Effectiveness Of Utilizing Bacteria In Processing Liquid Waste In Hospitals

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Abstract— There are many ways that can be done to treat liquid waste so as not to pollute the environment. One of them is with anaerobic-aerobic biofilter system which in its application utilizes natural microorganisms in wastewater. One of the bacteria used in the treatment of liquid waste, namely the use of EM4 in improving the efficiency of biofilter in wastewater treatment proved effective in reducing levels of Biological Oxygen Demand (BOD). This type of research is a quasi-experimental study. Design of more than 2 sample groups aims to determine the decrease in BOD levels in hospital wastewater through the use of EM4 bacteria with levels of 1 mg and 3 mg for 72 hours and 168 hours and the addition of aerators in the home sample sick in Deli Serdang Regency. The results of the study proved that the use of EM4 bacteria with a level of 3 mg for 168 hours with the addition of aerators most effectively reduced BOD to 84.6%. Hospitals should use a wastewater treatment system utilizing microorganisms to reduce the impact of waste while increasing the efficiency of financing.

Index Terms— Waste water, BOD, EM4 Bacteria

1 INTRODUCTION

Bacteria are one of the important microorganisms in the world, because almost all processes that take place in nature involve bacteria as microorganisms that play a role in the process. One of the bacteria that is often used in life is the EM4 bacteria, where one of the benefits is increasing the efficiency of biofilter in wastewater treatment in reducing organic pollutants. Jasmiati's research, et al (2010)[1] revealed that the removal of BOD and COD levels reached 98.65% and 89.95% on the thirteenth day.

Many types of waste can be decomposed by EM4 bacteria, one of which is hospital wastewater, especially many infectious ones that are still not managed properly. Most of the infectious waste management is compared to non-infectious medical waste. In addition, often mixed between medical and non-medical waste. Medical waste requires special management that is different from non-medical waste. Medical waste includes infectious waste, radiological waste, cytoksius waste and laboratory waste. Most infectious waste is discharged into septic tanks which can cause pollution, especially in ground water which is widely used by the community for daily needs.

Liquid waste can be a source of pollution that is very dangerous for the aquatic environment. The waste can be harmful to both humans and aquatic biota (Sukma, 2011)[2]. Therefore, the processing of liquid waste becomes increasingly important to be handled appropriately to secure water resources that are needed because the water is very limited and close to humans.

Protection against these hazards is determined by the Government, based on Government Regulation No.19 / 1994[3] Article 4 that every person or business entity is prohibited from disposing of waste directly into land, water or air. Therefore the hospital as one of the producers of liquid waste needs to have a good and comprehensive waste treatment, so that the hospital feels comfortable, fresh and maintained by its environmental health that can be felt by patients, workers, visitors, and the surrounding community.

One effective way to treat liquid waste so as not to pollute the environment is by utilizing microorganisms. Through waste treatment of anaerobic-aerobic biofilter system which in practice utilizes natural microorganisms in wastewater by formulating them on certain media to form biofilms (Prayitno, 2011)[4]. Based on research conducted by Nurdijanto, et al (2011) that the bio-aerobic filter bio system has been carried out and proven by anaerobic-aerobic biofilter system can reduce BOD 84.93%, COD 72.22% and TSS 76.71% with time only 16 hours after processing for 1 bulandi RS. Kristen Tayu.[5]

Likewise research conducted by Said, et al (2011) at the hospital. Elizabeth Situbondo proved that the IPA of anaerobic-aerobic biofilter system can reduce BOD from 100 mg / l to 12 mg / l and COD 170 mg / l to 30 mg / l. After the WWTP operates for 2 months all the parameters go down to meet the standard set which has been set.[6] Anaerobic-aerob combination bioflter has proven to be efficient in treating hospital wastewater. Therefore, the researchers intend to test the model to be applied to hospitals in Deli Serdang with different compositions from those that have ever existed.

2 LITERATURE REVIEW

Waste Treatment System

Waste treatment by utilizing processing technology can be carried out by physical, chemical and biological methods or a combination of these three treatment systems. Biological waste treatment can be classified into the processing of aerobic methods and waste treatment by anaerobic methods. Based on the operating system, waste processing technology is divided into physical operating units, chemical operating units and biological operation units. Meanwhile, when viewed from the level of treatment of processing the waste treatment systems are classified into: pretreatment, primary treatment system, secondary and tertiary treatment system treatment system (Prime Ginting (2007)[7]

Waste water treatment technology is the key to maintaining environmental sustainability. Whatever type of indus-

trial wastewater treatment technology is built must be operated and maintained by local companies. Various wastewater treatment techniques to eliminate pollutant materials have been tried and developed during ini.Teknik wastewater - processing techniques that have been developed are generally divided into three processing methods: the physics processing, chemical processing, and biological treatment. For certain types of wastewater, the three processing methods can be applied individually or in combination.

