where it presents moderate water deficiency and megatérmico, with values high annual evapotranspiration potential, with 28.29% of this evapotranspiration concentrated in the summer season.*

Keywords— *Climate classification, Hydric Balance, Thermal Index.*

I. INTRODUCTION

Water availability depends on the water capture capacity of a watershed and one of the most effective methods to estimate and determine the hydrological behavior, recharge capacity and water flow is the climatological water balance. Water balance is an accounting system for

monitoring soil water and results from the application of the principle of mass conservation for water in the volume of vegetable soil, being the variation of storage in a given time interval, which represents inputs and outputs of water from the volume control.

The climatic characterization of a municipality is fundamental to understanding the living conditions of any region, allowing a reliable evaluation of its aspects, which makes it relevant for areas with a high population density. Knowledge of the climatic conditions of a region is necessary to establish strategies with a more appropriate management of natural resources, aiming the pursuit of sustainable development and the implementation of viable and safe farming practices for the various biomes of the region (Sousa et al, 2010.)

With the reduction of water precipitation in the rainy months in the cities of the state of Tocantins, it is noticeable that the recharge of water to the reservoirs of sanitation companies are increasingly low and over the years we have identified the necessity of a climatic characterization for proper decision making in the operation of water supply reservoirs, since the population suffers greatly from the quantity and quality of water during periods of drought in some cities of the State of Tocantins, where it can lead to negative socio-environmental and economic impacts, such as: reduction of industrialized products, removal of solids deposited in domestic reservoirs (Water Box), clogging of domestic networks, pathologies in the structures of sanitation networks and hydraulic and sanitary installations such as

liquid hammering and cavitation caused by the absence or water reduction.

For (Mota et al, 2013), the search for strategies to assess adverse atmospheric phenomena and the interaction of bioclimatology with biodiversity (Fauna and Flora) depends heavily on the effects of weather and climate. According to (CUPOLILLO et al. 2013) the results of a hydric balance can be used for economic and ecological zoning involving the agro climatic functions of the region, potential water demand from irrigated crops in order to plan the priorities to preserve the region's water bodies.

The hydric balance has the characteristics of identifying and quantifying the variation of water storage in the soil, whether precipitation or infiltration, atmospheric demand and availability of water capacity. It will present estimates of actual evapotranspiration, water surplus and deficit and water storage in the soil. The model proposed in this work was that of Thornthwaite (1948), modified by Mather (1955), which became known as the Hydric Balance of Thornthwaite and Mather (1955), having as main function the climatic classification.

In this context the main purpose of this work was to perform the Hydric climatological Report together with the climatic characterization, using precipitation and air temperature data from the city of Porto Nacional, state of Tocantins, Brazil.

II. MATERIAL AND METHODS

The study was developed taking as basis the daily meteorological data from the conventional station 83064-Porto Nacional, which is part of the INMET stations network, in the period of January 1997 to December 2016, located in the city of Porto Nacional in 10°71' S e 48°41' W, with an altitude of 239,2 meters at sea level, according to figure (1).

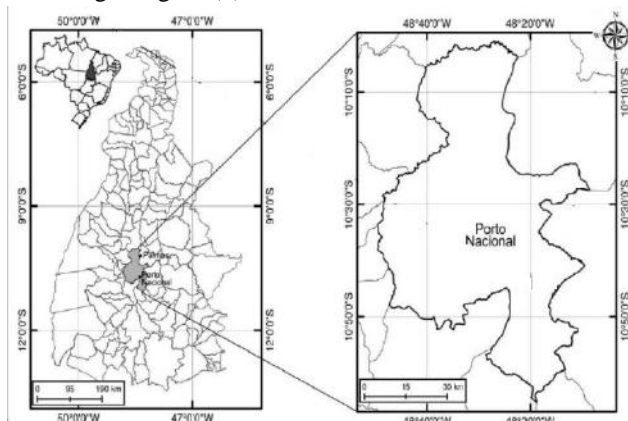


Fig. 1: Municipality of Porto Nacional – Tocantins

Belonging to the Legal Amazon in the state of Tocantins, the city of Porto Nacional has a total distance of 64 km to the state capital, the city of Palmas, possessing a

territorial area of 4.449.917 km² and a total population of 52.510 people (IBGE, 2017). The weather is typically tropical, with an annual average temperature of 26,1°C and an annual pluviometry average of 1,667,9 mm, referring to the period between 1961-1990 (AGRICULTURE AND AGRARIAN REFORM MINISTRY, 1992).

The climatic characterization of the municipality under study was obtained by the Thornthwaite (1948) methodology, which considers the water, aridity and humidity indices, together with potential evapotranspiration, based on monthly and annual values of temperature and precipitation, according to “equations 1, 2 and 3”.

$$I_H = 100 \cdot \frac{(100 \cdot EXC - 60 \cdot DEF)}{ETP} \quad \text{Equation 1}$$

In which:

I_H=water level

EXC = water surplus

DEF = water deficit

ETP = potential evapotranspiration

In the second step was determined the dryness index given by:

$$I_A = 100 \cdot \frac{DEF}{ETP} \quad \text{Equation 2}$$

in which:

I_A= dryness index

DEF = water deficit

ETP = potential evapotranspiration

The humidity index was calculated by using the values of the previous indexes, given by:

$$I_M = 100 \cdot \frac{EXC}{ETP} \quad \text{Equation 3}$$

In which:

I_M= humidity index

EXC = water surplus

ETP = potential evapotranspiration

After calculating the humidity, water and dryness indexes, it was used the table of the water balance extract to characterize the climate of Porto Nacional according to the purposed methodology, in which the water index, being the first classification symbol, was used to identify the climatic type, according to table (1).

