Effectiveness of Liquid Probiotics from Organic Waste to Treat Hotel Domestic Waste

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Abstract

With the hotel business rapidly growing, the emergence of pollution is increasing from year to year, including wastewater. Several processes are available to treat domestic wastewater. One of the biological processes that will be used is by using probiotics. This study aims to analyze the effectiveness of liquid probiotics from organic waste to treat domestic wastewater. The parameters observed in this study were PH, BOD₅, COD, TSS, oil and fat, ammonia, and total coliform. In this study, two types of treatment were applied, namely treatment I (liquid waste only) and treatment II (probiotics + wastewater from the WWTP aeration process). The volume of the wastewater is varied in treatment II. The mixing contact times used were 24 hours, 42 hours, and 72 hours. The best result is seen in Ammonia with 24 hours of aeration of wastewater and a mixture of 150 ml/liter probiotics. The improvements that meet the government's threshold value (TLV) are total coliforms in experiments with wastewater aeration for 42 hours and a mixture of 100 ml/liter probiotics. The total coliforms improvement was seen in the 72-hour aeration experiment of wastewater and a mixture of 100 ml of probiotics.

Keywords: *probiotics, domestic hotel wastewater, organic waste, aeration, waste water treatment*

Abstrak

Seiring dengan bisnis hotel yang berkembang pesat, polusi semakin meningkat dari tahun ke tahun, termasuk air limbah. Beberapa proses tersedia untuk mengolah air limbah domestik. Salah satu proses biologis yang akan digunakan adalah dengan penggunaan probiotik. Penelitian ini bertujuan untuk menganalisis efektivitas probiotik cair dari sampah organik untuk mengolah air limbah domestik. Parameter yang diamati dalam penelitian ini adalah PH, BOD₅, COD, TSS, minyak dan lemak, amoniak, dan total koliform. Pada penelitian ini dilakukan dua jenis perlakuan, yaitu perlakuan I (limbah cair saja) dan perlakuan II (probiotik + air limbah dari proses aerasi IPAL). Volume air limbah divariasikan pada perlakuan II. Waktu kontak pencampuran yang digunakan adalah 24 jam, 42 jam, dan 72 jam. Hasil terbaik terlihat pada parameter amoniak dengan aerasi 24 jam air limbah dengan campuran probiotik 150 ml/liter. Perbaikan yang memenuhi ambang batas pemerintah (TLV) adalah total koliform pada percobaan dengan aerasi air limbah selama 42 jam dengan campuran probiotik 100 ml/liter. Peningkatan total koliform terlihat pada percobaan aerasi 72 jam air limbah dengan campuran 100 ml probiotik.

Kata Kunci: *probiotik, air limbah domestik hotel, sampah organik, aerasi, pengolahan air limbah*

1. Introduction

The industrialization process in a country causes changes in various fields of life. Three important factors play a dominant role, namely: changes in the pattern of people's income, the work system of the population, and waste that is disposed of in the surrounding environment. Waste discharged into the environment comes from various activities, such as textile factories that produce carcinogenic dyes. Gold mining waste, one of the causes of mercury pollution in river sediments, can occur due to natural processes (weathering of mineral rocks), traditional gold extraction (amalgamation), and industrial processes that use raw materials containing mercury [1]. As well as the development of the city causes the growth of hotels, which later increase the amount of domestic liquid waste.

The increase in the number of hotels in Semarang City has a negative impact that cannot be considered simple, namely an increase in the generation of waste, especially organic waste and liquid waste. This waste problem needs to be addressed properly because it can cause environmental pollution both in drainage and on the surface of the receiving land which also will impact humans and other living things. Environmental pollution due to waste generated by hotels will be even greater if hotel waste disposal is

carried out directly without prior treatment. This can result in groundwater being inappropriate for consumption and soil contamination. In addition, hotel wastewater can also cause odors that can disturb the comfort of the surrounding environment. Sewage treatment system is very important to be owned by every hotel. Through appropriate processing, the wastewater can be treated so that the hotel waste will not be dangerous due to the concentration of pollutants has decreased to minimize the negative impacts caused by pollution. Wastewater treatment generally does use three kinds of processes, namely the processes of physics, chemistry, and biology. One of the biological processes is by addition or combination with probiotics.

In the hotel industry, generated waste consists of several types, namely (a) Organic waste, the source comes from the residual of the kitchen, restaurant, garden processes; (b) Inorganic waste, the biggest source comes from wedding activities or events, hotel rooms; (c) Domestic wastewater, the largest source comes from the use of bathrooms by hotel guests; and (d) Hazardous Waste Materials, the biggest source of equipment maintenance activities. Of the waste produced, the largest volume of waste is organic waste from the kitchen and domestic liquid waste. The resulting organic waste is managed by being collected in organic waste bins. The resulting domestic liquid waste is managed using WWTP (Wastewater Treatment Plant).

