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# The efficiency of the economic septic tank in the treatment of domestic wastewater and black water in rural areas

**Eficiência da fossa séptica econômica no tratamento de águas residuais domésticas e águas negras em áreas rurais**

**La eficiencia de la fosa séptica económica en el tratamiento de aguas residuales domésticas y aguas negras en zonas rurales**

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**Abstract**
Wastewater treatment in rural areas is important to prevent the pollution of aquatic environments and to protect the health of the population. Centralized treatment systems present a high cost, making the use of decentralized systems attractive. The use of septic tanks for on-site treatment of residential (single-family) is an attractive alternative within the context of Brazilian sanitation. Thus, the main objective of this study was to analyze the efficiency of the Economic Septic Tank in the treatment of wastewater of two residences located in a rural area. Two systems were installed: the first treat sanitary wastewater of a residence with three residents (A) and the second treat only the water from the toilet of a residence with five residents (B) (Black Water). For both systems, A and B, removal efficiencies were obtained in relation to total suspended solid (75%), biochemical oxygen demand (58 and 55%), and chemical oxygen demand (61 and 60%), respectively. Removal efficiencies were close, indicating that the system works satisfactorily in both systems, considering values indicated in the literature.
**Keywords:** Economic septic tank; Rural sanitation; Single-family wastewater treatment; Social technology.

**Resumo**
O tratamento de águas residuais em áreas rurais é importante para prevenir a poluição dos ambientes aquáticos e proteger a saúde da população. Os sistemas de tratamento centralizados apresentam alto custo, tornando atrativa a utilização de sistemas descentralizados. A utilização de fossas sépticas para tratamento in loco de residências (unifamiliares) é uma alternativa atrativa no contexto do saneamento básico brasileiro. Assim, o objetivo principal deste estudo foi analisar a eficiência da Fossa Séptica Econômica no tratamento de águas residuárias de duas residências localizadas em área rural. Foram instalados dois sistemas: o primeiro trata a água do esgoto sanitário de uma residência com três moradores (A) e o segundo trata apenas a água do banheiro de uma residência com cinco moradores (B) (Água Preta). Para ambos os sistemas, A e B, as eficiências de remoção foram obtidas em relação ao sólido total em suspensão (75%), demanda bioquímica de oxigênio (58 e 55%) e demanda química de oxigênio (61 e 60%), respectivamente. As eficiências de remoção foram próximas, indicando que o sistema funciona satisfatoriamente em ambos os sistemas, considerando valores indicados pela literatura.
**Palavras-chave:** Fossa séptica econômica, Saneamento rural; Tratamento de águas residuais unifamiliares; Tecnologia social.

**Resumen**
El tratamiento de aguas residuales en áreas rurales es importante para prevenir la contaminación de los ambientes acuáticos y proteger la salud de la población. Los sistemas de tratamiento centralizados tienen un alto costo, lo que hace atractivo el uso de sistemas descentralizados. El uso de fosas sépticas para el tratamiento in situ de viviendas (unifamiliares) es una alternativa atractiva en el contexto del saneamiento básico en Brasil. Así, el principal objetivo de este estudio fue analizar la eficiencia de la Fosa Séptica Económica en el tratamiento de aguas residuales de dos viviendas ubicadas en zona rural. Se instalaron dos sistemas: el primero trata el agua residual sanitaria de una casa con tres habitantes (A) y el segundo solo trata el agua del baño de una casa con cinco vecinos (B) (Água Preta). Para ambos sistemas, A y B, las eficiencias de remoción se obtuvieron en relación al sólido suspendido total (75%), la demanda bioquímica de oxígeno (58 y 55%) y la demanda química de oxígeno (61 y 60%), respectivamente. Las eficiencias de remoción fueron cercanas, lo que indica que el sistema funciona satisfactoriamente en ambos sistemas, considerando los valores indicados en la literatura.
**Palabras clave:** Fosa séptica económica, Saneamiento rural; Tratamiento de aguas residuales unifamiliares; Tecnología social.

## 1. Introduction

About 15% of the world's population lives in areas of water stress, where many people struggle simply to gain access to sufficient drinking water. More than a third of the world's population does not have access to improved sanitation and more than 1.5 million children die each year from diarrheal diseases (Fenwick, 2006; Zayed et al., 2015). Throughout the world, significant development has been made in wastewater treatment for urban areas; however, rural areas are lagging behind in this respect (Eggimann et al., 2018; Massoud et al., 2009).

This problem is not different in rural areas in Brazil. The lack of sanitary wastewater treatment is still one of the main socio-environmental problems, with a high deficit of coverage, with almost 59% of the rural population without adequate disposal of their wastewater from the sanitary and environmental point of view (Brazil, 2012).

The Brazilian rural area is commonly formed by small family units (4 to 6 people), where the use of centralized treatments is not the most indicated. The problems and limitations of centralized treatment include the fact that they are expensive to build and operate, especially in areas with low population density and dispersed households. Alternatively, the decentralized treatment is gaining more attention and its characteristics meet the need for single-family on-site treatment (Massoud et al., 2009).

