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Analysis of chemical variables in the water of the Córrego do Galante Watershed – SP

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SUMMARY

Population growth accompanied by inefficiencies in the management of sanitary effluents has been triggering adversities in relation to water quality. In view of the above, this work aims to analyze the concentrations of dissolved oxygen and biochemical oxygen demand in the water of the Córrego do Galante Hydrographic Microbasin - SP. Six strategic points were selected to carry out the research, each with its own characteristic, totaling eight collections of water samples, between the months of December/2021 to July/2022. Taking into account the results of the work, it was necessary to carry out an analysis of two chemical variables, which followed specific methodologies. Regarding the Dissolved Oxygen (DO), it was determined by the spectrophotometry methodology of HANNA Instruments, as for the Biochemical Oxygen Demand (BOD), it followed the method described in the Standard Methods for Examination of Water and Wastewater. The lowest DO concentrations obtained were recorded in the Dec/2021 and Jan/2022 periods. In general, over the period studied, the BOD resulted, for the most part, in values outside the limits established by legislation. The period Feb/2022 for point 1 – east – resulted in a concentration of 181 $mg.L^{-1}$. It is concluded that the Córrego do Galante Watershed is an example of an environment that has been supporting constant anthropogenic impacts, being able to confirm this state through the OD and BOD variables. Among the negative factors, those that most influence the variations in concentrations are the release of sanitary effluent and urban drainage.

KEYWORDS: Sanitary effluents. Water quality. Anthropogenic impacts.

1 INTRODUCTION

Seen as an essential element for the maintenance of life on Earth, water is the resource that establishes means for the development of the daily activities of human beings, being present in domestic tasks, farms, industry, transportation, leisure, and last but not least, in the preservation and conservation of fauna and flora (VON SPERLING, 2005; NOORI et at., 2019; RIBEIRO et al., 2022).

Water resources, despite being so important and indispensable, have been suffering serious problems with regard to pollution and contamination (PESSOA *et al.*, 2018; MORAES *et al.*, 2021). The factors that are associated with these imbalances are, in general, population growth, poor management of sanitary effluents and urban drainage, in addition to natural interference such as climate variation, weathering of the predominant rocks, soil dissolution, among others (VON SPERLING , 1996; SIMIONATTO; CARVALHO, 2022).

Based on this context, the water quality of a watershed is the result of natural or anthropogenic conditions (RAGASSI *et al*., 2017; MANOEL *et al*., 2019). Thus, the monitoring of physical, chemical and biological conditions becomes necessary, as it aims to institute measures that stop damage to the aquatic environment and human health (SARDINHA *et al*., 2008; SILVA JUNIOR *et al*., 2017).

Given this, organic matter is a parameter that makes it possible, through its evaluation, to establish degrees of pollution of a water resource, as it enhances the presence of oxygen-consuming microorganisms (VON SPERLING, 1996). With this, it is possible to obtain, through chemical analysis, results for the variables: Dissolved Oxygen (DO), which is the amount of oxygen present in the water resource; and Biochemical Oxygen Demand (BOD), defined by the amount of oxygen required for the oxidation of organic matter (RAGASSI et al., 2017; MANOEL et al., 2019).

The low concentration of DO is able to indicate the contamination of surface water by organic waste, such as domestic effluents (BASSO; CARVALHO, 2007; RAGASSI *et al*., 2017).

BOD, on the other hand, is an indicator that represents the potential for DO that may occur due to the stabilization of biodegradable organic compounds, and is therefore indispensable for works involving the phenomenon of self-purification (CETESB, 2008; MANOEL *et al*., 2019).

Thus, it becomes essential to analyze OD and BOD in the Córrego do Galante Watershed, since it is an example of an environment impacted by anthropic activities, among which the release of sanitary effluent and urban drainage are evident. These factors enhance the load of organic matter and aerobic microorganisms that consequently influence the degradation of the aquatic environment, making it inactive.

