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Evaluation of Water Quality of the Urban Supply Reservoir in the Municipality of Porto Nacional - Tocantins

Morgana Portilho Barros[1], Diogo Pedreira Lima[2], Ângelo Ricardo Balduíno[3]

[1] Academic of the Civil Engineering course - Instituto Tocantinense Presidente Antônio Carlos
[2] Research Teacher, Master in Environmental Engeenering– Instituto Tocantinense Presidente Antônio Carlos
[3] Research Teacher, Master in Environmental Sciences – Instituto Federal do Tocantins

***Abstract*—** *In the city of Porto Nacional – TO the only source of water supply is the São João River, and for this reason it is so important the preservation of this important natural resource that supplies this municipality. Based on this information, this work was developed to verify the water situation regarding the levels and amount of pesticide that is found in the sediments of this dam. Thus, the general objective is to analyze the water quality of the urban supply reservoir in the municipality of Porto Nacional - TO. And from this general goal, some specific objectives are outlined, such as identifying the multiple uses of water and analyzing the presence of glyphosate agrotoxic in the sediments. Therefore, the values obtained in the study should be correlated with the standards determined by the environmental legislation and technical literature, to verify the presence of glyphosate agrotoxic. The research to be performed will use the gas chromatographic method.*

***Keywords* — Sediment; Glyphosate; Agrotoxic.**

I. INTRODUCTION

Water is a natural and very essential resource for the origin and preservation of life, and although renewable, on the last couple of years a great deal of concern has been expressed regarding water scarcity, as water is losing the capacity for self-purification.

Many sources of water are already exhausted by now because of misuse. To paraphrase Umetsuet.al (2012 p.92) the environment is immensely subordinate and helpless to changes in hydrological conditions.

With complexity, but with subjectivity, it is important to realize that "socio-environmental responsibility can be generated in all places where there is human activity" (LUIZ et al. 2009 p.141).

However, because of the great increase in the world human population, negative environmental impacts are observed as a result of the degradation of natural resources and the accumulation of residues, evidencing threats to the sustainability of human life, compromising natural resources through pollution (punctual and diffuse form).

The agricultural activity appears as one of the responsible for the degradation of the waters, both superficial and underground. Precisely because primary vegetation is replaced by large plantations and by the use of pesticides used to improve and maintain them. Without the primary vegetation the pesticides are adsorbed by the soil, and when there is precipitation, they are taken directly to the water source.

In the study area in question, glyphosate is the most widely used pesticide, because it is very efficient in combating insects, fungi and weeds, in addition to combating pests, it still helps in the growth of plants.

Queiroz et al. (2011) states that although glyphosate is cited as the world's best-selling agrochemical and has great efficiency in pest and disease control, there is evidence of its environmental degradation, such as destruction of animal habitat, pollution of rivers and, in humans, health related problems such as pulmonary edema and respiratory distress.

The river basin of the São João River, which is located in the municipality of Porto Nacional - TO, is currently its only source of urban supply through surface capture. With the growing increase in agricultural production in the region, the question arises whether the water conditions of São João River are still suitable for use, mainly for the capture and supply of the population, and if there are residues of pesticide glyphosate present in the sediment of the supply dam.

Thus, this study has the purpose of analyzing the water of the reservoir and determining the concentrations of glyphosate agrotoxic present in the sediments of the supply dam of the São João river basin, municipality of Porto Nacional - TO.

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II. MATERIAL AND METHODS

STUDY AREA

The river basin of the São João River is located in the central region of the state of Tocantins, in the municipality of Porto Nacional, which is in a distance of 63 km from Palmas, the state capital.

According to SILVA (2010), the hydrographic basin of São João River (Figure 01) is located between the parallels 10 ° 46'43 "and 10 ° 41'20" south latitude and between the meridians 48 ° 14'16 "and 48 ° 24'51 "west longitude, in the southeast portion of the municipality of Porto Nacional.