Decentralized treatment is a less resource-intensive and more ecologically sustainable form of sanitation, focusing on on-site wastewater treatment and resource local reuse, being appropriate for low-density communities and varied conditions site and supporting agricultural productivity (Capodaglio, 2017, Jamshidi et al., 2014; Massoud et al., 2009). Its use is very common in many countries, such as the United States (Bradley et al., 2002), Australia (Ahmed et al., 2005), Germany (Meuler; Paris; Hackner, 2008) Canada, Greece, Turkey, and Tanzania (Nasr & Mikhaeil, 2015).

However, although it is commonly used, few studies about on-site treatment residential aim at the use of low-cost systems. Even though they may present satisfactory results as well as established systems such as the traditional septic tank. Low-cost technologies are not only attractive to rural areas in underdeveloped or developing countries but also very important for the protection of the health of needy populations.

With most research in this area to date has focused on large-scale and centralized treatment systems (Somlai et al., 2019), It has lack of studies with conclusive and adequate results on the efficiency of the use of low-cost systems in the decentralized treatment of single-family wastewater, mainly in Brazil, the present study evaluated a septic tank, which is the individual effluent treatment system more applied in the world (Ávila, 2005; Nasr & Mikhaeil, 2015; Van Haandel et al., 2006).

The type of the septic tank used in the study is an Economic Septic Tank (EST) and has received different types of recognition. For example, becoming part of the Bank of Social Technologies of the “Banco do Brasil Foundation”, in which it is edition 2011 finalist of the Prize of the same name, is still certified by the same entity in 2013 (BANCO DO BRASIL, 2014a, 2014b). An interesting aspect of this project is the possibility of reuse of bottles (used in the import of olives) in a waste recovery concept, which promotes the reduction of costs associated with this technology.

Therefore, it was investigated the efficiency of two ESFs installed in rural areas for single-family wastewater treatment, where one treated domestic wastewater (except water of the laundry) and the other treated only the black water (the wastewater coming from the toilet) of a residence; being then compared the treatment efficiency of both EST and its ability to remove organic matter and solids.

## 2. Methodology

**Experimental setup.** The treatment system chosen for study, EST, was designed for the treatment of single-family domestic wastewater, i.e. only one family/household. This was conceived by the Municipal Government of Caratinga (MG-Brazil) (BANCO DO BRASIL, 2014a, 2014b) and consists of three 240-liter polyethylene bottles (with screw cap) interconnected by pipes, which use domestic wastewater for flocculation, sedimentation, and anaerobic digestion processes. An interesting aspect of this project is the possibility of reuse of bottles (used in the import of olives, for example) in a waste recovery concept, which promotes the reduction of costs associated with this technology.

The ESTs were installed in two different locations in order to compare their efficiency. The first one was installed in Botucatu, São Paulo-Brazil, located in the Olaria colony, at Lageado farm, and treated all the wastewater of a residence, except water of the laundry. While the second one was installed in Bauru, São Paulo-Brazil, in a settlement of families (Settlement Horto-Aimorés) and treated the wastewater coming from the toilet of a residence (black water).

The treatment system (Figure 1) was composed of an upstream equalization tank (300 L in Botucatu/SP and 150 L in Bauru/SP) in which also the flow rate was measured and where the effluent samples were collected. The effluent was then directed to the EST, consisting of three bottles in series (useful volume of each of 220 L). At the end of the system, the effluent was disposed of in infiltration ditches. As shown in Figure 1, a register with a diameter of 60 mm to 1/3 of the total height of the first bottle (34.3 cm) was installed in order to remove the sludge when necessary (desludging), avoiding clogging in the system.

The EST effluent was disposed of in infiltration ditches 2 m long and 30 cm wide. A 100 mm PVC pipe was used with holes along its length so that the effluent could percolate. In its bed, construction waste was used instead of crushed stone, in order to reuse materials and reduce the cost of the system. In order to minimize the interference of rainwater (cooling) and ambient temperature variation to the anaerobic digestion process, the three bottles that make up the EST were semi-buried in the soil, providing the desired thermal insulation (Figure 2).

