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INTEGRATED MANAGEMENT OF SANITARY SEWAGE SYSTEMS

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Abstract: With the implementation of Sanitary Sewage Systems in 2012 and 2013, leveraged mainly by resources from FUNASA and CODEVASF and, consequently, operations starting in 2014 and 2015, the Companhia de Saneamento de Minas Gerais (COPASA MG) faced challenges with the Following the adoption of these Systems, the amount of sewage overflows became a very serious problem, causing negative impacts on society, also affecting the environment and even the final treatment of sewage. In an initial analysis, in the area of operation of COPASA MG's Januária Regional Management (GRJA), problems were identified with inexperienced teams, lack of equipment and inappropriate machinery, which made the execution of maintenance activities less efficient.

Faced with new challenges, there was a need for more in-depth management of the problems generated by overflows. The implemented practice consisted of a set of structured actions with the creation of a working group in order to identify the best actions that would impact the solution of the problem. The working group was initially composed of Management, the Technical Sector and the Sewage Chemical Technician. After critical analysis meetings using analysis and problem-solving tools such as Control Charts and Cause and Effect Diagrams, several actions were raised and listed in the EAP tool – Project Analytical Structure, among them are employee training, acquisition specific equipment for maintenance, construction of sandboxes, rental of vehicles with specialized implements. Another point of great relevance developed by the group was the creation of a calendar for service with the water jetting vehicle for predictive maintenance. With the implementation of the practice we can observe the evolution of the average annual results in the GRJA of the Sewage Overflow by Network Extension indicator. Furthermore, further results achieved were the reduction of impacts generated by overflows on the environment, improvement of the company's image in the eyes of customers and society, improvement of effluents in sewage stations and consequently the treatment results.

Keywords: Integrated management, operation of sewage systems, sewage overflow.

INTRODUCTION

Raw sewage that overflows from the system and returns to the environment without proper treatment affects the population's quality of life and can impact public health and the environment. In other words, the greater the tendency for sewage overflows to occur, the greater the need for improvements/ maintenance in the sewage system.

With the implementation of Sanitary Sewage Systems - SES, whose operations began in 2014 and 2015, the Regional Management of Company 1 faced challenges with the assumption of these Systems, such as the occurrence of sewage overflows, which became a very serious problem, causing negative impacts on society, also affecting the environment and even the final treatment of sewage. In the Regional Management of Company 1, through the Meetings system, during the analysis of the results, the root causes were identified as inexperienced teams, lack of equipment, inappropriate machinery and lack of adequate management tools for the SES, which made the execution of less efficient and effective maintenance activities.

Faced with the new challenges arising from the Sanitation Legal Framework, and aiming to meet the strategic objectives of Company 1, in 2019 the practice "Integrated Management of Sanitary Sewage Systems" was implemented with the aim of eliminating or mitigating the causes and effects generated by overflows. The practice is carried out routinely, using the operational structures and teams of the SES of the Regional Management of Company 1, through the analysis of SIGOS reports relating to sewage overflows by location and basin, which allows monitoring, controlling and preventive action in order to guarantee the effectiveness of the SES, enabling strategic decision-making, with the purpose of ensuring the efficiency of actions and improving the provision of sewage maintenance services, whether by in-house or outsourced teams. In addition, the Sanitation Information by Subject – ISAA platform is used, which allows the study of overflows on a georeferenced map, with the presentation of a heat map. After analysis, a calendar is prepared for service with the water jetting vehicle for preventive maintenance.

> According to Kardec and Nascif (2009), preventive maintenance is the opposite of corrective maintenance, as it obstinately seeks to avoid the occurrence of failures, that is, it seeks to prevent.
>
> "Maintenance carried out at predetermined intervals, or in accordance with prescribed criteria, intended to reduce the probability of failure or degradation of the functioning of an item" (NBR 5462, 1994).
>
> "It is the action carried out in order to reduce or avoid failure or drop in performance, following a previously prepared plan, based on defined time intervals" (PINTO; XAVIER, 1999 p. 35).