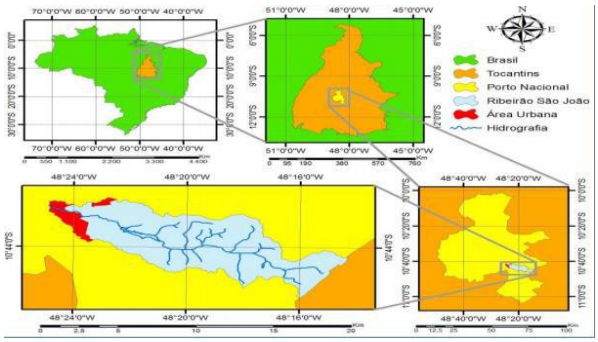

Fig.1: Map of the location of the São João Ribeirão Basin.

Source: SILVA (2010)

The economy of the municipality of Porto Nacional is the fourth largest in the state of Tocantins, located in the geographic center of this state, in the eastern mesoregion, with an average altitude of 212 meters above sea level, a surface of 4,449.9 km² and coordinates 10 ° 42'29 "latitude and 48 ° 25'02" west longitude.

Porto Nacional has an estimated population of 52,510 inhabitants (IBGE, 2016). According to the Ministry of Agriculture and Agrarian Reform (1992), the predominant vegetation is the savannah, the climate is typically tropical, with an annual average temperature of 26.1ºC and an annual rainfall average of 1,667.9 mm. The rainy season occurs between October and April, corresponding to about 80% of annual rainfall, while the dry season corresponds to the months of May to September (MUNICIPAL COUNCIL OF PORTO NACIONAL, 2007).

São João River has its source in the rural area, at Pilão Farm, following the municipality of Porto Nacional, crossing several rural properties and some neighborhoods of the city, with its mouth in the Tocantins River.

POPULATION AND WATER SAMPLE

For the study in the river basin of São João River, the sample unit was delimited and identified. The climatic regime is characterized to better understand the characteristics of the genesis and the climatic dynamics by the pluviometric variations. The choice of the collecting points was defined from a good interaction related to the preservation and conservation of riparian forest, allowing the bathymetry to determine the point for sediment collection for the analysis of glyphosate agrotoxic residue in the sediment after sampling were detected by GC/MS (Gas chromatograph with mass detector). The samples were collected in the sampling unit at the Porto Nacional water supply dam in the rainy season, where the highest sediment load occurs in the water source.

A satellite image was used to better understand the processes that occur in the vicinity of the studied watershed for quantification and qualification of the sampling unit.

FIELD METHODOLOGY

For the analysis of the glyphosate agrotoxic concentration the bottom sediment was collected in the water supply reservoir, which were performed using the Pertesen type sampler.

- Sampling point:
- Latitude -10°43'04.52''
- Longitude - 48°22'19.77''
- located in the reservoir of Porto Nacional - TO.

SAMPLE COLLECTION

The collection of the bottom sediment samples was performed using the Pertesen type sampler, which consists of two buckets that close together when touching the river bed, due to a bar device, to collect an upper layer of the material.

The collected bottom material samples containing slightly wet sediment were usually packed in plastic sacks and sent to the IFTO laboratory (Instituto Federal Tocantinense) for sediment analysis.

TEST PERFORMANCE

a) Sample preparation - (NBR 6457/2016):

The sample was prepared for the characterization tests with the previous drying method of the sample material

b) Sedimentation:

I. The material was passed through the 2.0 mm sieve, about 120 g, for sedimentation and fine sieving;

II. The material was transferred to a beaker, along with a deflocculant (sodium hexametaphosphate solution) and then stirred until all material was immersed. Soon after the material was rested for 12 hours;

III. The material was transferred to the dispersion cup. Distilled water was added until the level was 5 cm below the edges of the beaker, then it was subjected to the action of the dispersing apparatus for 15 minutes;