**Figure 1** - Hydraulic profile of the Economic Septic Tank installed in Botucatu/SP and Bauru/SP.

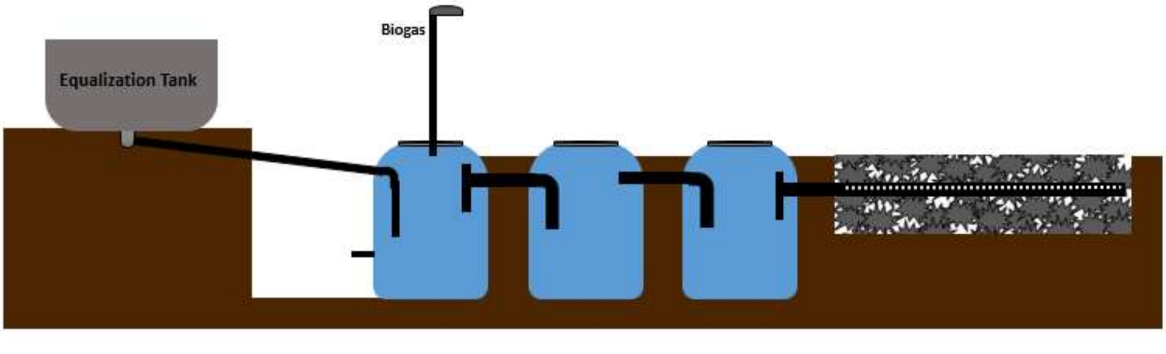


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**Figure 2 -** EST after installation in Botucatu/SP.

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Considering all the materials used for the construction of the ESF, its cost, without the flow equalization tank, since the system can operate without it, would be approximately R$ 350.00. For the inclusion of an equalization tank, the system value would be increased by R$ 150.00, totaling R$ 500.00.

**Operation of the Economic Septic Tanks.** The Botucatu/SP EST receives all the wastewater of a residence, except for the water of the laundry, being a load of wastewater coming from two adults and one child. The Bauru/SP EST receives wastewater from the toilet only, which is used by five adults and one child. In this way, this EST works with black water, composed mainly of feces and urine. In Brazil, black water differs from what is commonly found in studies, where a chemical oxygen demand (COD) of 5,000 $mg.L^{-1}$ is generally referenced. Due to the volume of water used in the toilets, from 6 to 12 L of water per discharge, occurs a dilution in the black water, reaching values around 2,000 $mg.L^{-1}$ (Slompo, 2018).

The average flow rate of the systems was measured by means of the volumetric method in the equalization tank installed upstream of the EST (Figure 1). The average was obtained from readings at 24 h intervals for one month for further calculation.

The average flow rate in the Botucatu/SP EST was 371.5 $L.d^{-1}$, which corresponds to 15.48 $L.h^{-1}$, with HRT of 1.77 days, and in the Bauru/SP EST, the average flow was 83.00 $L.d^{-1}$, which equals 3.46 $L.h^{-1}$, with a hydraulic retention time (HRT) of 7.95 days. As Botucatu/SP EST treats the wastewater of 3 people and the Bauru/SP of 6 people (including children), the average flow per inhabitant was 123.8 $L.d^{-1}.hab^{-1}$ and 13.84 $L.d^{-1}.hab^{-1}$, respectively. In the literature, HRT varies a lot from a few hours (6 to 12 hours) (Santos et al., 2017) to 72 h (Nasr & Mikhaeil, 2013; 2015). The choice for the best HRT is a function of the constructive characteristics of the EST and the quality of the wastewater to be treated.

**Analyses.** Analyses such as Chemical Oxygen Demand (COD) (5220 D), Biochemical Oxygen Demand (BOD) (5210), pH (4500-Hþ B), TSS (2540 D) and E. coli (9221 E, F) were carried out according to the methodologies described in Standard Methods for the Examination of Water and Wastewater (APHA, 2005).

In order to assess whether there are significant differences in the average values of the variables analyzed (pH, COD, and E. coli), a statistical method was used for comparison of means from two samples, using a Student t-test (Miller & Miller, 2013).

## 3. Results and Discussion

***Characterization of the affluent wastewater.*** Table 1 presents the results of the average values of the parameters monitored during the experimental period, promoting a characterization of the wastewater affluent in the two EST. According to its characteristics, the Botucatu/SP EST affluent, which is composed of all resident wastewater (except laundry), is considered to have a mean concentration in relation to COD and Total Suspended Solids parameters (TSS), but for BOD, it is considered wastewater with high concentration. The Bauru/SP EST affluent is characterized as high concentration, highlighting that this is black water (Metcalf & Eddy, 2005).

However, even with close rankings, it is noteworthy that COD of the Bauru/SP EST is 2.5 times larger than that of Botucatu/SP EST, in which to obtain equivalent organic matter removal efficiencies, a higher HRT is used for the Bauru/SP EST.

**Table 1 -** Characterization of wastewater from Botucatu/SP and Bauru/SP EST.

| **EST** | **Parameter** | **Average ± Standard Deviation** |
|---|---|---|
| Botucatu/SP | BOD ($mg.L^{-1}$) | 398 ± 167 |
| | COD ($mg.L^{-1}$) | 898 ± 490 |
| | TSS ($mg.L^{-1}$) | 382.35 ± 255.44 |
| | pH | 8.49 ± 0.54 |
| | *E. coli* ($MPN.100mL^{-1}$) | $5.92x10^7 \pm 4.33x10^7$ |
| Bauru/SP | BOD ($mg.L^{-1}$) | 717 ± 170 |
| | COD ($mg.L^{-1}$) | 2331 ± 1352 |
| | TSS ($mg.L^{-1}$) | 784.38 ± 427.77 |
| | pH | 6.74 ± 2.08 |
| | *E. coli* ($MPN.100mL^{-1}$) | $1.74x10^7 \pm 2.18x10^8$ |

