



## PERFORMANCE OF TWO PARALLEL COVERED LAGOON DIGESTERS IN THE TREATMENT OF PIG FARM WASTEWATERS

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### Keywords:

Anaerobic digestion  
Efficiency  
Pig farming  
Wastewater treatment

### ABSTRACT

Pig farming moves a large part of the Brazilian economy. However, due to the high polluting potential, alternatives to treat and take advantage of the effluents must be developed, being the use of digesters a possible solution. This study aimed to evaluate the performance of two parallel covered lagoon digesters (CLD) in the treatment of swine wastewater. Monitoring was performed on a farm installed in Teixeiras, Minas Gerais, Brazil, in terms of COD in the period from August 2018 to July 2019. The study demonstrated that COD removal efficiency in the CLD was 40.2 and 39.5%, which did not indicate a statistical difference at a 5% significance level. The two digesters in parallel were compatible with each other in terms of COD reduction. Furthermore, individually they did not present significant changes in their performance in the summer and winter periods.

### Palavras-chave:

Digestão anaeróbia  
Eficiência  
Suinocultura  
Tratamento de efluentes

### DESEMPENHO DE DOIS DIGESTORES ANAERÓBIOS MODELO LAGOA COBERTA OPERANDO EM PARALELO NO TRATAMENTO DE EFLUENTES DA SUINOCULTURA

### RESUMO

A suinocultura movimentava grande parte da economia brasileira. No entanto, devido ao alto potencial poluidor, alternativas para tratar e aproveitar os efluentes devem ser desenvolvidas, e nesse aspecto a utilização de digestores é uma possível solução. Este trabalho teve como objetivo avaliar o desempenho de dois digestores anaeróbios lagoa coberta (BLC) operando em paralelo no tratamento de efluentes da suinocultura. O monitoramento foi realizado em uma granja instalada no município de Teixeiras (MG), em termos de DQO no período de agosto de 2018 a julho de 2019. O estudo demonstrou que a eficiência de remoção de DQO nos BLC foi de 40,2 e 39,5%, o que não indicou diferença estatística a um nível de significância de 5%. Conclui-se que os dois digestores em paralelo foram compatíveis entre si em termos de redução de DQO e que, individualmente não apresentaram mudanças significativas no seu desempenho quando comparado os períodos de verão e inverno.

## INTRODUCTION

Brazilian pig farming is characterized as an activity of great economic importance. In 2019, the country produced 3.983 million tons of pork, occupying the 4<sup>th</sup> place in the world ranking (ABPA, 2020). However, due to the amount of waste produced daily, the sector has a high potential for polluting the environment, which requires the installation of effluent treatment units.

Among the treatment alternatives, the anaerobic digestion of effluents stands out. Anaerobic digestion is a complex biochemical process, in which different anaerobic microorganisms degrade organic substances present in the effluent giving rise to biogas and biofertilizer by-products (NAGARAJAN *et al.*, 2019). This method has advantages such as the possibility of adding value to the waste, as it results in biogas and biofertilizer. Biogas can be used to generate electric, thermal or fuel energy and biofertilizer according to Morgan *et al.* (2018) can present an ideal composition for crop fertilization.

For the treatment of animal waste by anaerobic degradation, the covered lagoon digester (CLD) stand out. The CLDs are built in inverted trapezoidal trenches and waterproofed with PVC or HDPE geomembrane. Its dome, where the produced gas is stored, is formed by closing the trench using a flexible PVC blanket (ANDRADE, 2018). CLDs can operate in series or parallel when there are more than one built in the area. In digesters with parallel configuration, treatment efficiencies should not differ from each other, however, the

formation of dead zones and preferential paths can cause different treatment efficiencies. Therefore, the objective of this study was to evaluate the performance of two covered lagoon digesters operating in parallel in the treatment of swine wastewater.