One of the efforts to manage liquid waste is to use a biological treatment unit. Biological treatment is the decomposition of organic matter contained in water by microorganisms so that simple chemicals in the form of elements and minerals are readily and safely disposed of into the environment. The purpose of biological wastewater treatment is to remove and stabilize dissolved organic pollutants carried out by microorganisms. In recent years, there has been increasing interest in the use of probiotic bacteria in aquaculture and in improving water quality. Because probiotic bacteria directly absorb or decompose organic materials or toxic substances in the water, thereby improving water quality [2].

2. Materials and Methods

This study was held in March 2021, at Patra Semarang Hotel and Convention. Organic waste that comes from the kitchen will be used as a base for making probiotic liquids. The trash from probiotics process can be used to make compost. However, this article will focus on the use of probiotics for domestic wastewater treatment at WWTP. Probiotics are live microorganisms, which in sufficient quantities to provide benefits. In this study, probiotics were produced by utilizing some organic waste from the kitchen through the process of decay. An experiment was carried out on the addition of probiotic bacteria to the aerobic unit, but using a laboratory scale to assess changes in the quality of waste water that occurs. This study used multiple variable timing and number of probiotics. The probiotics are mixed with 1000 ml of liquid waste sample.

Making Probiotics

In this study, the probiotic used is self-produced probiotics by using organic waste materials from a hotel. The materials and equipment used for the manufacture of probiotics are as follows.

Table 1. Experimental materials and equipment

Substance	Equipment
1. Sugar	1. Plastic bucket / drum Capacity of 20 liters: 1 Pc
2. Rice flour	2. Gauze for the bucket cover: sufficiently
3. Broiler chicken feed / BR	3. Rubber tires for fastening: sufficiently
4. Yeast tape	4. Small Aquarium Aerator : 1 Pc
5. Pineapple rind / pineapple fruit	
6. Raw tuna	
7. Yakult	
8. Ripe coconut water	
9. Clean Water (eg: Mineral Water, other than PDAM water)	

Source: Author's research and analysis (2021)

First, all the ingredients above are mixed into a plastic bucket or drum until blended. Attach the hose to the submerged aerator tank until the bottom of the bucket or drum and close the bucket or drum with gauze to avoid dirt into the container. Aeration for 7 x 24 hours non-stop. On the 7th day probiotics are ready for use.

Existing Type of Wastewater Treatment

The current domestic wastewater treatment uses physical, biological and chemical treatment. The processing units used are Equalizing, Aeration, Sedimentation, Clarification. Each processing unit consists of 2 (two) units that operate in parallel, this is to anticipate if there is damage to one unit, the processing can still run using other units. **Figure 1** is a picture of the existing processing unit:

Figure 1. Existing processing unit of WWTP
Source: Author's research and analysis (2021)

Domestic wastewater that is treated at the WWTP is black water which comes from the use of the hotel guests' bathrooms. The amount of wastewater generated per day on average 36 m³ per day.

Table 2. Laboratory test results initial characteristics of wastewater on March 16, 2021

No.	Parameters	Unit	Laboratory Analysis Results	TLV
1.	pH	-	7,54	6,0-9,0
2.	BOD ₅	Mg/L	130	30
3.	COD	Mg/L	283,33	100
4.	TSS	Mg/L	87,83	30
5.	Oil & Fat	Mg/L	10	5
6.	Amonia	Mg/L	30,31	10
7.	Total Coliform	Total/100ML	2000	3000

Source: Authour's research and analysis (2021)

From the laboratory test results above, it can be seen that several parameters have not met the environmental quality standards set by the Government in accordance with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number: P.68/Menlhk/Sekjen/Kum/8/2016 about Domestic Wastewater Quality Standards, which include: BOD₅, COD, TSS, oils & fats, and ammonia, while the other two parameters that meet the requirements are pH and total coliform.

Experiment

In this study a few variable samples. The stages were carried out as following, domestic liquid waste is taken from the WWTP in the aeration unit as much as 1000 mL per sample package. Then, the sample is poured into a plastic container made from Polypropylene. The aerator hose is installed and the use is shared with an air flowrate of 2.5 L/min, so that each container gets an air intake of 1.25 L/min. Probiotics is poured as much as a predetermined variable volume. The aerator is turned on in accordance with the time varied. Samples were taken by the method of collection in accordance with the Indonesian National Standard SNI 6989-59-2008 number 59 regarding the Method of Sampling of Wastewater.