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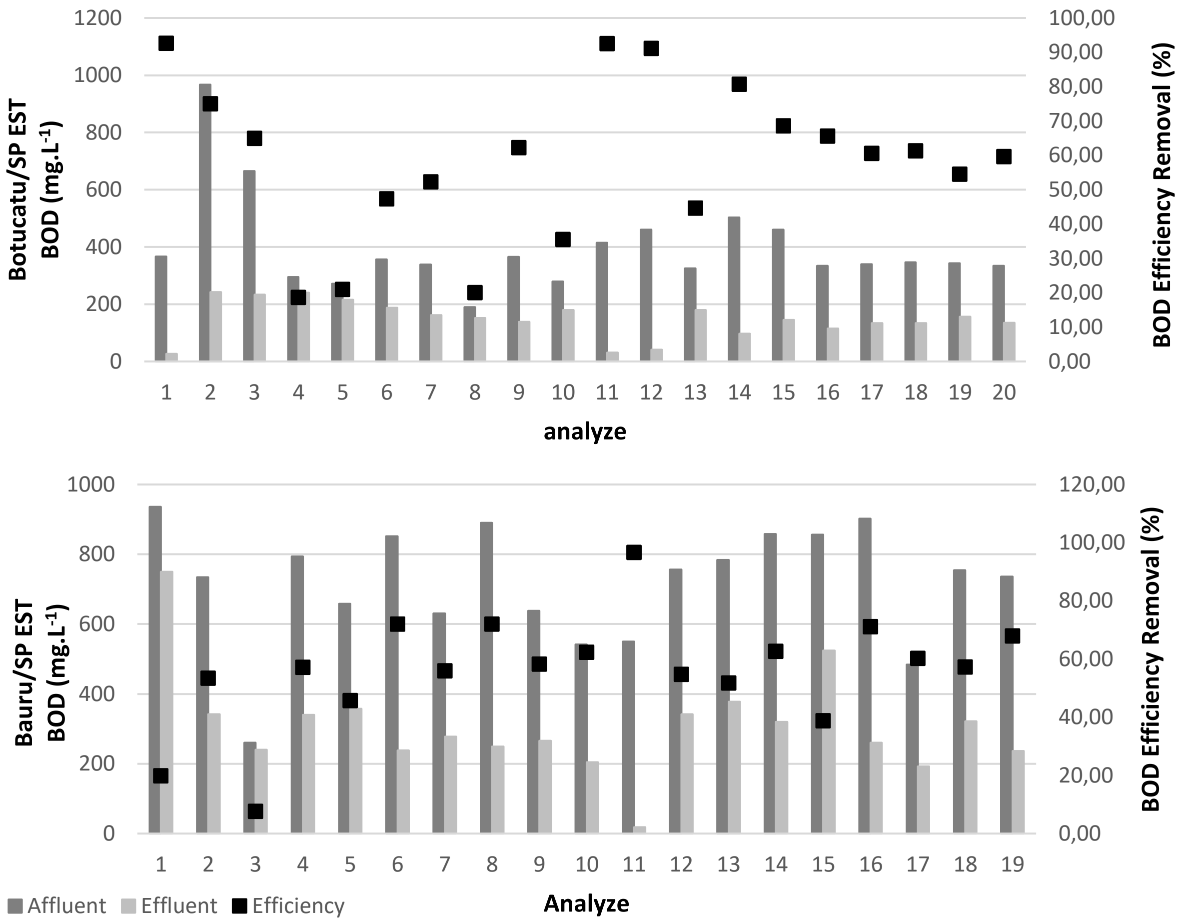
***pH.*** Anaerobic digestion has an optimal pH range between 6.5 and 7.5 (Chernicharo, 2008; Metcalf & Eddy, 2005). For the Botucatu/SP EST, the pH affluent and effluent values are, respectively, 8.49 ± 0.54 and 7.34 ± 0.36. For the Bauru/SP EST are of 6.74 ± 2.08 and 6.28 ± 1.61 for the affluent and effluent, respectively. In the Botucatu/SP EST, the measured values are within the range considered adequate for the occurrence of anaerobic digestion (Chernicharo, 2008; Foresti et al., 1999), suggesting that there was no excessive accumulation of organic acids within the treatment unit (Sharma & Kazmi, 2015). However, in the Bauru/SP EST, the values obtained at the effluent are below the optimal range for the occurrence of this type of digestion, indicating a possible anaerobic digestion imbalance.

As a result, the Botucatu/SP EST, presented higher stability of the process, whereas in Bauru/SP EST, may have presented imbalances due to the large variation of organic load at the entrance (expected occurrence because it is a single family unit for treatment of black water). The acid medium may have inhibited certain organisms responsible for the anaerobic digestion of organic matter (Chernicharo, 2008; Foresti et al., 1999), affecting the efficiency of the system for removal of TSS, COD, BOD etc.