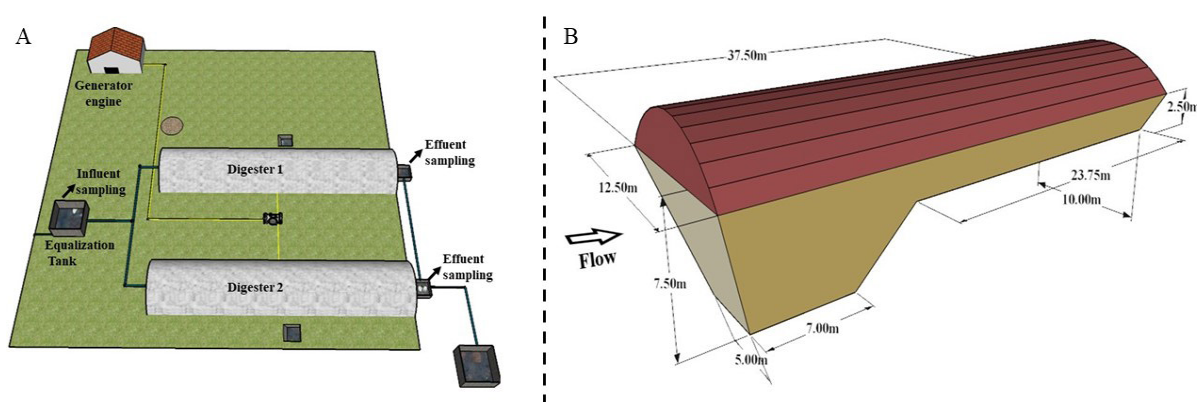
## MATERIAL AND METHODS

Monitoring was performed in a pig farm located in Teixeiras, Minas Gerais, Brazil. The system consists of two covered lagoon digesters operated in parallel, which receive a total average flowrate equal to  $102.3 \text{ m}^3 \cdot \text{d}^{-1}$ , distributed to the two digesters. Each unit has a volume of  $1,250 \text{ m}^3$  with a nominal hydraulic retention time (HRT) of 24.4 days. The effluent was characterized in terms of COD according to APHA (2017) from August 2018 to July 2019. In Figure 1-A is shown the collection points and in Figure 1-B is shown the CLD configuration.

In order to compare the efficiency of digester in terms of COD removal, the data were compared by analysis of variance (ANOVA) at 5% significance level. In addition, the performance of digester in the summer (December, January and February) and winter (June, July and August) periods was evaluated.

## RESULTS AND DISCUSSION

The time series in terms of COD at the entrance and exit of the CLD is presented in Figure 2-A, and the average influent value was  $31.4 \text{ g} \cdot \text{L}^{-1}$ . The COD