Table. 1: First symbol of climatic classification according to Thornthwaite and Mather (1955)

Symbol	Climate Type	I _H
A	Very humid	More than 100
B ₄	Humid	80 to 99,9
B ₃	Humid	60 to 79,9
B ₂	Humid	40 to 59,9
B ₁	Humid	20 to 39,9
C ₂	Humid subhumid	0 to 19,9
C ₁	Dry subhumid	-19,9 to 0
D	Semiarid	-39,9 to -20

E	Arid	-60 to -40
---	------	------------

With the dryness and/or humidity indices, according to the classification symbol, it was identified the climatic types indicative of the seasonal regime of humidity, according to table (2).

Table. 2: Second symbol of climatic classification according to Thornthwaite and Mather (1955)

Symbol	Period of the year with water deficit or excess	I _A e I _M
Humid Climates: A, B, C₂		Dryness Index
R	Deficit non-existent or very slight	0 to 16,7
S	Moderate summer deficit	16,7 to 33,3
W	Moderate winter deficit	16,7 to 33,3
s ₂	Sharp summer deficit	Greater than 33,3
W	Deficit accentuated in winter	Greater than 33,3
Dry Weather: C₁, D, E		Moisture Index
D	Excess nonexistent or very slight	0 to 10
S	Excess moderate in summer	10 to 20
W	Excess moderate in winter	10 to 20
s ₂	Excessive accentuated in summer.	Greater than 20
w ₂	Excessive accentuated in winter	Greater than 20

With the information of potential evapotranspiration, we found the third symbol, defining the climatic type indicative of thermal efficiency, according to table (3).

Table. 3: Third symbol of climatic classification according to Thornthwaite and Mather (1955)

Symbol	Climate Type	ETP (mm)
A'	Megathermic	Greater than 1140
B' ₄	Mesothermic room	1140 to 998
B' ₃	Mesothermic third	997 to 856
B' ₂	Second Mesothermic	855 to 713
B' ₁	First mesothermic	712 to 571
C' ₂	Second microthermic	570 to 428
C' ₁	First microthermic	427 to 286
D'	Tundra climate	285 to 143
E'	Cold weather	Less than 143

For the fourth and last symbol, the climatic type was obtained through the calculation of the summery concentration of thermal efficiency, according to table (4).

Table. 4: Fourth symbol of climatic classification according to Thornthwaite and Mather (1955)

Symbol	Summer concentration of thermal efficiency
a'	Less than 48
b' ₄	48 to 51,9
b' ₃	51,9 to 56,3
b' ₂	56,3 to 61,6
b' ₁	61,6 to 68
c' ₂	68 to 76,3
c' ₁	76,3 to 88
d'	Greater than 88

The climatological water balance was obtained according to the method of Thornthwaite & Mather (1955), which used the data of normal temperature and precipitation for the period from 1997 to 2016 and from a water storage capacity of 100 mm, with the data being processed in the software developed into Microsoft Excel by Rolim and Sentelhas (1999), in which the values of the variables of potential and actual evapotranspiration, surplus and water deficit were obtained.

III. RESULTS AND DISCUSSION

The result obtained from the climatological water balance is shown in Table 5, through Figure 2, for the series of years from 1997 to 2016 considering the available water capacity (CAD) of 100 mm. For the period under study it was observed that the average annual precipitation was 1563.16 mm with irregular distribution throughout the year, showing two well defined seasons, being the period of drought in the months of May to September, with this period contributing in the study with approximately 6% of the annual rainfall volume and the rainy season between the months of October and April, with this period contributing with approximately 94% of the annual rainfall volume.

Table. 5: Climatological Water Balance from 1997 to 2016 in the city of Porto Nacional

Months	T (°C)	P (mm)	ETP (mm)	ETR (mm)	DEF (mm)	EX C (mm)
January	26, 26	251,49	136,6 5	136,6 5	0,00	114, 84
February	26, 34	244,68	136,0 2	130,2 0	5,82	108, 66
March	26, 34	257,73 5	156,2 0	155,9 7	0,23	101, 54
April	27, 03	156,45	156,7 7	144,9 8	11,7 9	0,00

May	27,19	48,33	175,22	112,10	63,12	0,00
June	26,90	4,085	145,72	23,29	122,43	0,00
July	26,97	0,085	142,88	3,96	138,92	0,00
August	28,38	3,785	167,46	15,80	151,66	0,00
September	29,58	42,355	176,08	40,79	135,29	0,00
October	28,38	110,85	189,22	77,11	112,11	0,00
November	27,16	189,1	151,97	131,19	20,78	37,13
December	26,78	254,22	140,68	132,36	8,32	113,54
YEAR	27,28	1563,165	1874,87	1104,40	770,47	475,70