The observed reductions in pH were considered significant (p=0.05) only for Botucatu/SP EST, i.e., as in the Bauru/SP EST, this change cannot be considered significant (p=0.05) due to the large variation of the observed values (high standard deviation), it is possible to conclude a good buffering capacity of the wastewater (Abbassi et al., 2018).

***Removal efficiency of BOD and COD.*** The organic matter present can be estimated by calculating the BOD/COD ratio. The average value of this ratio was 0.4 for Botucatu/SP EST and 0.3 for Bauru/SP EST, which theoretically indicated a better suitability of Botucatu/SP EST for biological treatment (Metcalf & Eddy, 2005). Figure 3 shows the affluent and effluent concentrations of BOD of the Botucatu/SP and Bauru/SP EST with their relative removal efficiencies.

**Figure 3 -** Affluent and effluent concentrations of BOD for the Botucatu/SP EST and Bauru/SP EST.

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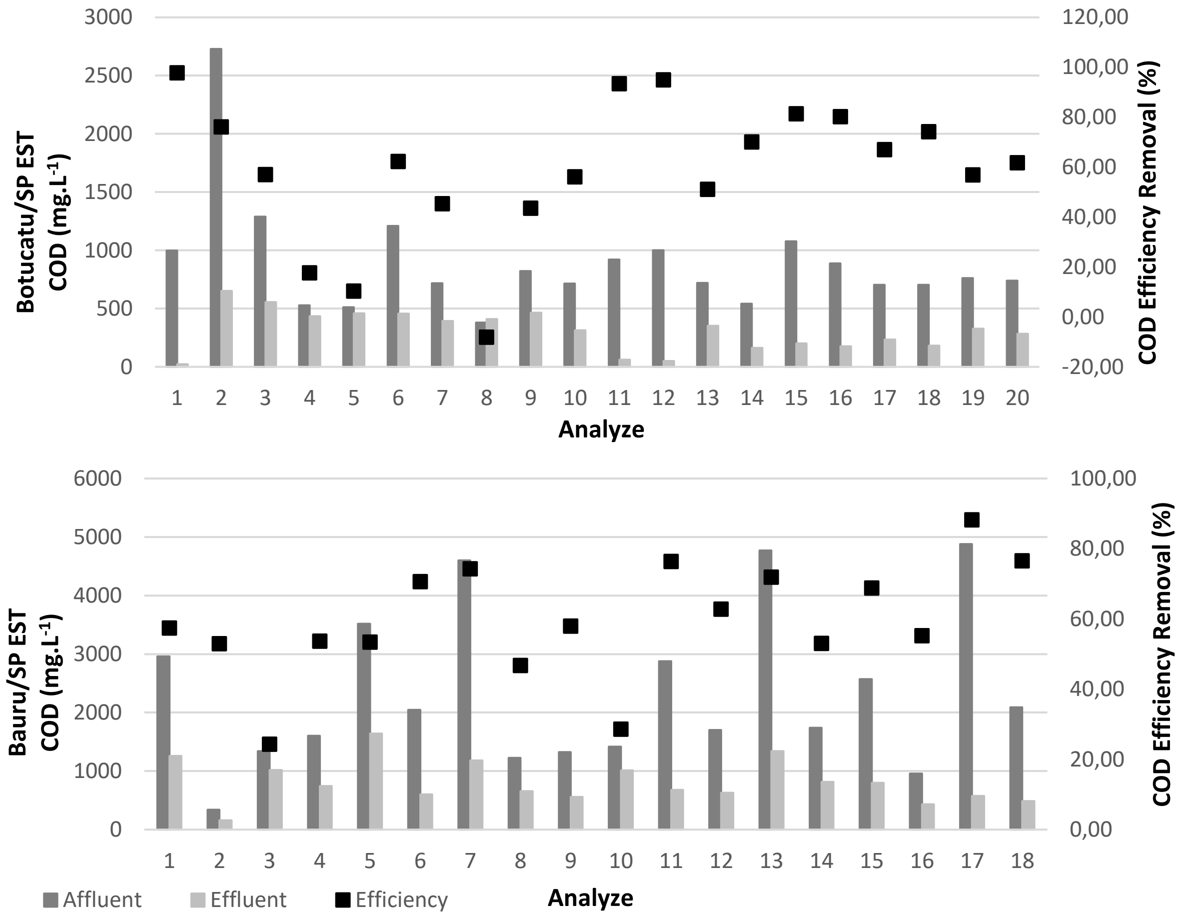
Because it is an on-site treatment system, that is, single-family and small-flow, it is common to observe variations in the affluent concentrations. This variation was more accentuated for the Bauru/SP EST, due to the treatment of a black water, the lower flow and higher average BOD load applied. This occurrence ends up reflecting an instability in the removal efficiency evaluated in percentage of removal. However, it should be noted that the concentration of BOD effluent remained more stable compared to the variation in the affluent, evidencing the stability of the system and its capacity to withstand variations. Both ESTs showed a significant efficiency of removal of BOD significant (p=0.05) and similar, with Botucatu/SP showing an average BOD removal efficiency of 58.4%, while 55.3% in the Bauru/SP EST.