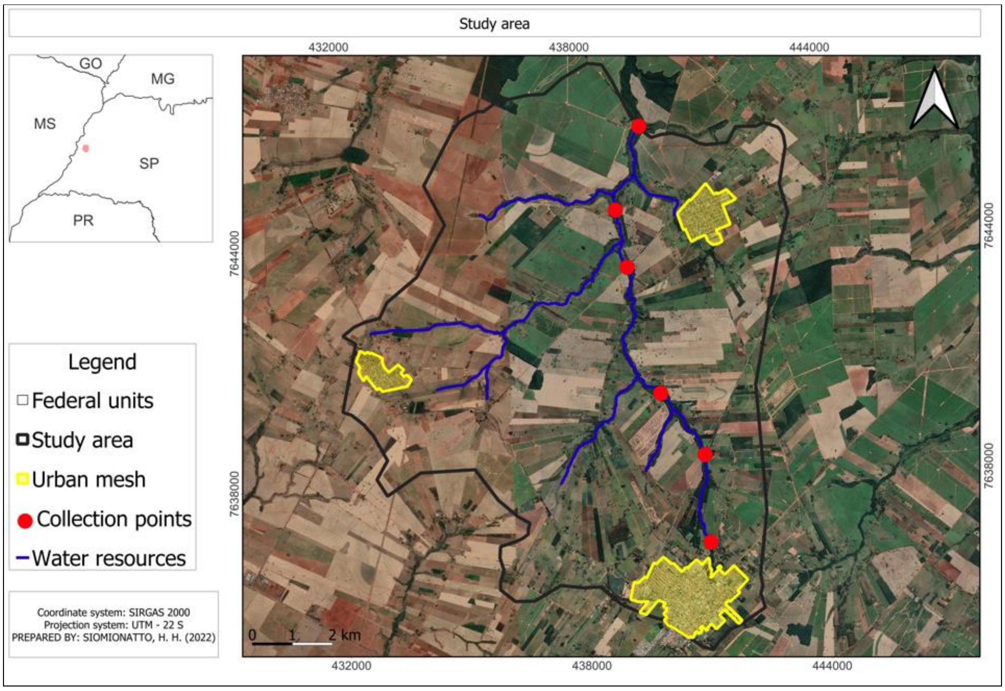
2 OBJECTIVE

This study aimed to analyze the dissolved oxygen concentrations and biochemical oxygen demand in the water of the Córrego do Galante Watershed - SP.

3 METHODOLOGY

The Córrego do Galante Watershed, with an area of 107 km², is located in the western region of the state of São Paulo between the geographical coordinates 21°17'11.24'' latitude S and 51°34'50.66'' longitude W (Figure 1). Its source is close to the urban perimeter of the city of Tupi Paulista and its outlet in the rural area of the city of Monte Castelo, on the Aguapeí River, an affluent of the Paraná River.

Figure 1: Location of the Córrego do Galante Watershed – SP



Source: The authors, 2022.

Six strategic points were selected for carrying out the research, each with its characteristic - Table 1 - totaling eight collections of water samples, between the months of December/2021 to July/2022.

Table 1: Description and geographic coordinates of the sampling points of Córrego do Galante Watershed – SP

Sampling Points	Location Description	Geographic Coordinates	
		Latitude	Longitude
P1	Spring	21°22'26.37"S	51°34'6.15"O
P2	Launch of the 1st and 2nd ETE – Tupi Paulista – SP	21°21'15.15"S	51°34'8.03"O
P3	Downstream of the 1st and 2nd ETE - Tupi Paulista - SP	21°20'23.86"S	51°34'44.23"O
P4	Amount to the affluent of Nova Guataporanga - SP	21°18'40.38"S	51°35'8.82"O
P5	ETE launch amount – Monte Castelo – SP	21°17'53.54"S	51°35'16.96"O
P6	River mouth	21°16'46.21"S	51°34'53.57"O

Source: The authors, 2022.

For each sampling point, 1L of surface water was collected, totaling six samples, for each month, which were stored in amber bottles and transported in thermal boxes to be analyzed at the Water Laboratory of the University Center of Adamantina (UniFai) - SP.

The collection and preservation procedure followed the methodology established by the Environmental Company of the State of São Paulo (CETESB, 2011).

Taking into account the obtainment of the results of the work, it was necessary to carry out the analysis of two chemical variables, which followed specific methodologies. Regarding Dissolved Oxygen (DO), it was determined by the spectrophotometry methodology of HANNA Instruments (2016), as for Biochemical Oxygen Demand (BOD), the method described in the Standard Methods for Examination of Water and Wastewater was used (ALPHA, 2017).

Table 2 details the methods and instruments used to determine the analysis presented.

Table 2: Methods and instruments used to determine DO and BOD

Variables analyzed	Method	Detection range	Equipment and materials
Dissolved Oxygen (DO)	Adaptation of Winkler's method	0.00 a 10.0 ($mg.L^{-1}$)	HI 83206 Environmental Testing Photometer
Biochemical Oxygen Demand (BOD)	Respirometric / Manometric - OXITOP - Incubated	0.0 a 200.0 ($mg.L^{-1}$)	Sensors/ Bottles/ BOD Incubator

Source: The authors, 2022.

It was based on these procedures that the values were obtained for each presentatio n of the results presented in this study.

4 RESULT

Tables 3 and 4 show the results obtained from the analysis of DO and BOD from water samples from Córrego do Galante - SP, together with the reference values of each variable according to CONAMA Resolution No. 357/05 for class 2 rivers, as is the case of Córrego do Galante (CETESB, 2022).