With the two seasons being well defined, the real evapotranspiration (ETR) accompanies the annual rainy season and reached a total of 1104.40 mm. Potential evapotranspiration (ETP) reached an average total of 1874.87 mm and is directly associated with high average monthly temperatures. In Figure 3 we observe that in six months there was an excess of water and in the other six months there was a water deficit, because the potential evapotranspiration is greater than the actual evapotranspiration. In the rainy season, which occurs from October to April, rain replaces the water in the soil, with the reposition occurring specifically in the months of November and December, when the period of water surplus begins, which totaled 475.70 mm. Taking into account the rainier months, January and February, Figure 3 shows that, according to the monthly soil water balance extract, soil saturation reached its maximum, with approximately 120 mm, which is 20% more than the 100 mm of CAD which are taken as the basis.

During the dry season, groundwater withdrawal occurred from May to July, with the beginning of the water deficit taking place from May to October, totaling 770.47 mm, with August and September being the most severe droughts, with the deficit going from 0 to -166.7 mm.

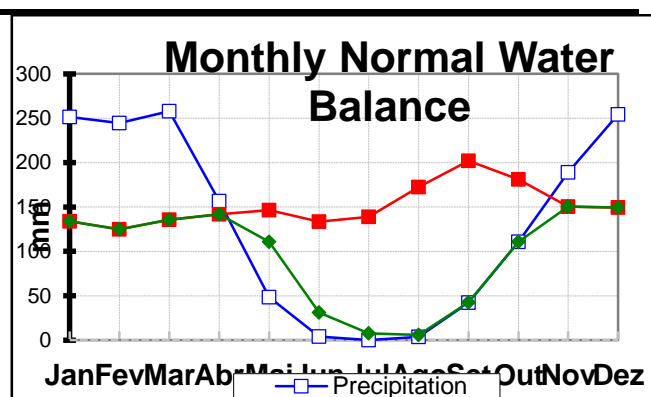


Fig. 2: Climatological Water Balance Chart for the municipality of Porto Nacional from 1997 to 2016.

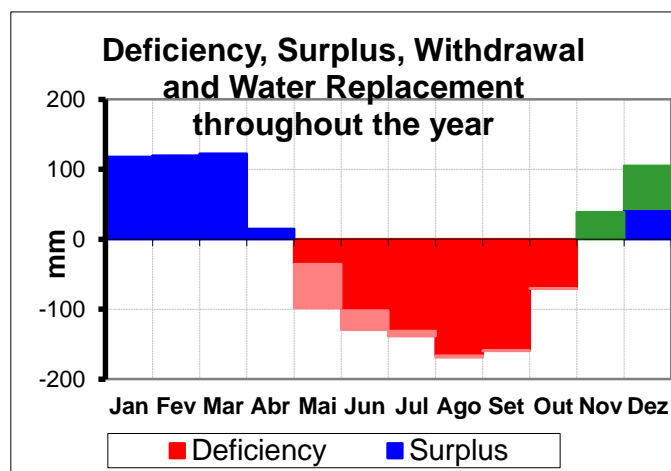


Fig. 3: Monthly Climatological Balance Sheet Extract from 1997 to 2016.

After the calculations of the climatological water balance, the water, dryness and humidity indexes were calculated using the tables in Torres & Machado (2012) by the method of Thornthwaite and Mather (1955), to obtain the climatic classification. The municipality under study obtained, respectively, the following results: IH = 0.72; IA = 41.09; and MI = 25.37.

The climatic classification for the municipality of Porto Nacional, in the state of Tocantins, according to the proposed method is from the "C2" type, with a water index of 0.72, classified as humid sub humid. As for the dryness index, which is a "W" type, the value was 41.09, which represents a moderate water deficiency in winter, with potential evapotranspiration higher than 1140 mm being classified as mega thermal, which is an "A" type, and a value of 1874.87 mm being found in the study period, which represents less than 48% of the total annual evapotranspiration, which is concentrated in the summer.

IV. CONCLUSION

Rainy and dry seasons for the Porto Nacional region are well accentuated by averages and precipitation anomalies in the annual period.

The rainiest months for the region are January, February and March and the least rainy is the month of August. Although the month of December is right in the middle of the months of the rainy season, it is characterized as period of reposition of water in the soil;

The water balance showed that the water reposition happens between the months of November and December, the water surplus occurs from December to April and the water deficit occurring from May to October.

The highest average temperatures contribute significantly for the annual total of the potential evapotranspiration exceeding the annual total of the puvliometric volume;

The climatic type of Porto Nacional is humid Sub humid, with two well defined seasons, rainy and dry, with the drought happening in the winter season in which it presents moderate and mega thermal water deficiency, with high annual values of potential evapotranspiration, with 28, 29% of this evapotranspiration concentrated in the summer season, being able to be defined by the formula as $C2wA'a'$.

With the average temperature of the rainiest month above $26.4^{\circ}C$, the annual average precipitation is 1563.165 mm with an annual average temperature is $27.28^{\circ}C$. These higher temperatures cause an increase in the consumption of water, both of the animals and of the human being and in the irrigation for the crops, causing a water deficit in the springs and consequently hydraulic problems in the sanitation and sanitary facilities in the municipalities, having as main problem the pressure oscillation, compromising the distribution of water in relation to quantity and quality.

