

Application Of Wastewater Treatment Technology In Tofu Industry, Pekanbaru City

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Abstract.

Tofu industry produce wastewater with low pH and high pollutant parameters, such as BOD, COD, TSS. Therefore, it is necessary to have a wastewater treatment plant so as not to pollute the environment and cause health problems. The purpose of this community service activity is the application of appropriate technology for processing liquid waste in the tofu industry in Pekanbaru City with a combination of equalization, filtration and phytoremediation processes. This service activity includes several stages, namely counseling to provide understanding to partners about the importance of treating waste, followed by building a liquid waste treatment plant and the application of liquid waste treatment technology. The sewage treatment plant consists of 3 concrete tanks that consisting of equalization, filtration (using coral, porous plastic, jute, gravel, and sand as filter media) and phytoremediation (using water hyacinth plants). This activity has a very positive effect for the owners of tofu industry. The levels of BOD, COD and TSS decreased significantly after the application of this wastewater treatment technology.

Keywords: *tofu industry, liquid waste, sewage treatment*

I. INTRODUCTION

Tofu is one of the most popular traditional food in Indonesia because tofu is healthy, nutritious, and inexpensive foods. Tofu contains high protein which comes from soybeans. Most of tofu in Pekanbaru is produced by small industries. Tofu is produced through complex process with addition of acidic chemical compounds such as acetic acid. Therefore, tofu industrial wastewater has a low pH. During the tofu production process, wastewater produced from soybean curd. Other sources of liquid waste are from the soybean washing process, washing process equipment, cooking and used solutions from the soybean soaking process. Wastewater from the tofu industry contains organic compounds such as proteins, carbohydrates, oils and fats with high concentrations. Therefore, tofu wastewater has high level of BOD, COD and TSS. This condition will cause serious environmental problems if discharged directly because it will be damaged very quickly due to high water content and also the presence of nutrients for bacterial growth.

Tofu industrial wastewater treatment can be done by filtration process using bioball and bioring media [1], combination of quartz sand, activated carbon, rice husk and zeolite as media filtration [2], and also combination of aeration and filtration processes [3]. Additionally, tofu industrial wastewater treatment can also be carried out with a phytoremediation process using water spinach and water hyacinth plants [4-6], *chrysopogon zizanioides* [7] as well as *typha latifolia* [8]. The wastewater treatment process for the tofu industry has also been carried out with a combination of filtration (using a combination of zeolite, activated carbon, limestone, rice husk ash and cement as media) and phytoremediation using *Vetiveria zizanioides* plants. The application of this process for 15 days was able to reduce COD 76%, BOD 71.78%, TSS 75.28%, and increase pH to 7.8 [9]. Tofu industrial wastewater treatment is also carried out using a diffusion aeration process with initial treatment in the equalization tank [10].

Tofu-processing wastewater treatment has also carried out by using combination of two-stage biological treatment with filtration system using river stone [11] and bioball [12] as media. Additionally, there are several methods applied for tofu industrial wastewater treatment, such as ozonation and adsorption method using natural zeolite [13], combination of coagulation and filtration methods [14], combination of Coagulation-Flocculation and Membrane [15], and also combination coagulation-flocculation and ultrafiltration processes [16]. The use of sequencing batch reactor, and anaerobic baffled reactor using activated sludge were also applied to treatment of tofu wastewater [17, 18]. The purpose of this community service activity is the application of appropriate technology for treatment of wastewater in the tofu industry in Pekanbaru City with the combination of equalization processes (initial disposal and deposition processes), filtration and phytoremediation. The existence of this wastewater treatment plant is very important because generally the tofu industries in Pekanbaru City are in densely populated areas so that there are no health problems in the future.

II. METHODS

This service activity was carried out in the Wardi tofu industry, Sialangmunggu Village, Tuah Madani District, Pekanbaru City. This activity is carried out through educational methods (socialization), design and construction of wastewater treatment plants, as well as training and assistance for operation and maintenance of wastewater treatment plants.

The stages of this service activity are:

1. Lecture and discussion methods to provide knowledge to tofu industry owners about the importance of properly processing waste so as not to cause health problems for local residents and also discomfort due to odors caused by the liquid waste produced.
2. Build a sewage treatment plant consisting of several concrete pools according to the processing stages, namely equalization, filtration and phytoremediation.

3. Assistance methods to provide knowledge and skills to operate liquid waste treatment units, as well as maintenance methods in case of troubleshooting.

This service program evaluation activity is carried out through direct observation with performance appraisals in the process of preparation, implementation and evaluation. To determine the success rate of this service activity, it is carried out through an evaluation using the indicators listed in Table 1.

Table 1. Check list of activity evaluation

No	Indicator	Score level			
		4	3	2	1
1	Understand the steps of waste treatment				
2	Skills to operate sewage treatment plant properly				
3	Skills in repairing sewage treatment plants if there is troubleshooting				
4	Skills for maintenance of sewage treatment plants				

Score level: 4 = very high, 3 = high, 2 = medium, 1 = low

Evaluation of this service program was also carried out by analyzing the concentrations of COD, BOD, TSS, and also pH level of tofu liquid waste before and after processing. The results of this evaluation will later become a reference for the development of this tofu industrial wastewater treatment plant.

