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MANAGEMENT OF HOSPITAL WASTE IN MAINTAINING THE ENVIRONMENT

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ABSTRACT

Management of Hospital Waste in Maintaining the Environment. Several areas in Indonesia need more well-developed sanitation infrastructure. Some industries and companies use domestic wastewater disposal systems outside the leading network, a cheaper alternative to centralized systems. The sewage treatment system in these areas typically consists of a septic tank and a medium-scale household wastewater treatment plant. This study aimed to evaluate the effectiveness of SMEC Eye Hospital's liquid waste management after it has been processed through its wastewater treatment system. This experimental research involves managing the liquid waste at SMEC Eye Hospital using an anaerobic-aerobic upflowed biofilter system. The experimental method adheres strictly to a scientific research design. The processed liquid waste is then tested in the laboratory to measure levels of pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), ammonia, oils and fats, and total coliform. The liquid waste from SMEC Eye Hospital was analyzed to determine if the hazardous substances had been reduced or eliminated to meet environmental safety standards. Laboratory tests on the hospital's liquid waste outlet showed that all parameters, including pH, BOD, COD, TSS, ammonia, oil and fat, and total coliform, were within the quality standard limits. To further enhance the environmental safety of the waste, seven steps can be taken to reduce levels of pH, BOD, COD, TSS, ammonia, oil and fat, and total coliform. These measures ensure that the liquid waste from the hospital does not harm the environment.

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INTRODUCTION

Several areas in Indonesia lack well-developed sanitation infrastructure. Some industries and companies that generate waste use domestic wastewater disposal systems outside the main network. This is a cheaper alternative to a centralized system. The sewage treatment system used in this area consists of a septic tank and a medium-scale household wastewater treatment plant. However, since 2016, the use of septic tanks for sewage treatment has increased due to the government's obligation to manage their respective wastes. According to records, 2 million 333 thousand such installations are used in Poland, and approximately 91% of them use the septic tank system [(1)].

The septic tank system is an alternative for some companies due to its low cost and minimal land use. Among other things, wastewater treatment plants focus on the issue of sustainability through energy and nutrient recovery from wastewater. Aeration is one of the most energy-consuming processes in conventional activated sludge systems using wastewater treatment technology. Oil and gas exploration and production result in substantial, high-salinity wastewater discharged from offshore oil rigs. As a first step, physical and electrolytic treatment methods are used. Downstream applications of membranes are of particular interest, including in hospital wastewater. The membrane bioreactor is a technology that has recently been applied to wastewater treatment with the goal of reusing treated water and improving the water's environmental sustainability (2).

The results of Ascon's research indicated that the electrocoagulation process in liquid five was very efficient in removing phosphorus, while for nitrogen, the efficiency decreased significantly. Electrocoagulation, however, has an advantage over other conventional processing technologies in that it does not require an additional processing unit to remove phosphorus (3).

Among the many water treatment methods currently practiced (both in municipal treatment plants and in industrial water treatment processes), the coagulation method, which allows the removal of contaminants of various origins, is most frequently used. (4). This method is simple, allows the use of different coagulants, and is quite effective. However, with coagulation, it is often impossible to carry out advanced purification of water that will be reused in the production cycle, which requires additional repair operations, such as adsorption. As is well known, adsorption is one of the most common methods of removing pollutants from liquid waste because the adsorption process will produce high-quality, well-designed processed waste. For this reason, ferrous coagulants are often used along with secondary treatment that involves adsorption on activated carbon in the traditional way of treating industrial wastewater (4).

One tried-and-true way to speed up the wastewater treatment process is to treat the biomass part of the activated sludge using either physical or chemical crushing methods. This is different from the biochemical purification scheme, which involves regenerating the activated sludge (5).

A hospital is a company that contributes to environmental pollution because almost every day it produces solid waste and liquid waste, which is very dangerous for the environment. The entire process of providing health services results in the production of these wastes. The types of wastewaters produced in hospitals can be divided into three categories, namely: domestic wastewater, clinical wastewater, and laboratory wastewater (6). In general, the hospital's sewage treatment system is managed independently by a wastewater treatment plant that uses a septic tank (7).