REFERENCES

- [1] CUPOLILLO, F., ANTUNES D. A. (2013) Climatological Water Balance: Case study of the municipality of Governador Valadares – MG. Annals. XVIII Brazilian Congress of Agrometeorology.
- [2] Journal of Hyperspectral Remote Sensing. v. 2, p. 0250-036, 2012.
- [3] IBGE – Brazilian Institute of Geography and Statistics. Ministry of Planning, Budget and Management, Cities@, Brasília, 2017. Available at: <http://www.ibge.gov.br/cidadesat>. Access on 17/11/2017.
- [4] INMET. National Institute of Meteorology. Meteorological survey of the municipality of Porto Nacional from 1997 to 2016. INMET. Brasília, 2017.
- [5] MINISTRY OF AGRICULTURE AND AGRARIAN REFORM. National Secretariat of Irrigation. National Department of Meteorology. Climatological Norms (1961-1990). Brasília, 1992.
- [6] MOTA, L. L., BOTON, D., FONSECA R. C., SILVA, W. C., SOUZA, A. P. (2013) Climatic Water Balance and Classification of Climate of the Region Sinop, Mato Grosso State, Brazil. Scientific Electronic Archives. v. 3, p. 38 – 44.
- [7] ROLIM, Glauco de Sousa, SENTELHAS, Paulo Cesar (1999). Normal Water Balance by Thornthwaite & Mather (1955). Piracicaba. ESALQ. CD-ROM.
- [8] SOUSA, E. S., LIMA, F. W.B., MACIEL, G. F., SOUSA, J. P., PICANÇO, A. P. (2010) Water balance and climatic classification of Thornthwaite for the city of Palmas. Anais: Amazon and Global Climate. Brazilian Congress of Meteorology. Belem, PA.
- [9] Thornthwaite, C.W. 1948. An approach toward a rational classification of climate. *Geography Review* 38(1): 55-94.
- [10] Thornthwaite, C.W.; Mather, J.R. 1955. *The water balance*. Publications in Climatology. New Jersey: Drexel Institute of Technology, 104p.
- [11] TORRES, F. T. P., MACHADO, P. J. O. (2012) Introduction to Climatology. São Paulo: Cengage Learnig.

Study, Design and Test of a LENZ-type Wind Turbine

André Heiji Nishioka, Odenir de Almeida

Experimental Aerodynamics Research Center (CPAERO-UFU), School Mechanical Engineering, Federal University of Uberlandia, Uberlandia, Brazil
Email: odenir.almeida@ufu.br

Abstract— The current concern about reducing dependence on fossil fuels and issues about environmental conditions have guided the survey for renewable energies around the world. The present work was focused in the study, design, construction and laboratorial tests of a small-size vertical-axis wind turbine (VAWT) of Lenz-type. The wind turbine was chosen based on criteria of operation in turbulent winds and mainly due to low-cost of fabrication and possibility to use it in farms. The study was carried out in the description of wind resources in a specific area from countryside of Brazil. The Lenz turbine was designed, drawn, built and later tested in a low-speed wind tunnel. Experimental data were gathered to describe the characteristics of the prototype and to guide for further modifications to improve wind power efficiency.

Keywords—Environmental, Lenz turbine, Renewable energy, Wind turbine, Wind tunnel.

I. INTRODUCTION

The wind power usage is not new in terms of human history. Wind power extraction and conversion into electric energy has increasingly evolved in the last decades, mainly after the petrol crisis in 1970s. The survey for renewable sources of energy has led to different types of mechanical designs and wind turbines of distinct shapes.

Another important aspect about wind power is the increase awareness of government and worldwide population about environmental conditions and the scarcity of fossil fuels.

In Brazil, due to the natural abundance of water resources and relatively low cost for production of electrical energy, the main energy matrix is substantially based on hydroelectric. The Brazil power generation by source in the new polices scenario could be summarized in Fig.1, according to Al-Saffar (2014).

Nevertheless, the recent water crisis which Brazil has faced in the last years (2014/2015) led to the need of diversification in the energy matrix, since the country has potential to use solar powerplants and wind power extraction by use of large field of wind turbines.

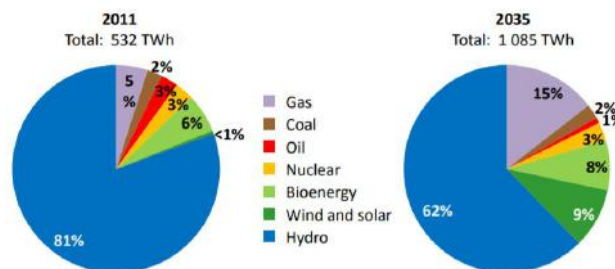


Fig. 1: Brazil power generation by source – Al-Saffar (2014).

According to Global Wind Energy Council (2016), Brazil has one of the best wind resources in the world. Also, it has been identified an expressive increase in wind energy production in Brazil in the last decade, allowing the country to be positioned among the top 10 countries that generate the most wind energy in the world – fig.2.