The reports analyzed by the team also direct the execution of services, such as: construction of sandboxes, manholes – PV, adaptation of collection networks and interceptors, among others. In addition to the actions mentioned above, the effectiveness of the practice is analyzed monthly, in critical analysis meetings, observing the evolution of the results of the Sewage Overflow by Network Extension and Efficiency in BOD Removal indicator, contributing to improving the image of Company 1.

The proper functioning of the Sanitary Sewage System from collection, transportation, treatment and final disposal requires a sequence with as few interruptions as possible, so that none of the steps interfere with the final result of the process. Unfortunately, inappropriate use of the facilities by customers tends to harm the process due to the large volume of garbage and rainwater dumped into the pipes, causing frequent blockages. This situation requires the development and application of new maintenance management methods.

According to Medeiros Filho, in the Sanitary Sewage Collection System, the majority of occurrences that require continuous maintenance work, mainly in the collectors, as 70 to 80% of blockages originate from the internal installations of contributing buildings, as a result of misuse of these installations, normally resulting from users' lack of awareness.

Pieces of wood, cloth, plastic, sand, gravel and other objects unsuitable for the environment, in addition to grease, are frequent reasons for causing problems and complications in the continuous functioning of the system. Medeiros Filho, (2005).

The present work aimed to eliminate or mitigate the causes and effects that generate sewage overflows in the 14 municipalities operated by GRJA of COPASA MG.

METHODOLOGY

The development of the practice took place with the creation of a working group in order to identify the best actions that would impact the solution of the problem. This group was initially composed of Regional Management, which would act as project manager, Project and Construction Technicians, responsible for compilation of data, contracting and implementation of the necessary works and Sewage Chemical Technician and Sewage

Supervisor who, having more specific technical knowledge, would permeate the other members providing information, data and technical support, the Systems Managers were also involved and were very important in the initial critical analysis, data collection and implementation of actions in the field. The project followed the following steps:

1. Meetings using analysis and problem-solving tools such as Control Charts, Brainstorming and Cause and Effect Diagrams.

2. Mapping and review of operational procedures.

3. Analysis and restructuring of the company's own staff and verification of needs for hiring outsourced workers.

4. Technical visits to Sanitary Sewage Systems to assess Strengths, Opportunities, Weaknesses and Threats.

5. Survey of new technologies and maintenance equipment and their respective costs.

6. Resource equation.

7. Team training and retraining.

8. Implementation of works and improvements.

9. Monitoring and controlling results.

The risks inherent to the project were also raised, highlighting those that could delay the progress of the actions, such as climate variations, unqualified service providers and budget insufficiency.

The operational strategies were planned in the short and medium term, continuously and aligned with the Company's interests, the mapping of the effluent collection, transport and treatment processes was fundamental for defining the most relevant actions and prioritizing activities, Among them are the training of employees, acquisition of specific equipment for maintenance, construction of sandboxes, rental of vehicles with specialized implements, another point of great relevance developed by the group was the creation of a calendar for servicing all Systems with the water jetting vehicle for predictive maintenance.

To assist group members with an overview of the work and with the purpose of organizing each stage of the process, distributing activities among team professionals, the EAP tool – Project Analytical Structure (Figure 1) was adopted, where everyone would have a overview of the actions to be developed.

As a systematic approach for developing the project, the stages of Diagnosis, Planning, Execution, Monitoring and Control were followed. After the initial surveys and understanding the causes, some solutions were arrived at that would impact the various Sanitary Sewage Systems of the Januária Regional Management, the project team distributed all tasks, prioritizing alternatives involving innovative solutions, always seeking to meet the company's objectives and guidelines.

To implement the first Diagnosis stage of the project, a tool of fundamental importance in support and already widely used by the company was used, it is the Structured Meeting System (Figure 2), where leaders meet periodically to make decisions.