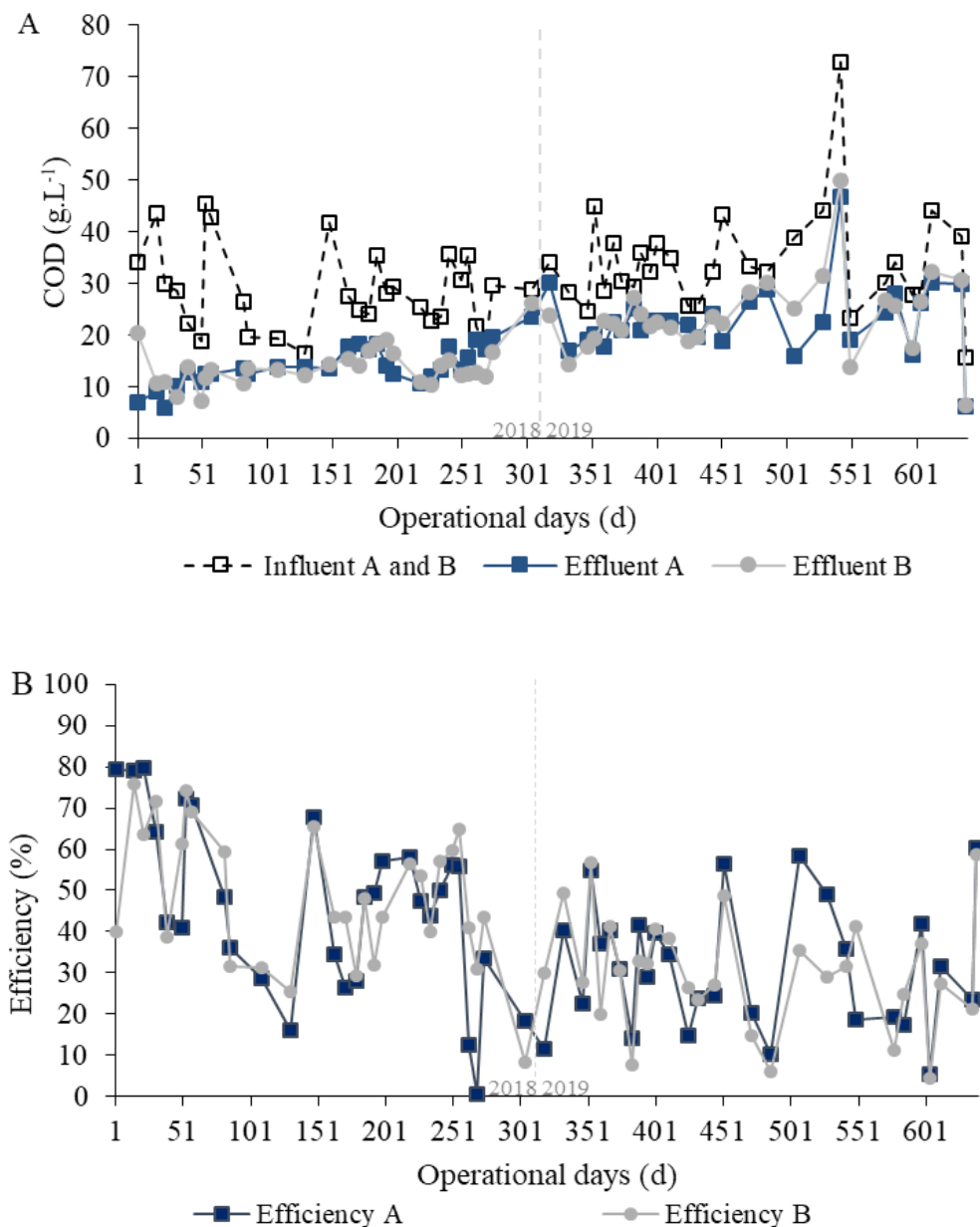


**Figure 1.** Indication of sample collection points before and after treatment (A); configuration of the covered lagoon digester (CLD) (B)

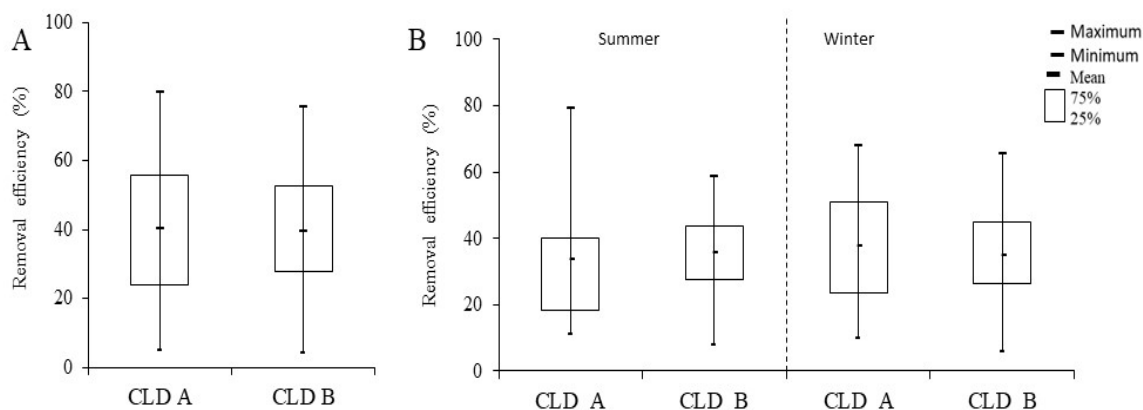
values at the BLC outlet were 18.4 g.L<sup>-1</sup> and 18.9 g.L<sup>-1</sup>. We can observe that the COD at the exit of the digesters showed more stabilized values when compared to those at the entrance, which undergo changes during the day and the week, varying according to the farm management. As a result of this behavior, oscillations in efficiency were observed and also a reduction in the efficiency of the system over time, which may be related to several operational parameters, beyond the COD loading. Variations in parameters such as alkalinity, pH and temperature, for example, can also impact

the efficiency of the system.

The box-plot graph of the two digesters is presented in Figure 3-A. We can observe that the results are similar, with an overall efficiency of 40.2 and 39.5% for digester A and B, respectively. However, the COD removal efficiency did not meet the launching standard established in the Minas Gerais state requirements, which determines a minimum COD reduction of 70% or 75% on an annual average. Thus, effluents require post-treatment (COPAM, 2008) as aerobic or facultative stabilization lagoons.



**Figure 2.** COD time series (A) and efficiency (B) over the monitoring period of digesters A and B



**Figure 3.** Box-plot graph in terms of global (A) and seasonal (summer and winter) (B) COD removal (%)

When considering the summer and winter period (Figure 3-B), no statistical differences were identified at the 5% significance level between the CLDs. Therefore, regardless of climatic conditions, the performance in the operation of digester did not show statistical difference. Kunz *et al.* (2019) pointed out that in the summer period the efficiency would be higher, since the temperature influences the growth speed and metabolism of microorganisms. However, in the present study, despite the traditional temperature difference between the periods, in winter there was no significant reduction in the performance of digester.

## CONCLUSION

- The two CLDs operating in parallel showed similar results in terms of COD degradation.
- Individually, the digester did not present significant change in their performance in the summer and winter periods.
- The performance of the CLD was below that reported in the literature.

## AUTHORSHIP CONTRIBUTION STATEMENT

**ALMEIDA, A.A.:** Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft; **ROSA, A.P.:** Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft; **SOUSA, I.P.:** Conceptualization, Data curation, Formal

Analysis, Writing – original draft, Writing – review & editing; **LOPES, J.O.:** Conceptualization, Formal Analysis, Methodology; **BORGES, A.C.:** Conceptualization, Formal Analysis, Writing – review & editing; **MELO, S.M.:** Data curation.

## DECLARATION OF INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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