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IV. The mixture was transferred to a graduated cylinder, completed with distilled water to a 1000 ml level, then stirring the soil/water mixture;
V. The densimeter (figure 10) was read at 30s, 1 and 2 minutes, 4, 8, 15 and 30min, 1, 2, 4, 8 and 24h.
VI. After the last reading, the material of the beaker was placed in the 0.075mm sieve, then the sample was washed in the sieve with low pressure drinking water, removing all material from the sides.
c) Fine Screening
The material retained in the 0.075 mm sieve was placed in the oven at 105 ° C to 110 ° C for 24 hours after leaving the oven (Figure 11). The material was washed to the mechanical stirrer to pass through the sieves of 1.2,0.6, 0.42, 0.25, 0.15, 0.075mm. The results were registered with a resolution of 0.01g in the retained mass accumulated in each sieve.
LABORATORY ANALYSIS

Glyphosate was detected by GCMS (Gas Chromatograph with mass detector) using capillary columns containing several stationary phases and the use of selective detectors, following the standards according to Standard Methods (APHA, 2005).

Considering that Gaseous Chromatography is currently the most used technique for the characterization of pesticides. The limitation of this technique is that it requires the sample to be thermally stable and volatile.

The collected sediment was analyzed by the equipment, identified and quantified the presence of glyphosate in the sediment of the Hydrographic Basin.

Equipment used were:

- Chromatographic System Reservoir. The most commonly used gases are H2, He and N2, which are contained in cylinders under pressure; the flow of the entrainment gas, which must be controlled, is constant during the analysis.
- Sample Introduction System. In Gas Chromatography, the injector (or vaporizer) is the place where the sample is introduced. Where solid samples are present, they may be dissolved in a suitable solvent. In order for the sample to completely volatilize, the injector must be at the boiling temperature of the sample, so the sample is charged to the column, when the temperature is higher than the boiling point the sample may decompose. The sample should enter the column in the form of a narrow segment to avoid the widening of the peaks;
- Chromatographic Column and Column Temperature Control. After passing through the sample introduction system, the sample is introduced into the chromatographic column, where the separation is carried out. The analysis is done as a function of the time the substance passes through the chromatogram. What makes it possible to analyze the quantity is that the substances present in the apparatus as peaks with area proportional to their mass.
- The detector quantifies and indicates what comes out of the electronic treatment column and purifies the noise for better analysis;
- Signal recording: Analyzes and evaluates the data obtained in the process.

The results obtained in the laboratory analysis of the agrochemical will be presented below.

III. INDENTATIONS AND EQUATIONS

ENVIRONMENTAL IMPACTS

To ensure environmental protection, it is important to maintain at least the water quality parameters within pre-established limits. In Brazil this regulation is based on Resolution No. 357 of CONAMA - National Environment Council (Brazil, 2005) and Order No. 2914 of the Ministry of Health (Brazil, 2012), which provide for the maximum permissible limits. In the absence of information on the chemical groups of pollutants in water, limiting values are sought in international legislation, such as those of the United States Environmental Protection Agency (USEPA, 1995) and the European Union (CEE, 1980).

PERMISSIBLE QUANTITY LIMITS OF GLYPHOSATE

According to the CONAMA Resolution 357/2005, the limit of the organic substance glyphosate in fresh waters is of 65 µg/L, and the Ministry of Health (Brazil 2012) states that for this purpose the limit quantity is 500 µg/L. However, international parameters such as the United States Environmental Protection Agency (USEPA) define the limit as 700 µg/L as the maximum value of the substance glyphosate in potable water. As for the European Union (CEE, 1980), the established value is 0,1 µg/L for any pesticide. Currently in the European Union there has been a ongoing discussion regarding the prohibition of the commercialization of the herbicide in all of its Member States.

The active substance of the glyphosate did not present sample values superior then the ones stablished by the CONAMA resolution (2005). The chromatography test showed that in the sediment in the bottom of the São João River contained in the average of a 5-months period of mg/l is of 0.038.

The collection was carried out during the non-rainy period corresponding to the months of August and September, and rainy in the months of October,

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November and December, with the months of October and November corresponding to the months of application of glyphosate in the field, Queiroz et al. (2011), states that the substance is present about 60 days after dispersion in surface waters where the herbicide can be adsorbed in the sediment and is therefore a long term contamination factor and not expected to detect any amount of the agrochemical.

Table 1- Results of glyphosate detection analyzes.