As results, the efficiencies obtained in the present research can be considered satisfactory, since normally only about 40% of the BOD is removed in septic tanks (Meuler et al., 2008). Superior efficacy was obtained in some studies with septic tank. Moussavi et al. (2010), for example, obtained an 85% BOD removal efficiency at HRT of 24h with an upflow septic tank for the on-site decentralized treatment of residential wastewater. Nasr and Mikhaeil (2013) conducted a comparative study of domestic wastewater treatment using conventional septic tanks in three different HRTs (24, 48 and 72 h) with organic loads of 0.321, 0.436 and 0.885 kg.COD.m$^{-3}$.d$^{-1}$, respectively. The performance of septic tanks in the three HRTs was satisfactory, with removal of BOD from 68.4%, 57, 53.5%, for HRTs of 24, 48 and 72 h, respectively.

With respect to COD, Figure 4 shows the affluent and effluent concentrations of COD of Botucatu/SP and Bauru/SP EST with their relative removal efficiencies. The average organic load applied was 0.37 $kg.DQO.d^{-1}$ and 0.19 $kg.DQO.d^{-1}$, the organic volumetric load being 0.56 $kg.DQO.m^{-3}.d^{-1}$ and 0.29 $kg.DQO.m^{-3}.d^{-1}$ for Botucatu/SP EST and Bauru/SP EST, respectively. Thus, in spite of having a higher concentration of organic matter (COD), the rate applied in the Bauru/SP EST was much lower, due to the higher HRT used (Botucatu/SP EST = 1,77 and Bauru/SP EST = 7.95 days), also resulting in a lower operating flow.

**Figure 4 –** Affluent and effluent concentrations of COD for Botucatu/SP EST and Bauru/SP EST.

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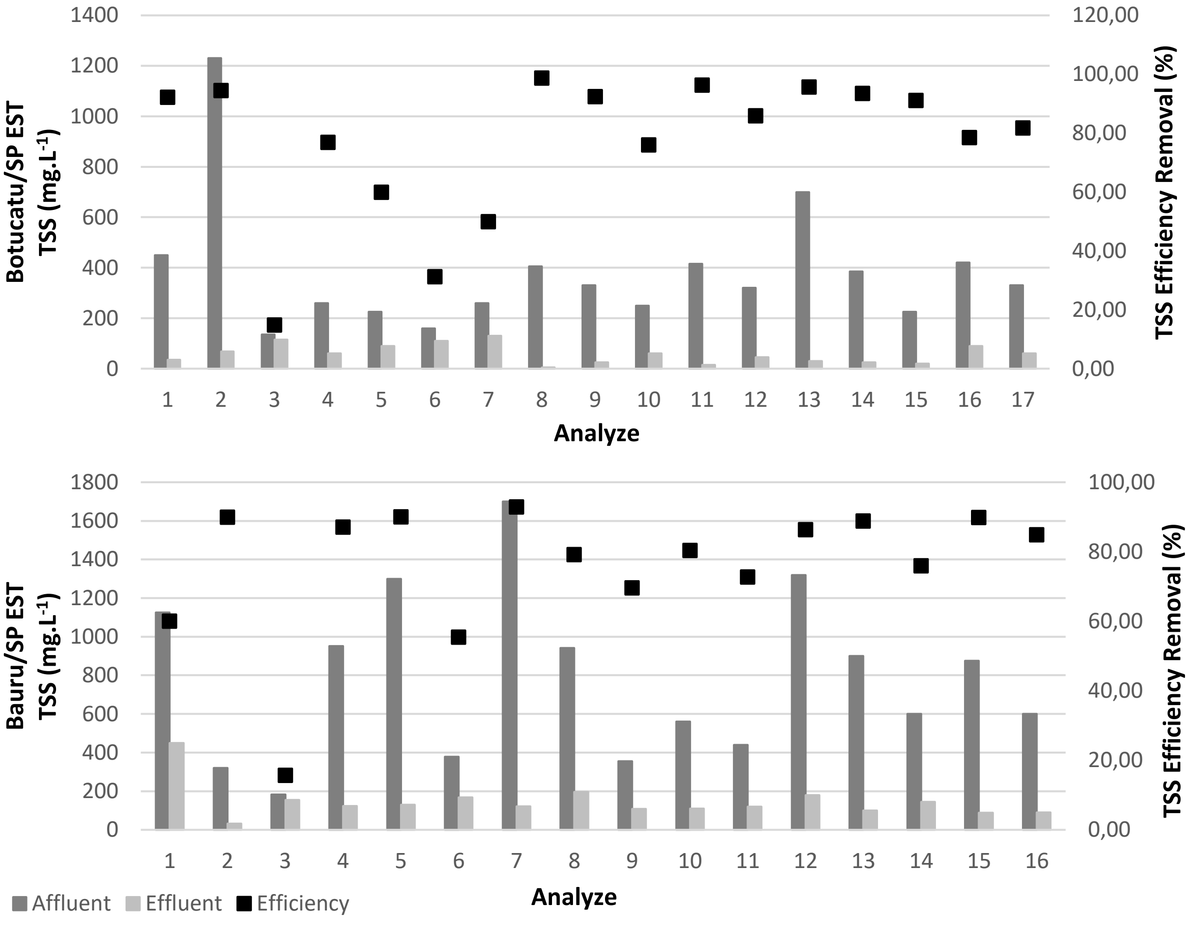
These characteristics in the operation may have favored the similar removal efficiencies between the two EST. Thus, even with the variation in the affluent, as occurred for BOD, the average COD removal efficiencies were also significant ($p=0.05$) and similar, being 61.4%, in the Botucatu/SP EST, and 60.0% in the Bauru/SP EST.