Biological Oxygen Demand (BOD)

BOD examination in waste is based on the oxidation reaction of organic substances with oxygen in water where the process can take place because there are a number of bacteria. Calculated for two days of reaction more than part of the reaction has been achieved (Perdana Ginting, 2007)[7]. BOD inspection is one of the most important test examinations to determine the polluted power of wastewater.

Biochemical examination that measures organic substances that are likely to be oxidized by aerobic bacterial activities within 5 days at 200 C. The method of examination is with Winkler (Titration in the Laboratory), and uses the following analysis principles; Examination of BOD parameters is based on the oxidation reaction of organic substances with oxygen in the water and the process takes place because of the presence of aerobic bacteria. To decompose organic matter takes ± 2 days for 50% reaction, 5 days for 75% reaction is achieved and 20 days for 100% reaction is reached.

Effective microorganisms-4 bacteria (EM4)

The development of the use of microorganism resources in Indonesia has not been so rapid in technology, but has slowly been developed. One of the probiotic microorganisms that have been able to be produced domestically in the form of liquid-shaped culture media that can be stored for a long time is EM4 (Effective Microorganisms-4). This EM4 bacteria contains 90% of the Lactobacillus sp. (Lactic acid-producing bacteria) phosphate solvent, photosynthetic bacteria, Streptomyces sp, cellulose-degrading fungi and yeast. This EM4 bacteria is an addition to optimize the utilization of food substances because the bacteria contained in EM4 can digest cellulose, starch, sugar, protein, fat.

3 METHODS

Test location

The location of the testing was carried out at the basic laboratory at the Faculty of Mathematics and Natural Sciences, Medan State University.

Materials and tools

The materials used in this study include liquid waste taken from one hospital in Deli Serdang District, chlorine, clean water, and EM4 bacteria. While the tools used in this study include, among others, a tub of waste water and processing, pipes, mini air generating pumps

Mechanism

The implementation mechanism of this research can be explained as follows;

1. In general, processing is carried out using a liquid waste treatment system using an active sludge system.
2. Wastewater from the hospital is collected and put into the waste water reservoir that has been prepared. This storage tank functions as a wastewater discharge regulating tub equipped with a rough filter to separate large dirt.
3. Waste water in the reservoir is pumped to the initial settling tank. The initial settling basin functions to reduce suspended solids and BOD.
4. Water from the initial settling basin is then flowed to the aeration bath naturally through gravity. In this body, wastewater is assisted by air blowing so that the micro-organisms that are present break down the organic substances in it. At this stage it will be divided into 6 tubs, each of which will be added with 1 mg of EM4 bacteria as many as 3 tanks, and 3 mg of EM4 bacteria as many as 3 mg. Two tanks containing 1 mg and 3 mg will be left for 72 hours and the rest will be soaked for 168 hours, then 2 tanks containing 1 mg and 3 mg will be added with aerator.
5. After that the water is flowed to the final settling basin. In this body activated sludge containing the mass of deposited micro-organisms is precipitated first
6. After that, it will be channeled to the chlorine basin. In this body, wastewater is contacted with chlorine to kill pathogenic micro-organisms.
7. Processed water, namely water that comes out after the chlorination process can be immediately discarded

Data analysis

The analysis used in this study is used to describe descriptively the frequency distribution and the proportion of each variable studied both dependent and independent variables. Data analysis will use the Kruskal Wallis test to measure samples free.

4 RESULTS AND DISCUSSION

RESULTS

The results showed that there was a change in the BOD kadaer in the liquid waste that had been intervened with several combinations, while the results can be seen in the following table,

Table 1. Changes in BOD levels of liquid waste before and after several treatments

Sampel	BOD Before (mg/l)	BOD After (mg/l)	Difference (%)
EM4 (1 mg) 72 hour	560	375	33,0
EM4 (3 mg) 72 hour	560	356	36,4
EM4 (1 mg) 168 hour	560	253	54,8
EM4 (3 mg) 168	560	147	73,8

hour			
EM4 (1 mg) 168 hour with added aerator	560	98	82,5
EM4 (3 mg) 168 hour with added aerator	560	86	84,6

Table 1 shows that there was a 33% decrease in the BOD value in the sample that received 1 mg of EM4 bacteria. Then there was a 36% decrease in the BOD value in the sample that received 3 mg of EM4 bacteria. Although the number of EM4 given is different, only a few changes occur.

Then based on the mixing time it was found that there was a change of 54.8% in the sample with a mixture of 1mg EM4 and there was a change of 73.7% in the sample with a mixture of 3 mg EM4 with 168 hours and normal aerator.