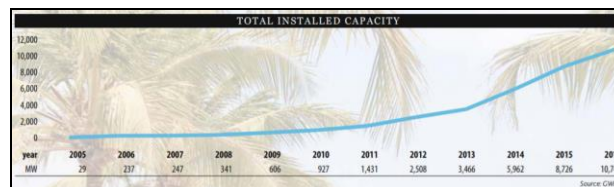


Fig. 2: Total installed capacity of wind energy in Brazil. Source: GWEC, 2016.

The northeast region in Brazil is where the country's largest wind potential is concentrated. For this reason, the largest number of wind turbines is installed at that location. Trade wind, large oceanic cover without obstacles and sea breezes are other important features which makes this region attractive for investment in the sector. Fig.3 illustrates the magnitude and wind distribution in Brazil's territory, according to the Brazilian Wind Energy Center (CBEE – Centro Brasileiro de Energia Eólica).

Other states like Santa Catarina and Rio Grande do Sul show potential for expanding the current wind powerplants. However, great part of Brazil of has wind velocities below 5 m/s, making difficult the power extraction at that speeds.

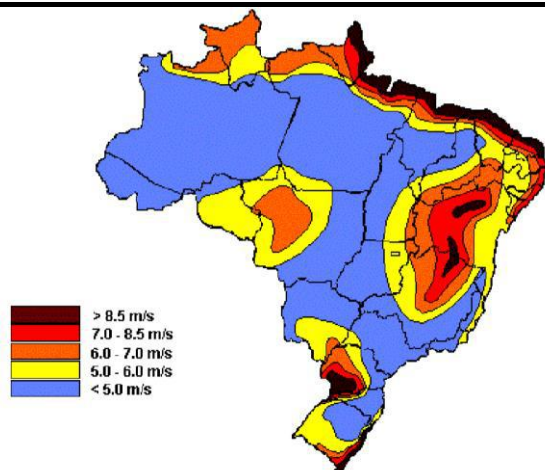


Fig. 3: Contour map for wind velocity distribution in Brazil. Source: CBEE, 2008.

Given the current context for the search for renewable energy sources and the high Brazilian wind potential, the current work was proposed to study, design and test a vertical-axis wind turbine (VAWT) of Lenz-type. The choice for this model was based in some characteristics as for instance, the possibility of operation in urban and rural areas, which in Brazil constitutes a market still not explored yet. Other aspects such as low-cost and reliability were also considered. After the conceptual study, the prototype was sized and 3D-designed in CAD. The wind turbine was built, and experimental tests started in a low-speed wind tunnel at different wind speeds to extract the mechanical power and electrical capability of the wind turbine prototype. All the data gathered is being used to promote further improvements in the prototype and to enhance the wind power extraction and conversion. Further steps are planned towards the fabrication of a specific generator for this VAWT.

II. VERTICAL-AXIS WIND TURBINE (VAWT)

It is well known that VAWT is a type of wind turbine where the main rotor shaft is set transverse to the wind. One of the advantages of this type of wind turbine is the location of generator and gearbox that could be placed close to the ground helping maintenance issues. Other positive aspects are related to omni-directionality, that means they do not need to track the wind, and the possibility of operating at low velocities and/or with turbulent and gusty winds. Another favorable point is the low-cost of fabrication and the capability of increasing the generated power per unit of land area, making it ideal to be installed on a wind farm in countryside of Brazil. Fig. 4 illustrates one of the VAWTs, most commonly called Darrieus-type.

It is possible to find different applications for Darrieus-type wind turbines. However, a lot of disadvantages are

seen for making it available at large size. Also, its efficiency is around 30% and there are major difficulties in protecting the Darrieus turbine from extreme wind conditions and in making it self-start.



Fig. 4: Vertical-axis wind turbine – Darrieus-type. Source: Wikipedia, 2018.

Savonius-type wind turbine is another possibility. Even though they have low efficiency, they are often used because its low cost and high durability. Due to high torque on the rotating shaft, one of the applications is water pumping.

Based on Darrieus and Savonius-type wind turbine, Edwin Lenz proposed a different kind of mechanical device, combining aerodynamic lift force and drag actions in the rotor airfoils or turbine's blades – Fig.5.

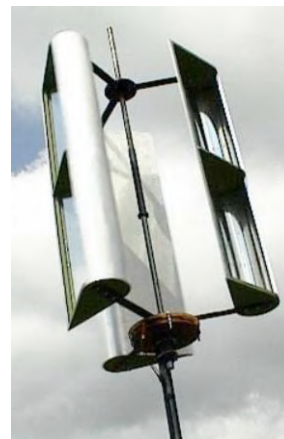


Fig. 5. Example of a Lenz-type wind turbine (Lenz, Edwin).

Advantages of Lenz-type wind turbine are related to low-cost of fabrication due its simplicity, robustness, reliability, possibility of working with low speed winds, easier self-starting and possibility of higher efficiency when compared to Savonius, crediting to this design the capability to be installed in farms and houses in countryside Brazil.

