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REVITALIZATION OF THE LAMELAR SYSTEM OF THE MORRO DO GAIA COMPLEX

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Abstract: Decantation constitutes a fundamental step in the water treatment process, being responsible for the retention/removal of larger solid particles. To do this, the water finds lamellar profiles as a physical barrier, which prevent the free flow of particles and make access to the clear liquid zone on the surface difficult. It is noted, therefore, that the absence of inadequate lamellas and/or profiles reduces the performance of the decanters. From this perspective, the detachment of lamellar blocks was seen at the Morro do Gaia Complex Treatment Station, negatively impacting the decantation rate, increasing the frequency of maintenance, and system shutdowns. Therefore, the objective of this work is to describe the operational systemic process that was applied in the revitalization of this lamellar system. To this end, the methodology for applying and reusing the lamellas was planned. using the PDCA cycle (Plan, Do, Check, Act) as a tool, proving to be an essential tool for quality management and continuous process improvement, and applicable for this purpose. Based on this analysis, the profiles that would be reused and those that would be replaced were classified, destined for companies that use thermoplastic as a raw material in their production processes, constituting a circular economy. Furthermore, to ensure that the profiles would be stable, the use of steel cables and riveting of the lamellar blocks was established, guaranteeing the fixation and structural support of the lamellar blocks. This way, the efficiency of the lamellar system was ensured, resulting in high-performance decanters and significantly increasing the useful life of the lamellar system. Thus, floc drag was reduced, increasing the amount of incoming liquid flow, as well as obtaining low turbidity analyses.
Keywords: High performance, Lamellar system, Revitalization.

INTRODUCTION

The PCDA (Plan, Do, Check, Act) methodology has proven to be an essential tool for quality management and continuous improvement of systems (GHADGE et al., 2021). This cyclical approach seeks to promote excellence by defining clear goals, implementing actions, monitoring results and adjusting for continuous improvement. From this perspective, it is noted that the application of this principle is fundamental to improving operational efficiency in the basic sanitation sector.

Thus, the implementation of the PCDA allows for structured and results-oriented management, offering a systematic approach based on planning, execution, verification and action (Figure 1) in relation to processes and activities (SARWOKO et al., 2020). This way, it is observed that planning allows you to establish objectives and goals, which ensure the optimization of activities.

In parallel, the execution stage involves the implementation of planned actions, focusing on team coordination, resource allocation and efficient execution of construction activities. This involves analyzing the results obtained, through performance indicators, inspections and audits, in order to assess the degree of compliance with the established goals. Finally, the action stage involves identifying necessary improvements and implementing corrective or preventive actions to optimize processes and results.

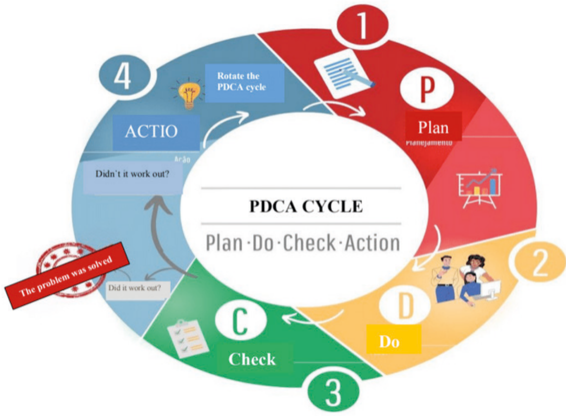

Figure 1: PDCA Cycle

Source: Google images, 2023.

Figure 2: ``***Morro do Gaia Complex***``, Farm: ``***Santa Fé***``

Source: Wild region; Sanitation, 2022.

In this sense, it is clear that when applying the aforementioned methodology in activities there is continuous improvement of processes, promoting increased operational efficiency – this parameter leads to cost reduction and an increase in the quality of results (ZHU et al., 2019). This way, we sought to adopt methods based on the aforementioned systematic approach, in order to guarantee the optimization of processes, in an efficient and lasting way. Specifically, the use of PCDA in a revitalization that impacts the entire functional system of the operation.

DESCRIPTION OF ``*MORRO DO GAIA*`` COMPLEX

The Morro do Gaia Complex makes up the Wild region Collective System (SCA), located in the municipality of São Brás-AL. This is responsible for the water capture, supply and treatment processes, serving a population of approximately 400 thousand inhabitants, located in 10 municipalities in the state of Alagoas, with a work flow of around 1,900 m^3/h, as seen in Figure 2.

CHARACTERIZATION OF THE ETA OBJECT OF THIS RESEARCH

Regarding the treatment stage of this water resource, the Morro do Gaia complex has two treatment stations. Specifically, this research refers to ETA 02. This consists of 03 decantation tanks, which have an area of $65m^2$. The decanters are subdivided into modules, totaling 6 modules, with an area of $32.5m^2$. Furthermore, all tanks are structured in reinforced concrete. The layout of the aforementioned ETA can be seen in Figure 3.