The detail of the project phases with their respective responsible parties and deadlines was managed by the Gantt Diagram tool (Figure 2), facilitating the visualization of actions as well as the monitoring of executions. Course corrections were discussed in weekly project team meetings, where in addition to the physical financial schedule, all other aspects related to project management were monitored, such as meeting the scope, team communication, purchasing, risk

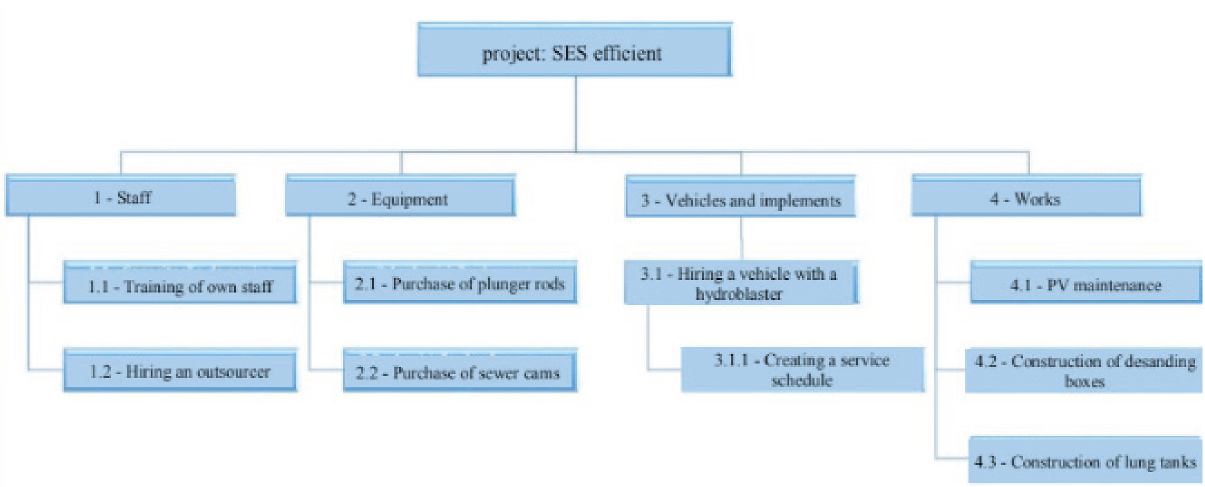


Figure 1 – Project Analytical Structure – EAP.

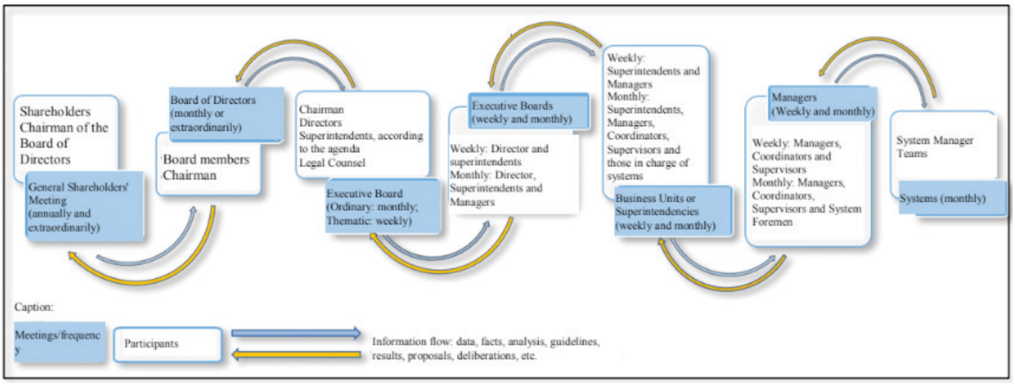
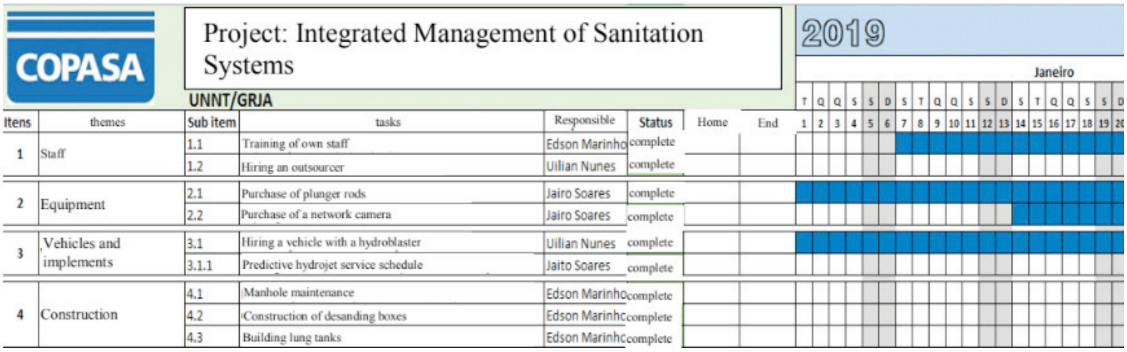