3. Results and Discussion

The research results are contained in figures below:

Table 3. Results of experiments with 1000 mL wastewater samples and probiotic mixture

Parameter / Probiotic Dose	BML*	24 hour				24 hour			42 hour			72 hour		
		0	300	400	500	50	100	150	50	100	150	50	100	150
PH	6,0-9,0	7,54	5,47	5,1	4,91	7,39	7,29	6,86	7,67	7,76	7,35	7,23	7,56	7,55
TSS	30	130	172	154	214	112,7	114,7	138,5	283,3	121,8	338	67	169	136,3
COD	100	283,3	983,33	980	990	163,3	530	833,33	166,67	236,67	443,33	116,67	280	256,67
BOD ₅	30	87,83	304,83	303,8	306,9	50,63	164,3	258,33	51,67	73,37	137,43	36,17	86,8	79,57
Ammonia	10	30,31	23,92	27,85	24,44	28,4	23,04	15,81	30,84	33,29	31,1	23,41	31,23	30,62
Oil and Fat	5	10	9	9	16	14	13	13	13	16	15	23	10	13
Total Coliform	3000	2000	6000	4600	3100	4200	9100	8300	6200	2200	7700	6400	1700	4300

Source: Author's research and analysis (2021)

Figure 2. Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL probiotic mixture
Source : Author's research and analysis (2021)

Figure 2 shows that aeration carried out for 24 hours without a mixture of probiotic do not show results parameters that meet threshold limit value (TLV) set by the Government except for total coliform.

Figure 3. Results of 24-hour aeration experiments with 1000 mL wastewater samples and 300 mL, 400 mL, 500 mL probiotic mixtures
Source: Author's research and analysis (2021)

Figure 3 shows that the aeration is done for 24 hours with a variable mixture of probiotics respectively 300 mL, 400 mL, 500 mL do not show the results of the parameters that meet the threshold limit values (TLV) established by the Government, but there was improvement in BOD₅, ammonia, oil and fat, compared to the experiment in **Figure 2**.

Figure 4. Results of 24-hour aeration experiments with 1000 mL wastewater samples and 50 mL, 100 mL, 150 mL probiotic mixtures
Source: Author's research and analysis (2021)

In Figure 4, it can be seen that the aeration carried out for 24 hours with a variable probiotic mixture of 50 mL, 100 mL, 150 mL respectively do not show the results of the parameters that meet the threshold limit value (TLV) set by the Government, but there is an improvement in TSS compared to experiment in **Figure 2** and **Figure 3**.

Figure 5. pH Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures
Source: Author's research and analysis (2021)

Figure 6. TSS Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures
Source: Author's research and analysis (2021)

Figure 8. BOD₅ Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures
Source: Author's research and analysis (2021)

Figure 7. COD Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures
Source: Author's research and analysis (2021)

Figure 9. Ammonia Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures
Source: Author's research and analysis (2021)

Figure 10. Oil and Fat Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures

Source: Author's research and analysis (2021)

Figure 11. Total Coliform Results of 24-hour aeration experiments with 1000 mL wastewater samples and 0 mL, 50 mL, 100 mL, 150 mL, 300 mL, 400 mL, 500 mL probiotic mixtures

Source: Author's research and analysis (2021)

Figure 12. The results of the 42-hour aeration experiment with a 1000 mL wastewater sample and a 50 mL, 100 mL, 150 mL probiotic mixture

Source: Author's research and analysis (2021)

In Figure 12, it can be seen that the aeration carried out for 42 hours with a variable probiotic mixture of 50 mL, 100 mL, 150 mL respectively shows that the results of the parameters that meet the threshold value (TLV) set by the Government, are total coliform in the probiotic mixture of 100 mL, but the other parameters do not meet the threshold limit values (TLV).

Figure 13. Results of 72 hours aeration experiment with 1000 ml wastewater sample and 50 mL, 100 mL, 150 mL probiotic mixture
Source: Author's research and analysis (2021)

Figure 13 shows that the aeration is done for 72 hours with a variable mixture of probiotics, each 50 mL, 100 mL, 150 mL show the results of parameters that meet the threshold limit values (TLV) set by the government, is total coliform in a mixture of probiotics as many as 100 ml, but other parameters do not meet the threshold value (TLV). It shows almost the same results with the experiment in **Figure 12**. Based on previous study, the use of probiotics in processed waste oil palm that probiotics can reduce COD, BOD, ammonia, and the whole of pollutant parameters on organic waste with a ratio of 1 liter of probiotics to treat 50-100 liters of liquid waste after 48 hours of use [4].

4. Conclusion

The addition of probiotic fluids with a determined volume variation and time variation did not significantly indicate a better change in wastewater quality. The best results were seen in ammonia with aeration for 24 hours of wastewater and a mixture of probiotics as much as 150 mL/L. And improvements that meet the government's threshold limit value (TLV) are total coliforms in experiments with wastewater aeration for 42 hours and a mixture of probiotics as much as 100 mL/L.

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