III. DESIGN AND CONSTRUCTION

One of the design restriction for this Lenz-type VAWT was the size of the exit nozzle from the wind tunnel, where the turbine was tested. In this work, the size was $h = 0.6$ m. According to this limitation for testing the final prototype, the wind turbine height was assumed $H = 0.6$ m. To keep a swept area below 0.30 m^2 the wind turbine radius was determined by the following equation:

$$A = 2R \times H \quad (1)$$

Thus, the wind turbine radius was $R = 0.225$ m. The aspect ratio of the VAWT could also be calculated based on radius and height, according to:

$$AR = 2R / H \quad (2)$$

The shape of the blade was kept according to the original's Lenz vertical axis turbine recommendations, as visualized in Fig. 6, where R is the wind turbine radius, W_c is the wind turbine chord and W_w is the wind turbine width.

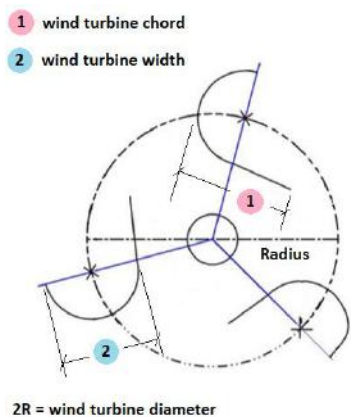


Fig. 6: Wind turbine sizing - sketch.

The final sizing of the Lenz-type VAWT gave the following shape for the 3-blades design, as illustrated in Fig. 7.

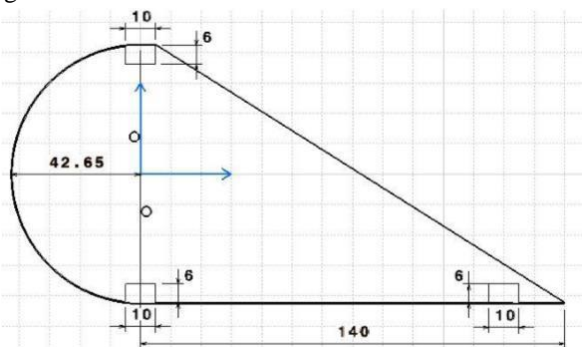


Fig. 7: Final shape of the wind turbine blade (dimensions in mm).

As discussed in literature, Gohil and Patel (2014), 3 blades are most preferred and most applicable for wind turbine rotors. A few troubles are related to the use of 2 blades, which are noisier when compared to designs with 3 or more blades, imbalance of the wind turbine that

could lead to rattle, difficult to self-start and discontinuous spin, among others.

The pitch-angle for the blade was kept closest to 9° according to the recommendations from the Lenz's design. Table 1 summarizes the prototype's design parameters for the Lenz-type wind turbine built in this work.

Table.1: Summary of VAWT's design parameters.

Parameters	Current Value
Aspect ratio	0.75
Diameter	450 mm
Height	600 mm
Wing width	85.3 mm
Wing chord	182.65 mm
Frontal area	0.27 m^2
Pitch angle	$\sim 9^\circ$

Fig. 8 illustrates the final prototype CAD's design and photo of the Lenz-type VAWT, to be tested. The entire cost of fabrication for the prototype of this small-size wind turbine was around \$90,00 (ninety American dollars) and took not more than a week for being completely assembled.



Fig. 8: 3D-drawing and photo of the Lenz-type VAWT.

IV. EXPERIMENTAL TESTS

The experiments were carried out with the use of a $60 \times 60 \text{ cm}^2$ wind tunnel (WT) at the Experimental Aerodynamics Research Center (CPAERO) from Federal University of Uberlandia, Brazil, shown in Fig. 9. Flow momentum was generated by a rotor of 12 blades driven by a 25 hp electrical engine. The maximum air speed in the tunnel test section is approximately 30 m/s with minimal blockage.



Fig. 9: Lenz-type turbine under tests.

As the wind turbine was designed to not exceed 60 cm in height, it was placed at 1 chord-length from the wind tunnel test section exit, as demonstrated in Fig. 9. Wind tunnel power-up conditions were set for velocities of 5, 6, 7, 8, 9, 10, 10.8 and 11.7 m/s with different resistive loads (R_c) applied in the electrical system as 14.7, 12, 9, 6 and 3 Ω (ohms), making the total test matrix with 40 points. To evaluate the shaft mechanical power, it was necessary to use a DC generator and a resistive load, as sketched on Fig. 10. The DC generator was energized, and the resistive loads were applied in the circuit as seen below:

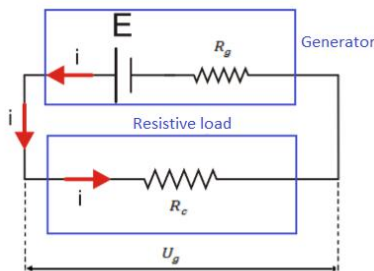


Fig. 10: VAWT's electrical circuit sketch.

The experimental evaluation was carried out by setting the wind tunnel speed measured by a Pitot-tube installed in the test-section. Confirmation for the averaged flow velocity was assured at the WT nozzle exit by a portable digital anemometer. With the flow velocity adjusted, the Lenz-type self-started and was kept steady for a while. After the stabilization of the system, the resistive load was then adjusted, according to the test-matrix. The wind turbine revolutions per minute (rpm) started to decrease and stabilized again. Then, the rpm was measured by a digital tachometer in the main shaft of the VAWT. A mean of three measurements were taken for the main shaft's rpm and this value was assumed to be the correct output. Figure 11, illustrates the electrical system, mainly the rheostats used to adjust the resistances in the circuit.