Studies carried out in Brazil presents some variation regarding the efficiency of a traditional septic tank to remove COD. Von Sperling (2005) indicates efficiency values for septic tanks between 25 and 35%, while Andrade Neto et al. (1999) between 50 and 80% and Além Sobrinho and Said (1991) found a removal efficiency of 64% in research with decant-digesters in series.

This variation is also observed in the international literature, mainly due to the HRT used. Moussavi et al. (2010) obtained a COD removal efficiency of 77% with 24 h HRT with an upflow septic tank. Nasr and Mikhaeil (2013) in a comparative study of domestic wastewater treatment using conventional septic tanks in three different HRTs; 24, 48 and 72 h with organic loads of 0.321, 0.436 and 0.885 $kg.COD.m^{-3}.d^{-1}$, respectively. The performance of the septic tanks in the three TDHs was satisfactory, with COD removal of 53.4%, 56% and 65.3%, in TDH of 24, 48 and 72 h, respectively.

***Removal Efficiency of Total Suspended Solids (TSS).*** One of the mechanisms that septic tanks use to remove solids is their decantation as sludge to the bottom of the tank (Crites & Tchobanoglous, 1998). The solids stored in layers of sludge and slag can naturally vary their quality depending on the characteristics of the treated wastewater and the septic tank and its operation, with the septic tank being able to reduce sludge volumes by up to 40% (Nasr & Mikhaeil, 2013, 2015). Figure 5 shows the SST affluent and effluent concentrations in Botucatu SP and Bauru/SP FSE and their relative removal efficiencies.

**Figure 5 -** Affluent and effluent concentration of the SST for Botucatu/SP EST and Bauru/SP EST.

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As for the parameters previously discussed, it is possible to observe that the Bauru/SP EST presents a greater variation in the affluent values than the Botucatu/SP EST. As pH variation in the Bauru/SP EST was not ideal, this is a relevant concern, since in conventional septic tanks, high levels of solids in the effluent may represent the main cause of most dysfunctions in septic systems, evidencing problems in their removal (Withers et al., 2014).

However, in spite of the large variations observed at the affluent, the Bauru/SP EST was able to withstand these peaks, which is observed in the concentrations of SST effluent, where in addition to the concentrations present some stability; these are similar to the values found for the Botucatu/SP EST. Conventional septic tanks generally exhibit a SST removal of 50 to 70% (Metcalf & Eddy, 2005). In the present study, the obtained efficiencies were significant (p=0.05) and higher than this value. The average efficiency of removal of TSS was of 75.1% and 75.6 % for the Botucatu/SP EST and Bauru/SP EST, respectively, showing similar again.

Nguyen et al. (2005) obtained average removal efficiencies from 44 to 69% of TSS, depending on the HRT adopted, in conventional septic tank. Already, Moussavi et al. (2010), when conducting study with a pilot scale upflow septic tank, obtained a TSS removal efficiency of 86% with 24h of the HRT.

The FSE of Bauru / SP, due to a higher affluent concentration in terms of COD (2,338.23 mg.$L^{-1}$) and similar COD and TSS removal efficiency of Botucatu/SP EST, resulted in the necessity of three cleanings (removal of about 60% of the volume of the septic tank (USEPA, 2002), in this case of the first bottle) during these 2 years and 2 months of operation. While Botucatu/SP EST (COD = 987.15 mg.$L^{-1}$), operated for 2 years and 4 months without cleaning.

Added to these factors, it is believed that the HRT of 7.95 days of the Bauru/SP EST had great influence in the increase of the sedimentation process of solids and accumulation of sludge in its first bottle. Considering only this first bottle from Bauru/SP EST, the HRT in it is 2.65 days, still high value compared to the HRTs discussed in the present study (between 24 h and 72 h). Which may have been fundamental for this large accumulation of solids, a fact that did not occur in the Botucatu/SP EST that treated a mixed effluent, with a higher flow rate, which resulted in a total HRT of 1.77 days. Thus, it is concluded that a higher concentration of matter (BOD and COD) and a higher HRT also result in a higher formation of sludge (Nasr & Mikhaeil, 2015).