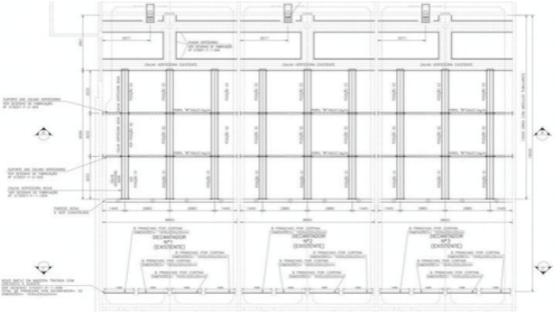

Figure 3: Layout of settling tanks

Source: South Atlantic; Environmental sanitation, 2016.

ANALYSIS OF THE PROBLEM SITUATION

It was seen that the lamellar profiles of the aforementioned ETA were detached. Thus, a significant number of lamellae was accumulated at the bottom of the decanters. This problem intensified over time, due to the pressure exerted during periodic cleaning. As a consequence, solid particles were deposited in areas that were difficult to access, increasing turbidity levels and increasing sludge production, as seen in Figure 4.

Figure 4: Panorama of the decanter lamellar system

Source: own elaboration, 2022.

GOALS

This project aims to highlight the construction system that was used in the revitalization of the lamellar system of the Morro do Gaia Complex, with the aim of optimizing the decantation process and enhancing the performance levels of the decanter tanks. Furthermore, we sought to implement an operational methodology aligned with the parameters of innovation, sustainability and quality, ensuring that the lamellar profiles remain stable for long periods. Furthermore, we attempted to make use of the 3 R's of sustainability policy, which was applied in their order of importance, as follows: reduce, reuse and recycle. Reduce consumption as much as possible, reuse products and materials as long as they can be reused and, finally, recycle those that have reached the end of their useful life.

METHODOLOGY USED

A preliminary study was carried out on possible construction methodologies for revitalizing the lamellar blocks. Based on this analysis, the use of 1/16" steel cables were defined, which can withstand a load of up to 164 kgf – according to manufacturer data (VONDER). These cables, together with the existing wooden structure, were responsible for the structural support of the loads applied to the decanters (Figure 5), acting in a similar way to the foundations. Furthermore, the lamellas were riveted at their ends (Figure 6), using 4x25mm aluminum rivets, with the purpose of ensuring that there is no segregation of these profiles and subsequent deposits at the bottom of the settling tanks. This material has a tensile strength of 95 kgf and a shear strength of 75 kgf as a technical characteristic. Still with the aim of preserving the fixed lamellar profiles, Aquatherm adhesive (Figure 7) was used to provide greater adhesion between them.

Figure 5: Application of steel cable to support profiles

Source: own elaboration, 2022.

Figure 6: Riveting of lamellar strips

Source: own elaboration, 2022.

Figure 7: Application of sticky adhesive

Source: own elaboration, 2022.

Finally, an analysis and classification of the lamellas was carried out, using all suitable profiles (Figure 8) – reusing around 70% of the material. This reuse resulted in savings, time optimization and sustainability. The remaining 30% went to the Association of Waste Collectors of Arapiraca (ASCARA), where they were pressed and melted, going to companies that use recycled thermoplastic in their processes (Figure 9). Thus, it was possible to allocate the byproduct generated in the revitalization of the lamellar system, guaranteeing a closed cycle economy structured on the pillars of sustainability (Figure 10).

Figure 8: Reuse of lamellas

Source: own elaboration, 2022.

Figure 9: Allocation of lamellas to another production chair

Source: own elaboration, 2022.

Figure 10: Circular economy

Source: Google imagens, 2023.

FLOW CHART OF OPERATIONAL ACTIVITIES

For the development and monitoring of activities to revitalize the lamellar system, the flowchart shown in Figure 11 was created.

RESULTS OBTAINED

The results obtained in this study were:

- Stability of the lamellar system;
- Increased performance of the decantation module;
- Reduction of water turbidity levels;
- Optimization of the periodic cleaning process;
- Adoption of sustainable practices, with reuse of products and disposal of waste to other production chains based on 3R's principles;
- Savings of approximately 70% of the total cost of the lamellar profiles that would be used if there was no reuse.
- Increase in the useful life of the lamellar system.

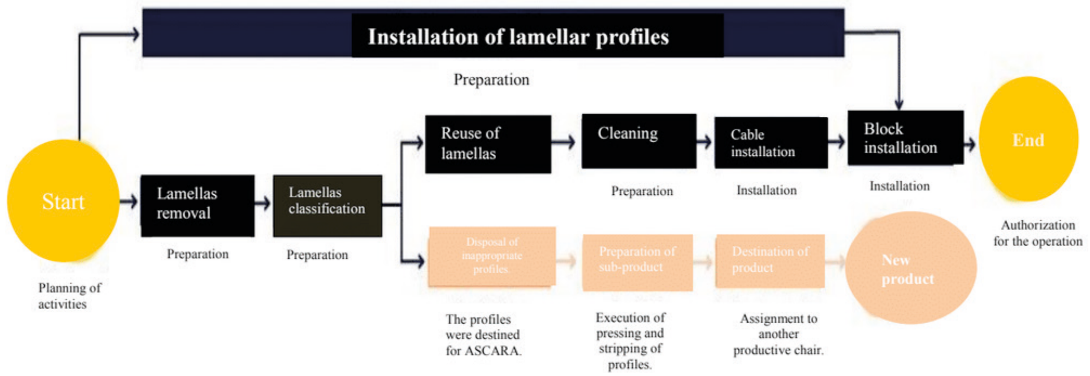

Figure 11: Sequence of constructive steps

Source: own elaboration, 2023.