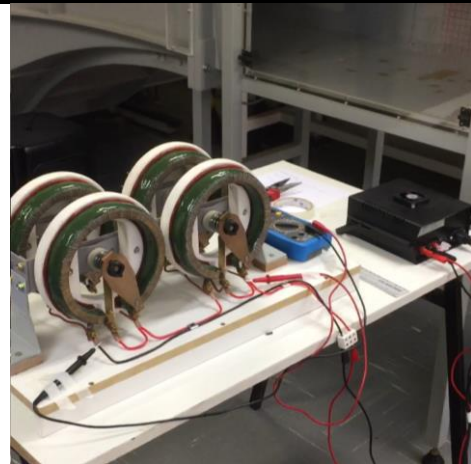


Fig. 11: Lenz-type turbine under electrical tests.

As measurement procedure for the electrical system, first the voltage in the generator was gathered to calculate the electric output power (P_g). After, by measuring the electric armor resistance (R_g) the dissipated electric power (P_d) could be calculated. At the end, the mechanical power of the prototype shaft (P_m) is equal to the electric input power (P_e) that is the sum of the electric output power and the dissipated electric power (P_d):

$$P_m = P_e = P_d + P_g \quad (3)$$

The mechanical efficiency of the wind power (η_m) is given by the relationship between the available mechanical power in the shaft and the wind potential (P_w) for each wind tunnel speed.

$$\eta_m = P_m / P_w \quad (4)$$

For this specific design the maximum power of wind energy has been estimated from the equation:

$$Power_{max} = (0.5929) \times (1/2) \rho A V^3 \quad (5)$$

where the factor 0.5929 is the maximum power that can be extracted from any kind of wind turbine, according to the Betz theory. For a mean and local wind velocity of 6 m/s the maximum power of wind energy calculated was:

$$Power_{max} = 21.18 \text{ Watt} \quad (6)$$

V. RESULTS

From the data gathered for the different wind tunnel velocities, the mechanical power as a function of resistive loads and revolution per minute (rpm) could be evaluated. Fig 12 illustrates the surface 3D-plot showing the data.

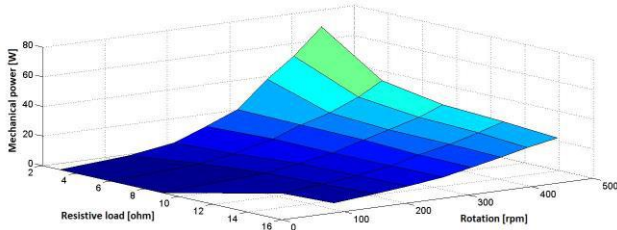


Fig. 12: Surface 3D-plot of mechanical power as a function of resistive load and revolution per minute.

The results in Fig. 12 show the increase in the mechanical power as the wind turbine rotation is augmented while the resistive load is decreased. The peak in the mechanical power close to 73 Watts was reached when the revolution was 420 rpm and the resistive load equal to 3 Ω. At this point, the mechanical efficiency (η_m) reached the maximum value of approximately 28%.

The 2D-plot for the mechanical power as a function of shaft rotation is presented in Fig. 13, for the different resistive loads employed in this work. As expected, for a given shaft rotation, the mechanical power is decreasing as the resistive load is augmented.

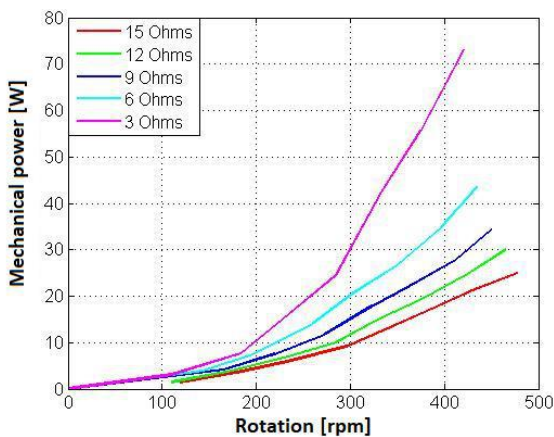


Fig. 13: Mechanical power as a function revolution per minute at different resistive loads.

Fig. 14 presents the variation of mechanical power as a function of the shaft rotation for different wind speeds tested in the wind tunnel. The results were consistent with the theory as the power is proportional to the cube of wind speed.

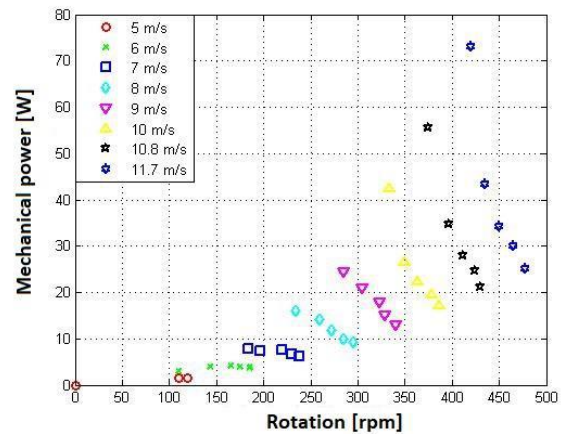


Fig. 14: Mechanical power as a function revolution per minute at different wind speeds.