The Medan SMEC Eye Hospital also uses an aerobic-aerobic upflowed biofilter system to manage the wastewater it produces. There are many benefits to this system, such as its ability to lower the amount of organic matter and high-suspended solids, slow down the movement of particles in water, lower the number of high-phosphorus compounds, absorb biological oxygen demand (BOD) to lower the BOD content after the filter process, and raise the oxygen level through the aeration process.

By utilizing this process, the wastewater produced by the SMEC Eye Hospital after this process will be minimal and below the permissible threshold for the surrounding environment. Thus, the wastewater disposed of by the eye hospital will not affect or damage the environment. This study aimed to determine how well the management of the SMEC Eye Hospital manages the liquid waste produced by the hospital after going through the wastewater treatment system.

MATERIALS AND RESEARCH METHODS

The method in this research is an experimental research method carried out by the management of liquid waste at the SMEC eye hospital with an anaerobic-aerobic up flow biofilter system. Experimental research is a study that strictly adheres to a scientific research design[8]. It includes a hypothesis, a variable that can be manipulated by the researcher, and variables that can be measured, calculated and compared. Most importantly, experimental research is completed in a controlled environment. The researcher collects data and results will either support or reject the hypothesis[8].

The results of the resulting liquid waste are then tested in the laboratory to determine the levels of water pH, BOD, Chemical Oxygen Demand (COD), Total Suspended Solid (TSS), Ammonia, oils and fats, and total coliform. The liquid waste produced by the SMEC eye hospital will be analyzed to determine whether the content of hazardous substances in cir waste has been reduced or even eliminated so that it does not interfere with the environment. The levels of elements of liquid waste that are approved as the applicable environmental quality standard limits in Indonesia are stated in the following table.

Table 1. Liquid Waste Quality Standard Limits

Element Parameters	Units	Quality Standard Limits
pH		6-9
BOD	mg/l	30
COD	mg/l	100
TSS	mg/l	30
Ammonia	mg/l	10
Oil and fat	mg/l	5
Total Coliforms	Jlh/100 ml water	3000

RESULTS OF RESEARCH AND DISCUSSION

The laboratory tested the liquid waste produced by the SMEC eye hospital over a period of six months, from January 2019 to June 2019, and obtained the following results:

Table 2. Liquid Waste Measurement Results

Element Parameters	Units	Laboratory Outlet Results						Note
		January 2019	February 2019	March 2019	April 2019	May 2019	June 2019	
pH		7.33	6.83	6.02	8.14	7.93	7.01	M.S
BOD	mg/l	26.8	20.6	18.4	24.8	22.8	22.6	M.S
COD	mg/l	61.82	45.97	42.74	56.84	50.04	44.17	M.S
TSS	mg/l	27	22	20	26	23	25	M.S
Ammonia	mg/l	0.91	0.16	0.11	0.27	0.19	0.62	M.S
Oil and fat	mg/l	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	M.S
Total Coliforms	Jlh/100 ml water	460	110	90	180	90	180	M.S

Based on table 2 above and comparing it with table 1, it is concluded that each element of the parameters of liquid waste produced from the SMEC Eye Hospital as a whole has met the established quality standards, so it can be safe for the environment. If you pay attention, the pH level of the resulting water ranges from 6.02 to 8.14. This means that the quality of the liquid wastewater produced still meets the recommended level of water that is safe for human consumption, so it can be stated that the wastewater will also be safe for the environment, as stated by the Environmental Protection Agency (EPA) in the United States. The level of biochemical oxygen demand in wastewater is between 18.4 mg/l and 26.8 mg/l, which is below the established quality standard threshold. Likewise, the chemical oxygen demand levels were between 42.74 mg/l and 61.82 mg/l, which were below the established quality standard threshold. This means that the dissolved oxygen content in the water is still good, so aquatic organisms can still live properly.

According to Kerubun, high BOD and COD content can cause a decrease in dissolved oxygen content in the waters, which can lead to the death of aquatic organisms [7]. High levels of BOD and COD are feared to pollute water bodies still used by residents for their daily needs, causing itching (dermatitis) and diarrhea, and potentially leading to death if exposed for an extended period [9]. Determining the COD element enables an assessment of wastewater's susceptibility to biological treatment, identifies pollutants that are difficult to break down, and reduces the effectiveness of biological wastewater treatment. A distinction is made between compounds that are readily biodegradable, nearly non-biodegradable, and non-biodegradable [10]. According to Ignatowicz and Smyk (2020), an increase in the number of easily available carbon compounds has contributed to an increase in denitrification rate [10].