Whereas in the sample with the addition of aerator there was a significant change in the sample with a number of 1 mg and a time period of 168 hours at 82.5% and in the sample with a total of 3 mg 168 hours long by 84.6%.

Descriptively it can be seen that there is the biggest change when using EM4 3 mg mixture for 168 hours with the addition of aerator, where there is a decrease in the number of BOD reaching 84.6%.

After obtaining the results descriptively it was tested to measure the effect of the method used to decrease BOD, based on the results of the test using Kruskall Wallis, the results were obtained as in the following table,

Table 2. Results of the Analysis of the Difference in the Average Value Using Kruskall Wallis

Variable	Mean	SD	p
EM4 (1 mg) 72 hour EM4 (3 mg) 72 hour EM4 (1 mg) 168 hour EM4 (3 mg) 168 hour EM4 (1 mg) 168 hour with added aerator EM4 (3 mg) 168 hour with added aerator	389,58	197,78	0,012

Table 2 shows that in the 95% confidence level it is known that the proportion value in the test results is p = 0.012 where p <0.05. This shows that there are differences in BOD levels in the sample before and after the application of the method. This means that the application of the EM4 mixing method, the length of the day and the addition of aerator significantly influence the decrease in BOD levels in the sample.

Discussion

a. Analysis of the amount of EM4 content to decrease BOD

Descriptive results showed that there was a change of 36.4% when mixed with EM4 3 mg, where the results were not much different from the sample with the amount of EM4 of 1 mg.

Rizky's (2013) research proves that liquid waste treated with EM-4 doses of 1 ml / l, 2 ml / l and 3 ml / l can reduce the BOD value to reach 112.75 mg / l, 98.82 mg / l and 82.44 mg / l with the effectiveness of each reduction of 55.43% for a dose of 1 ml / l, 60.94% dose of 2 ml / l and 67.41% at a dose of 3 ml / l. Doseis which is added to the sample effectively affects the decrease in BOD levels of tofu liquid waste shown by the decreasing BOD levels along with the addition of EM-4. doses.[8]

Effective Microorganism 4 (EM4) which is a mixed culture of fermented and synthetic microorganisms that work synergistically to ferment organic matter. In waste containing organic matter there are substances which are food for microorganisms that will be used in the active sludge process, namely EM4. The sludge process is biologically active in line with the use of EM4, where wastewater and activated sludge are mixed in a reactor or tub containing an aerator. Biologically active solids will oxidize biological substances in wastewater, which at the end of the process will be separated by a precipitation system.

b. Analysis of EM4 immersion day length to decrease BOD

Descriptive results showed that there was a change of 73.8% when mixed with EM4 3 mg for 168 days where the results were quite different from the sample with the amount of EM4 of 1 mg with the same day.

This supports Susanto's (2012) research that the longer microorganisms are soaked in activated sludge, the better it will be in reducing BOD levels in the waste.[9] Likewise with Sato's research (2015) which shows that the decrease in the value of organic content in tofu wastewater industry is strongly influenced by the length of stay in each process, the longer the residence time the efficiency that is produced is also higher.[10]

Biochemical Oxygen Demand (BOD) is the amount of organic substances in solution or waste that can be oxidized by aerobic bacteria or can be said the amount of oxygen used to oxidize certain amounts of organic substances in aerobic conditions. BOD is an indicator of organic pollution in a waters. Waters with high BOD values indicate that the water is polluted by organic matter. Microbes through an aerobic and anaerobic oxidation system will stabilize biologically by involving organic matter.

c. Aerator Addition Analysis on BOD reduction

Descriptive results showed that there was a change of 84.6% when mixed with EM4 3 mg for 168 days with the addition of aerators where the results were not much different from the sample with the amount of EM4 of 1 mg with the same day and the addition of aerators. However, it differs greatly from the initial conditions.

This is in line with the research of Jasmiyati (2010) which proves that the interaction between effective microorganisms (EM4) and liquid waste goes well.[11] EM4 bacteria are bacteria that degrade waste with the help of free oxygen, so that by adding aeration continuously the waste treatment process is better. Therefore microorganisms that multiply rapidly help decompose pollutant compounds to be more effective. It can be concluded that the effectiveness of microorganisms (EM4) is estimated to be more active in degrading the organic content of liquid waste with the help of aeration.

4 Conclusion

There are differences in BOD levels in the sample before and after the application of the method. The biggest change is when using EM4 3 mg mixture for 168 hours with the addition of aerator, where there is a decrease in the number of BOD reaching 84.6%.
The hospital should develop technology for processing sludge activated sludge by utilizing EM4 bacteria before disposing of liquid waste to the water bodies around the hospital.

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