Figure 2 – Meeting System



Itens	themes	Sub item	tasks	Responsible	Status	Home	End
1	Staff	1.1	Training of own staff	Edson Marinho	complete		
		1.2	Hiring an outsourcer	Uilian Nunes	complete		
2	Equipment	2.1	Purchase of plunger rods	Jairo Soares	complete		
		2.2	Purchase of a network camera	Jairo Soares	complete		
3	Vehicles and implements	3.1	Hiring a vehicle with a hydroblaster	Uilian Nunes	complete		
		3.1.1	Predictive hydrojet service schedule	Jaito Soares	complete		
4	Construction	4.1	Manhole maintenance	Edson Marinho	complete		
		4.2	Construction of desanding boxes	Edson Marinho	complete		
		4.3	Building lung tanks	Edson Marinho	complete		

Figure 3 – Gantt Diagram

management and contracts.

The success of the practice can be attributed to the periodic meetings held between the project manager and the team, in addition, frequent field visits are highlighted with the aim of verifying the existence of operational problems.

RESULTS

Figure 4 shows a graph showing the evolution of the increase in the length of sewage networks in GRJA.

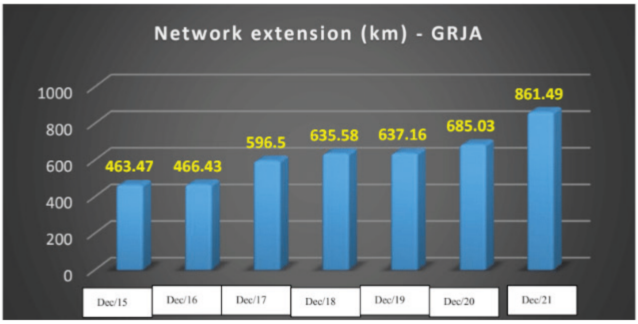


Figure 4 – Graph of the Network Extension indicator – GRJA.

With the application of the practice from 2019 onwards, even with the continuous increase in the length of networks, sewage overflows per 100km of networks decreased, showing the efficiency of the actions, as shown in the graph in figure 5.

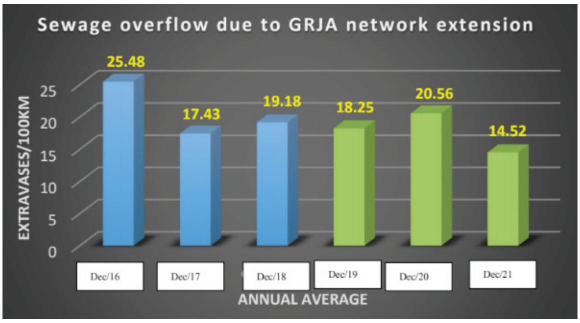


Figure 5 – Graph of the Sewage Overflow by Network Extension indicator – GRJA.

Figure 6 shows the degree of competitiveness that GRJA achieved with the implementation of the practice when compared to results from other regional reference managements of COPASA MG.