The TSS levels produced by wastewater indicate that they are still below the established quality standard threshold, which is between 20 mg/l and 27 mg/l. TSS is considered very important for the environment because it is closely related to water turbidity. The higher the TSS value, the cloudier the water will be. High TSS will block sunlight from entering the water, thus blocking the photosynthesis process and reducing dissolved oxygen levels. In addition, suspended solids will reduce the penetration of light or rays into the water, thereby affecting oxygen and photosynthesis [11]. Likewise, other elements such as ammonia, oil and fat, as well as total coliform, are also below the quality standard threshold set so as not to endanger the environment and the aquatic organisms that live in it. Observing the processing process reveals that there are seven steps involved in producing high-quality waste for the surrounding environment:

1. Equalization: This process is aimed at dividing and leveling the volume of supply (effluent) to enter the treatment process, leveling the variables and fluctuations of the organic load to avoid shock loading in the biological treatment system, leveling the pH to minimize the need for chemicals in the neutralization process, and leveling the solids content to minimize the need for chemicals in the coagulation and flocculation processes, as well as reducing the load of particles for the biofiltration process.
2. Pre-sedimentation: This process is intended for the initial sedimentation process, where the suspended matter is deposited by gravity. In this tub, the fat separation process is also carried out so that the processing load is ready for the next process. This tub will also reduce TSS levels and help neutralize the water temperature.
3. An-Aerobic Biofilter: This tub is filled with solid media, which will be useful in processing carbon organic materials in wastewater. In principle, this tank does not require oxygen, and the gases resulting from the decomposition (fermentation) of microorganisms are released through the ventilation holes that are installed at the top of the tank and under the sludge drainage channel installed below the tub.
4. Aerobic Biofilter: This tub is filled with plastic media with a diameter of 2.5 meters. The goal is to remove organic matter, phosphorus and ammonia from nitrates. In this tub, there are aerobic microorganisms, facultative bacteria, fungi, algae, protozoa, higher animals, and insects.
5. The process of adding chlorine to liquid waste is referred to as chlorination. Its purpose is to disinfect wastewater and remove its odor, so that it does not pollute the air.
6. Late sedimentation is the process of releasing suspended particles into wastewater via gravity. This tub also functions to remove fine, unprocessed particles from the previous processing unit and the floc produced by the coagulation process.
7. Bioindicators are used as an effluent indicator to determine whether the processed water is no longer harmful to the environment. This tub can be filled with high-

sensitivity fish, such as goldfish (Cyprinus carpio), to test the safety of the water treatment results.

The installation utilized by the SMEC eye hospital consists of highly efficient equipment to clean the filtering elements during the realization of the work process, which provides high and stable maintenance productivity. Simple installations are usually quite reliable and have low energy costs [(12)]. The main operational parameters of some simple installation models differ, including changes in the cross-sectional area of the filtering elements and the productivity of the work process, the frequency of cleaning the grids and screens, and the electrical power required for the installation drive [(12)].

The area after the disposal of treated wastewater will experience a twofold increase in the rate of nitrification in the water layer, compared to the area before discharge [(13)]. Biochemical and microbiological indicators of nitrification in activated sludge from wastewater treatment facilities have been established according to established process standards. No doubt that the release of sewage and bacteria that break down nitrogen from facilities that do biological treatment with nitrification (but not denitrification) makes the nitrification process stronger in the natural reservoir water layer further downstream.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of laboratory tests carried out on the outlet of liquid waste produced by the SMEC eye hospital, it shows that:

1. Each element of liquid waste parameters such as: pH, BOD, COD, TSS, ammonia, oil and fat, and total coliform is within the specified quality standard limit.
2. There are seven steps that can be taken to reduce levels of pH, BOD, COD, TSS, ammonia, oil and fat, and total coliform so that it is safe for the environment.

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