ANALYSIS AND DISCUSSION OF RESULTS

The stability of the lamellar profiles optimizes the sedimentation process of solid particles, acting as a reducing agent for floc drag, as well as accentuating the flow of water into the decanters. As a result, the decantation tank operates efficiently, maximizing the flow of treated water, which supplies around 400,000 citizens. At the same time, the effect of fixed and appropriately inclined lamellas allows turbidity to be reduced, as evidenced in the ETA object of this study. This had turbidity levels that reached 4.02 NTUs (Nephelometric Turbidity Units), according to data provided by the local treatment sector (Table 1). This value was reduced, reaching 0.86 NTU after the revitalization of the lamellar system, as can be seen in table 2.

May	June	July
1,58	4,02	2,15

Table 1: Average turbidity obtained in the months preceding Revitalization

Source: own elaboration from the Wild region treatment sector; Sanitation, 2022.

September	October	November
0,86	0,92	0,94

Table 2: Average turbidity obtained in the months following Revitalization

Source: own elaboration from the Wild region treatment sector; Sanitation, 2022.

From these values, you can find the graph with turbidity levels (Figure 12).

Furthermore, the detachment of the lamellar strips causes accumulation at the bottom of the settling tanks, obstructing the bottom discharge and, consequently, making the cleaning process difficult. This deficit was resolved by reinforcing the fixation of the lamellar system, as well as by structuring the steel cables – which provided uniform distribution of the acting loads. This way, it was possible to ensure the effective execution of cleaning. Furthermore, it can be stated that a closed cycle economy was adopted, in which 100% of materials were reused, either for the main purpose of the lamella or as a by-product in another production chain, promoting savings of around 70 %, referring to the total value of the lamellar profiles that would be used if there was no reuse - this value is around R$ 30,086.88 (Thirty Thousand Eighty-Six Reais and Eighty-Eight cents). It must also be noted that the disposal of the by-products generated also reduces

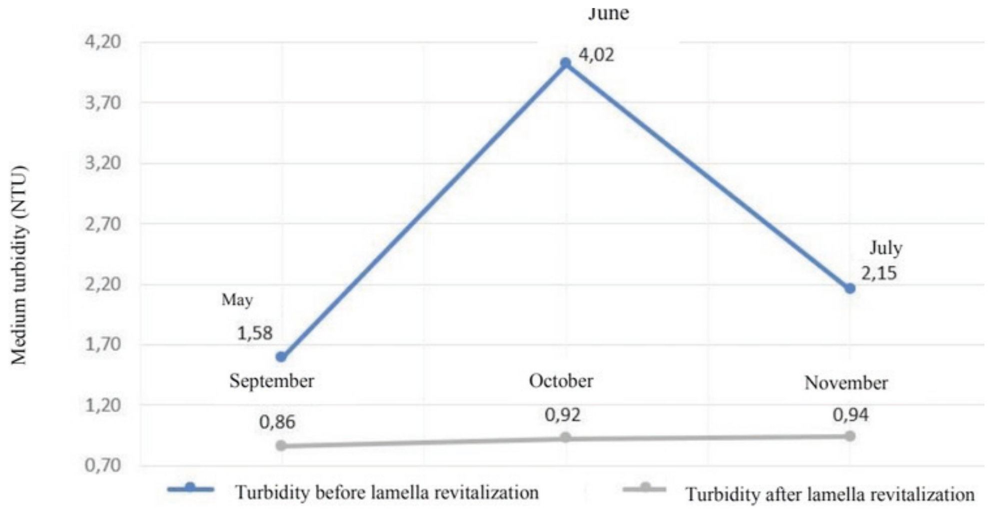

Figure 12 – Medium turbidity levels

Source: own elaboration from the Wild region treatment sector; Sanitation, 2022.

the environmental impacts arising from this service, contributing in a sustainable way to the environment.

CONCLUSIONS AND RECOMMENDATIONS

The results obtained in this study make it possible to conclude that it is possible to adopt construction methodologies based on innovation and sustainability. Thus, it appears that the use of steel cables in structures such as settlers, acting on the stability of lamellar blocks, is viable. These, together with rivets and stickers, make the lamella system resistant to the action of tensions that are applied during the water treatment process, without the lamellas moving. Furthermore, it was noted that this project directly influences the sustainable development objectives established by the UN, given that the use of high-performance decanters ensures drinking water and sanitation for more individuals and for an infinite period of time (SDG 6 – Drinking water and sanitation), just as the development of this service took place consciously, supported by sustainable pillars, thus contributing to SDG 12 (Responsible consumption and production).

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