Table 3: DO concentrations in water samples from Córrego do Galante Watershed – SP

DO (mg.L $^{-1}$)							
Period	**Collection Points**						**Reference value**
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	
Dez/2021	2.4*	2.4*	2.7*	3.4*	2.2*	1.4*	**CONAMA Resolution No. 357/05 Not less than 5 mg.L $^{-1}$ O2.**
Jan/2022	0*	0*	0.77*	2.19*	0.27*	0.79*	
Feb/2022	0.1*	6.1	1.6*	6.5	6.2	5.7	
Mar/2022	1.2*	4.7*	5.4	6.4	5.9	4.5*	
Apr/2022	7.1	3.8*	6	7.3	6.5	5.4	
May/2022	7.4	2.9*	6.5	8.2	7.2	6.5	
June/2022	7.2	3.3*	7.1	7.7	6.8	5.9	
July/2022	7.6	3.2*	4.7*	7.7	7.2	5.8	

*: concentrations in non-compliance with legislation.
Source: The authors, 2022.

Table 4: BOD concentrations in water samples from Córrego do Galante Watershed – SP

BOD (mg.L $^{-1}$)							
Period	**Collection Points**						**Reference value**
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	
Dez/2021	125*	99.5*	46*	14*	14*	14*	**CONAMA Resolution No. 357/05 BOD 5 days at 20°C up to 5 mg.L $^{-1}$ O2.**
Jan/2022	23*	44*	25.5*	17*	20*	19*	
Feb/2022	181*	56*	21*	15*	15*	19*	
Mar/2022	33*	16*	10*	2	4	11*	
Apr/2022	26*	38.5*	16*	3	5	12*	
May/2022	19*	61*	22*	4	5.5*	11.5*	
June/2022	5	106*	12*	6*	7.5*	12*	
July/2022	3.5	64*	13*	6*	6.5*	9.5*	

*: concentrations in non-compliance with legislation.
Source: The authors, 2022.

The lowest concentrations of DO obtained through analysis of water from Córrego do Galante were recorded in the periods of Dec/2021 and Jan/2022. These values may be associated with some factors such as: leakage of domestic effluent, release of clandestine sewage, urban drainage, among other causes that favor the increase of organic matter, this way triggering the production of aerobic microorganisms that, consequently, through the breathing they demand, results in a DO decrease in the water (MEDEIROS et al., 2016; RAGASSI et al., 2017; RIBEIRO et al., 2022).

Regarding the improvement of DO concentrations, this can be observed at the beginning of the dry period, which according to the National Institute of Meteorology (INMET) classifies as a dry period, which varies between the months of April and September (INMET, 2022). Still taking into account the weather conditions, in the rainy season – December to March – resulted in 70.83% of the samples below the value established by law, leaving only 29.17% adequate to the stipulated value. However, analyzing the dry period – April to September – in the vast majority, 79.17% of the samples, accounted for values that meet the determined. Even if there had been an increase in precipitation in this watershed, it would not have been enough to improve the DO conditions in the analyzed stream during this period.

The improvement in DO concentrations is evident from points 4, 5 and 6, this occurs due to the increase in flow and the appearance of tributaries that feed the analyzed stream. The increase in DO in water is associated with rapids and waterfalls that intensify turbulence, causing reaeration or the introduction of atmospheric oxygen into the water resource (NOZAKI et al. 2014; RAGASSI et al., 2017).

In general, throughout the period studied, the BOD resulted, for the most part, values outside the limit established by law. As presented for DO, the periods that most extrapolated, in terms of concentration, were Dec/2021 and Jan/2022. This explains the disturbance between the variables, showing that lower concentrations of DO correspond, for the most part, to those with higher levels of BOD, demonstrating that the increase in biodegradable organic matter implies a decrease in DO in the water (RIBEIRO, 2022).

The period Feb/2022 for point 1 – spring – resulted in a concentration of 181 $mg.L^{-1}$ of BOD. This value may be associated with the release or even a large leak of sanitary effluent occurred because of the damage to the pipe, due to heavy rains in the microbasin.

For deterioration to happen in relation to the DO and BOD variables, it is enough to release sanitary effluent with low efficiency or even clandestinely, that is, without prior treatment, in a given water resource, generating, in most cases, undesirable damage to water quality. Consequently, resulting in an environmental imbalance, thus affecting humans and animals that consume or maintain contact with this water (SARDINHA et al., 2008; MANOEL et al., 2019). This way, a receiving body that maintained its balance starts to establish a certain disharmony, until it establishes self-purification that can be understood as a process of ecological succession, where the water resource reestablishes its balance through natural mechanisms, with a systematic sequence, in which one community is replaced by another, until the aquatic environment is in tune again (VON SPERLING, 1996; MANOEL et al., 2019).

5 CONCLUSION

It is concluded that the Córrego do Galante Watershed is an example of an environment that has been supporting constant anthropogenic impacts, which can be confirmed through the DO and BOD variables. Among the negative factors, those that most influence variations in concentrations are discharges of sanitary effluents and urban drainage. These conditions, required for the analyzed stream, lead to biotic inactivity in the aquatic environment, in addition to socio-environmental problems such as public health disorders and deterioration of the environment, degrading environmental balance and a healthy quality of life. Therefore, environmental monitoring is necessary, as in addition to being an indispensable instrument in a watershed, it quantifies and determines the anthropic effects, validating and providing the search for resources for effective decisions that certify the conservation and preservation of natural resources, establishing ideal conditions that favor present and future generations.

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