To illustrate the mechanical power generated by the wind turbine, the output electric power of the generator and the maximum wind potential were represented in Fig. 15. It is possible to verify that the wind turbine reached 75 Watts of mechanical power while the electric generator gave around 13 Watts of useful electrical power. This low value for the electrical power was attributed mainly due the nature of the electric generator utilized in this experiment which was designed for operation at higher shaft rotation. In this case, it is believed that most of the energy produced was internally dissipated.

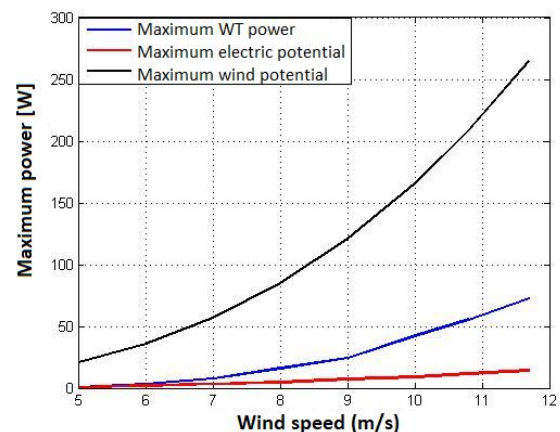


Fig. 15: Mechanical power as a function revolution per minute at different wind speeds.

The mechanical power coefficient as function of the wind speed is presented in Fig. 16 for different electric loads tested. For loads below 15 Ω the maximum power coefficient was around 9 m/s (peak value) decreasing afterwards. One of the reasons for this decaying in the power coefficient maybe attributed to the loss in aerodynamic efficiency due to the interaction of the blades and the wind flow. For safety reasons no tests were carried out for speeds above 12 m/s.

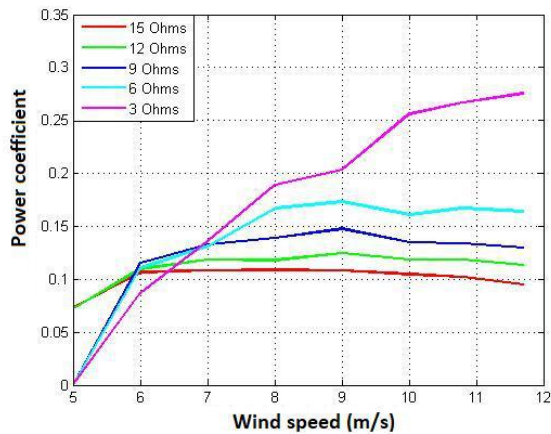


Fig. 16: Power coefficient as a function of wind speeds at different resistive loads.

For wind tunnel speeds below 5 m/s and with resistive loads of 3, 6 and 9 Ω the wind turbine was not self-started. Without resistive loads the wind turbine self-started at 4.5 m/s.

At least two important drawbacks of this design should be mentioned herein, which are attributed to the quality of bearings used and the power of the generator used for qualifying the electrical system. It is believed that the conjunction of these two factors had decreased significantly the power coefficient for values close to 27%. Other works in literature have listed values of order 30 – 40%. Thus, this point out towards further improvements in the current wind turbine.

VI. CONCLUSION

In this work a conceptual study on Lenz-type wind turbines (VAWT) was carried out. After, the design and construction of a small-size vertical-axis wind turbine was accomplished. The Lenz-type wind turbine was considered due to its low cost, durability and averaged efficiency when compared to others VAWT's like Darrieus and Savonius-type. With a very low-cost, below \$100,00 (US American dollars), the VAWT was completely assembled very quickly, once the design was finished. Laboratorial tests, by using a wind tunnel, have shown important results for the mechanical power and power coefficient for the wind turbine. The mechanical power with a resistive load of 3 Ω reached around 73 Watts and the functioning of the wind turbine was quite safe up to wind velocities around 11 m/s. Despite some losses in the bearings and in the electrical generator, the Lenz-type wind turbine showed potential for use in areas with low winds in countryside of Brazil, such as farms or even in small urban centers.

ACKNOWLEDGEMENTS

This work was supported by the Experimental Aerodynamics Research Center – CPAERO at Federal University of Uberlandia.

REFERENCES

- [1] Al-Saffar, Ali (2014). Brazil Energy Outlook. International Energy Agency, from <https://www.iea.org/>
- [2] GWEC (2016). Global Wind Report – Annual Market Updated. Retrieved from <http://gwec.net/publications/>
- [3] CBEE (2008). Centro Brasileiro de Energia Eólica. Retrieved from <http://www.cresesb.cepel.br/>
- [4] H. P. Gohil, S.T. Patel (2014). Design Procedure for Lenz Type Vertical Axis Wind Turbine for Urban Domestic Application, International Journal for Scientific Research & Development, vol.2, Issue 3, (ISSN 2321-0613), pp.1609–1613.