This occurrence cannot be considered a negative point of the EST studied, since it should be noted that the Bauru/SP EST treated a black water, with concentrations higher than that of Botucatu/SP EST that treated domestic wastewater (excluding water laundry) and obtained similar results. Therefore, if it is defined to treat an effluent with a higher load, it is only necessary to observe that the cleaning of the sludge will have to be carried out with a higher frequency. Since this period can vary from one to several years for most septic tanks (Van Haandel et al., 2006).

The infiltration ditches used during the study period for the disposal of liquid effluent, even after two years of operation did not fill up. This demonstrates that the soils where they were disposed were able to promote the filtration of this material, which is relevant and positive, in view of the low cost proposal of this social technology. However, it is suggested to study deeper layers of these soils to better understand the present processes for these types of effluents and the presence of pathogens.

***Removal efficiency of E. coli.*** The results obtained for the removal of *E. coli* are presented in Table 2. It is important to remember that the septic tank does not purify the wastewater, it only decreases its organic load to a degree of admissible treatment, and therefore, its effluent still involves high amounts of pathogenic microorganisms (Jordão & Pessoa, 2009; Zago & Dusi, 2018).

The two EST showed similar average efficiencies in *E. coli* removal, 1.42 and 1.53 log removal, respectively, for Botucatu/SP EST and Bauru/SP EST. Knowing that in an EST the pathogen removal occurs by the precipitation/decantation of these inside the reactors, a higher HRT could influence this removal. However, the Bauru/SP EST that has a HRT of 7.95 days, much higher to 1.77 days HRT of Botucatu/SP EST, it was on average only 0.09 log better in the removal.

**Table 2 –** *E. coli* concentrations and removal efficiency.

| EST | Average ± Standard Deviation | | Average Efficiency Removal (%) | Log inactivation |
|---|---|---|---|---|
| | Affluent | Effluent | | |
| **Botucatu/SP** | $5,92x10^7 \pm 4,33x10^7$ | $2,25x10^6 \pm 9,85x10^6$ | 96,199 | 1,42 |
| **Bauru/SP** | $1,74x10^7 \pm 2,18x10^8$ | $5,08x10^5 \pm 1,66x10^6$ | 97,098 | 1,53 |

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Another point to note is that despite the Bauru/SP EST treating black water, the average concentrations of E. coli at the entrance of the system were similar to Botucatu/SP EST that treated the domestic wastewater (except water laundry). However, as there was a larger variation in the affluent from Bauru/SP EST, only removal from Botucatu/SP EST was significant (p=0.05) in relation to the affluent concentration, but there was no significant difference (p=0.05) between log removal of the two EST.

In their studies, Nasr and Mikhaeil (2013) observed a fecal coliform removal efficiency of less than 1 log when evaluating conventional septic tank in HRTs of 24, 48 and 72 h, with the effluent of the system still containing a concentration of the order of $10^8$ MPN.100mL$^{-1}$. Harrison et al. (2000), who observed in septic tanks concentrations between 2.5x$10^7$ and 1.2x$10^8$ MPN.100mL$^{-1}$, also observed a residual concentration of this order. However, it is not clear how the concentration of *E. coli* changes during its passage through the septic tank (Appling et al., 2013).

Considering the values found in the literature, and even that depending on the liquid temperature, it would be possible to increase the concentration of *E. coli* in the effluent (Appling et al., 2013), it has been observed that the average removal efficiencies can be considered satisfactory for this type of system. Especially the 1.53 log of *E. coli* found in the Bauru/SP EST. However, the concentration of *E. coli* in both effluents is still very high, and depending on the final destination chosen for the effluent (reuse or disposal in water bodies or soil), a tertiary treatment is required (Abbassi et al., 2018).

## 4. Conclusion

Despite the low cost (between R $ 350,00 and R $ 500,00) and the small useful volume of the system (660 L), the economic septic tank is evidenced as a technology that deserves to be better studied and applied, since it presents satisfactory performance when compared to conventional septic tanks. EST satisfactorily treated both studied effluent, with this being concluded that it can be operated with a different organic loads and HRTs. The EST is able to withstand organic load variation by operating in a continuous mode, maintaining relative removal stability. Effluents with higher concentrations of solids/matter lead to a higher frequency in the removal of excess sludge in the EST. However, the EST effluent needs treatment to remove and/or recover nutrients, as well as a disinfection step to ensure safe use. It is also suggested the study of the soil profile where the effluent can be discarded. This way, future studies can focus on complementary steps of nutrient removal and low-cost disinfection, in addition to studying the long-term effects of disposing of this effluent directly into the soil.

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