RESULTS OF GLIFOSAT ANALYSIS		
MONTHS	UNIT	RESULT
AUGUST	µg/L	0.03
SEPTEMBER	µg/L	0.03
OCTOBER	µg/L	0.06
NOVEMBER	µg/L	0.06
DECEMBER	µg/L	0.07

Table 2 – Permissible quantity limits of the glyphosate.

PERMISSIBLE QUANTITY LIMITS OF GLYPHOSATE		
PARAMETERS	UNIT	RESULT
Result Chromatography	µg/L	0.038
CONAMA 357/2005	µg/L	65
Ministry of Health	µg/L	500
United States Protection Agency (USEPA)	µg/L	700
European Union (CEE 1980)	µg/L	0.1

According to Marcus Vinicius (2018), the amount of agrochemical glyphosate present in the bottom sediment of the São João river stream barrage, which was collected in the dry season and about five months after the application of glyphosate in the crop was of 0.01 µg/l., when comparing with this research that the result was of 0.038 µg/l it´s possible to see that they were different, but not very relevant, because although this research was carried out in different months of the previous research, in the rainy and dry season, none of the two results presented in the samples values higher than the limits established by resolution 357 of CONAMA (2005).

IV. CONCLUSION

The results obtained in the period under study regarding the presence of glyphosate agrotoxic in the bottom sediment of the supply dam of the São João river stream, allow the following conclusion:

The results obtained in the period under study regarding the detection of agrochemical glyphosate did not present in the sample values higher than the limits established by resolution 357 of CONAMA (2005).

The results indicate that the collections were carried out before and after the application of glyphosate in the crop, and the results detected in the samples were below the limits established by the legislation; however, it is a factor of cumulative long term contamination in the sediments, and preventive and preservation measures must be adopted in the management of the water resources of the São João river basin.

As a preventive measure it can be adopted the terracing system, which on agricultural land is one of the most used practices for the control of water erosion. Terraces are structures composed of a dam and a channel, arranged transversely according to the declivity of the terrain, forming physical obstacles to reduce the speed of the surface runoff, but this is a subject that suggested for the next works.

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REFERENCES

[1] APHA. Standard Methods for the Examination of Water and Wastewater. 21st Edition, American Public Health Association/American Water Works Association/Water Environment Federation, Washington DC, 2005.

[2] BRASIL - Conselho Nacional do Meio Ambiente (CONAMA). Resolução CONAMA nº.357. Diário Oficial da União de 18/03/2005. Brasília, 2005.

https://dx.doi.org/10.22161/ijaers.6.5.28 *ISSN: 2349-6495(P) | 2456-1908(O)*

[3] BRASIL - Ministério da Saúde. Portaria MS nº. 2914/2012. Ministério da Saúde, Secretária de Vigilância em Saúde, Coordenação-Geral de Vigilância em Saúde Ambiental. Brasília: Editora do Ministério da Saúde, 2012.

[4] CEE. Directiva 80/778/CEE relativa a qualidade de águas destinadas ao consumo humano. Jornal oficial da comunidade europeia. Bruxelas, 1980.

[5] LUIZ, Leiliana. A. Casagrande. Economia e Responsabilidade Socioambiental; **Gestão Ambiental**ll/São Paulo:Pearson Prentice Hall, 2009.

[6] UMETSU, R. K.; PEREIRA, N.; CAMPOS, E. M. F. P.; UMETSU, C. A.; MENDONÇA, R. A. M.; BERNASCONI, P.; CAMARGO, M. F. Análise morfométrica e socioambiental de uma bacia hidrográfica amazônica, Carlinda, MT. ***Revista Árvore***, **Viçosa,** v. 36, n. 1, p. 92, 2012.

[7] QUEIROZ, G.M.P. et al. **Transporte de glifosato pelo escoamento superficial e por lixiviação em um solo agrícola**. Quim. Nova vol.34 no.2 São Paulo, 2011.

[8] SOUZA, M V V. CARVALHO, A C V. BRITO, C B BALDUINO, A Caracterização de Resíduos Químicos nos Sedimentos da Barragem de Abastecimento de Água no Ribeirão São João no Município de Porto Nacional, Tocantins. COBRAMSEG 2018