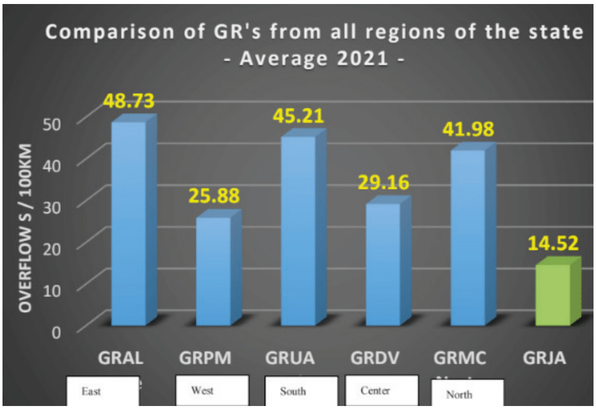


Figure 6 – Comparison of the Sewage Overflow indicator by GR's in all regions of the state.

The results of the GRJA BOD Removal Efficiency (%) performance indicator demonstrate how the actions developed with the new maintenance management methods were reflected in the final treatment. As well as the improvements implemented in the effluent collection and transport processes and consequently increasing their quality, the effects on the Sewage Treatment Stations were evident, as demonstrated in the graph below this indicator.

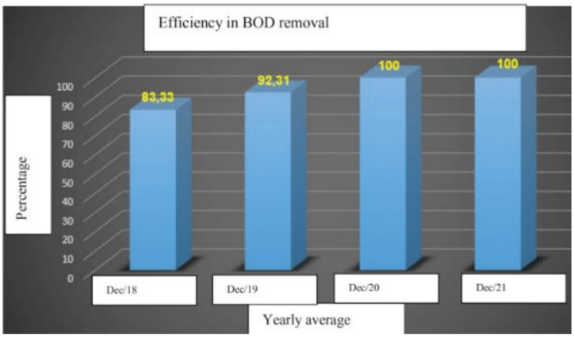


Figure 7 – Graph of the BOD Removal Efficiency indicator – GRJA.

ANALYSIS AND DISCUSSION OF RESULTS

From 2019, beginning of the practice, until 2021 there was an increase of 36% in the extension of sewage networks in GRJA, going from 636 km of networks to 862 km, despite this significant growth in practice, Integrated Management of Sewage Systems Sanitary - SES, proved to be efficient, which can be evidenced by the performance of the following indicators:

- Sewage overflow due to network extension;
- Reduction from 19.18 overflows per 100 km of networks in 2018 to 14.52 overflows per 100 km in 2021, a reduction of 24.3%;
- Efficiency in BOD Removal
- With the increase in the quality of effluents as a result of the implemented actions, the efficiency in the treatment of ETE's also achieved a substantial gain, evidenced in the BOD Removal Efficiency indicator of 79.86% in 2018, reaching 89% in 2019 and finally the efficiency maximum of 100% in 2020 and 2021.

CONCLUSIONS/ RECOMMENDATIONS

After developing actions, training, investments and control, we understand even more that the universalization of quality and sustainable water and sewage services is our daily commitment to our customers, as we understand our contribution, through of our services, for socioeconomic development and people's quality of life.

We further reinforce our perspective that, with adequate training and qualification, the partnership between our own and outsourced employees can generate value for our business and contribute to the dissemination of environmental awareness, in addition to the fact that, together, we can work to reduce and contain social and environmental impacts of our operations. We are protagonists in the development of the places where we provide our services and contribute to social and economic development.

The partnership developed with outsourced teams provided maturity and constancy of purpose, reflected in the processes and consequently observed in the results we seek.

Another very important lesson learned was the adoption of actions with a preventive, responsible and proactive approach. The gain in productivity is very large when we act in advance of problems occurring, especially environmental challenges.

Currently, most companies are getting involved with the ESG agenda, seeking to balance environmental, social and governance aspects in business management, seeking to ensure competitiveness, longevity and sustainable development. In view of this, it is understood that responsible management such as the practice described is solidly consistent with this new reality, which makes it fully applicable in other COPASA MG Regional Managements.

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