III. RESULT AND DISCUSSION

The implementation of this service activity begins with lectures and discussions to provide understanding to tofu industry owners about the importance of processing liquid waste properly so as not to pollute the environment. The next activity is the construction of a wastewater treatment plant as shown in Figure 1. This activity begins with a discussion with tofu industry owners who know about the technical construction of a wastewater treatment plant (Figure 1a). Subsequently, land clearing was carried out (Figure 1b) and the construction of a wastewater treatment plant (1c). Figure 1d shows the wastewater treatment plant that has been completed. The wastewater treatment unit consists of 3 tanks, each of which has a length of 3m, a width of 2.5m and a depth of 1.5m. The equalization process occurs in the first tank. Then, the filtration and phytoremediation processes occur in the second and the third tank, respectively.

Figure 2 shows the stage of filling the filter into the filtration tank. At bottom of the filtration tank is placed the coral (Figure 2a). Next, on top of this coral a porous plastic (Fig. 2b) is placed and followed by burlap (Fig. 2c). At the top it is covered with gravel and sand (Figure 2d).



Fig 1. Stages of construction activities for wastewater treatment plants



Fig 2. Stages of filling the filter in the filtration tank

The stages of applying the tofu industrial wastewater treatment technology can be seen in Figure 3. The first processing is the equalization process. Liquid waste from the production unit is channeled to the equalization tank through pipelines. In the equalization tank, there are process of decreasing the temperature and process of deposition. The presence a filter made of coral and burlap at the outlet of this equalization tank in order to sediment and solids in the top layer are easily separated and do not clog the outlet channel. After 3 days of the deposition process, the settled solids will float on the surface of the equalization tank. Then, these solids can be processed into compost.

After the equalization process, the waste flows into the filtration tank. At this stage, the filtration process occurs using a filter media (Figure 2). In the filtration of wastewater, there is an adsorption process of pollutant molecules on the surface of filtration media such as activated carbon. Therefore, the concentration of pollutant will decrease in the tofu wastewater. Adsorption occurs because there is a force field on the adsorbent surface that attracts the adsorbate molecules and forming a thin layer on the surface of filtration media [14]. After the filtration process, the wastewater transferred to the phytoremediation tank. In this phytoremediation tank, water hyacinth plants are given. The presence of microorganisms on the roots of water hyacinth plants is able to degrade organic compounds in the wastewater. These organic compounds serve as a source of nutrition for microbes and then turn into simpler compounds [6].



Fig 3. Application of tofu industrial wastewater treatment technology

Table 2 presents the results of the evaluation of the implementation of this community service activity based on the check list of activity evaluation (Table 1). Generally, the owner of the tofu industry already understands the steps for waste treatment and already has the skills to operate and maintain a waste treatment plant.

Table 2. Activity evaluation before and after community service activities

Indicator of activity evaluation	Before community service activities	After community service activities
Understand the steps of waste treatment	Tofu industry owners do not understand at all how to treat liquid waste	Tofu industry owners already understand well how to treat liquid waste
Skills to operate sewage treatment plant properly	The owner of the tofu industry does not yet have the skills to operate a waste treatment plant	The owner of the tofu industry is able to operate the sewage treatment plant with the correct steps
Skills in repairing sewage	Tofu industry owners do not	Industrial owners know that

treatment plants if there is troubleshooting	have the skills to repair sewage treatment plants if there is troubleshooting	they already have the skills to repair sewage treatment plants if there is troubleshooting
Skills for maintenance of sewage treatment plants	The owner of the tofu industry does not yet have the skills for maintenance of sewage treatment plants	The owner of the tofu industry already has the skills for maintenance of sewage treatment plants

Table 3. The concentrations of pollutants and pH in the liquid waste of tofu industri

Pollutans	Unit	Before treatment	After treatment
COD	mg·L ⁻¹	5000	2600
BOD	mg·L ⁻¹	3.264	2.856
TSS	mg·L ⁻¹	20.00	0.391
pH	-	4.5	5.5

Based on the data shown in Table 3, there was a decrease in the levels of COD 48%, BOD 23%, TSS 98%, and an increase in pH in the liquid waste of the tofu industry after the application of this wastewater treatment technology. This community service activity has proven to be beneficial to the owners of the tofu industry because there is no more odor arising from liquid waste. In addition, the pollutants in the liquid waste discharged into the environment have also decreased significantly.

IV. CONCLUSION

This community service activity regarding the application of tofu industrial wastewater treatment technology has a positive impact on the owners of the tofu industry. The owner of the tofu industry has been able to process liquid waste independently so that it does not pollute the surrounding environment. Furthermore, the existence of this tofu industrial wastewater treatment plant is expected to be a model for other tofu industries.

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