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THE INFLUENCE OF EFFECT FLOW RATE AND TOTAL TIME PROVIDES IN IMPROVING THE QUALITY OF WASTE LIQUID INDUSTRY WASTE

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ABSTRAK

The industry of making tempe very much produces liquid waste that comes from the process of soaking soybeans, boiling, washing and stripping the skin. Untreated liquid organic waste can have a negative impact on the environment because it is degraded by microorganisms, causing smell bad. To avoid this, the liquid waste before being discharged into the river needs to be treated first. Processing is done by adjusting the speed of the effluent entering the reactor and adjusting the processing time so that it can compare the quality of the waste obtained. In this study using an bioactiveator from cow dung and the reactor conditioned anaerobic. The study was conducted with two models: the first model with an effluent speed of 1 lt / day with a total processing time of 13.5 days and the second model using an effluent speed of 2 lt / day with a total processing time of 11.5 days. From the results of the research it was obtained that the output of model II waste with the same initial waste quality as model I BOD value decreased 92.1% from 1743.2 mg / L to 132.62 mg / L, COD value decreased 92.8% from 3239 , 1 mg / L to 233.22 mg / L, the value of TSS decreased 96.0% from 2500.6 mg / L to 100.1 mg / L while the pH value rose 39.32% from 5.42 to 8, 29. From the parameters measured, the output of model II meets the required quality standards for waste.

Key Words : Processing, Liquid Waste, Tempe Industry

INTRODUCTION

Tempe is one type of food that has a distinctive taste and is a source of high protein and is a favorite food among Indonesian people. Tempe industry is a home industry that absorbs a lot of labor. We will find it very easy to find the tempe industry, especially in Java, because tempe for Javanese people is already a hereditary meal.

In the process of making tempe very much using water starting from the process of soaking soybeans, boiling, washing and stripping the skin of soybeans. The waste generated from the process of making tempe is mostly in the form of liquid waste. The resulting solid waste can be used as animal feed, while the liquid waste is just thrown into a ditch and flows into the river which results smell bad. The stench can be caused by the process of degradation of organic waste by microorganisms that produce hydrogen sulfide, ammonia and phosphine gas (Wardoyo, 1975). The unbalanced condition between chemical, biological and physical content in the run that continuously accommodates liquid waste both from the tempe production process and from household activities will greatly affect water quality which has an impact on environmental damage.

Soybean as the main raw material for making tempe contains high protein and carbohydrates and a small amount of fat, so the waste is also thought to contain these ingredients. Because of the large number of organic pollutants in the waste it causes a decrease in the concentration of dissolved oxygen in the water because it is used to decompose organic substances present in the waste. Waters that experience organic matter pollution need more dissolved oxygen while less oxygen intake from the surface, as a result organic material that has not been completely decomposed by aerobic microbes will be broken down by anaerobic microbes resulting smell bad.

The liquid waste from soybean stew usually has a temperature of around 900C and above. When waste heat is continuously channeled directly into the river it can interfere with the activity of living things such as animal and plant life because at high temperatures the oxygen content dissolved in water will decrease (Wardhana, 2004). The optimal temperature of life of organisms in water is 250C to 300C. If the temperature of the waste is high there can be an increase in the respiratory rate of aquatic organisms, which results in a decrease in the rate of dissolved oxygen (DO) (Connel and Miller, 1995).

Based on this, so that tempe industry waste does not cause problems for the environment, it is necessary to find alternative environmentally friendly wastewater treatment technologies that are easily applied by the community. One of them is by bioremediation technology that uses potential bacteria that can remodel organic compounds which are hazardous substances in waste forming new compounds that are not dangerous so that the life activities of aquatic organisms will run well. Research conducted by Wignyanto et al (2009) on boiremediation of Sentara liquid waste in Sanan tempe industry, concluded that with bioremediation technology is able to provide output that meets the quality standards of industrial liquid waste that is required in the environment. By adjusting the 3vvm aeration speed and incubation for 7 days can reduce BOD values by 83.9%, COD by 73% and TSS by 93.1%. While the technology of tofu waste processing with anaerobic and aerobic biofilter processes implemented by Nusa Idam S and Heru DW (1999) waste output obtained greater efficiency, namely BOD decreased 89.4%, COD decreased 88.2% TSS decreased 94% . If by using the anaerobic process, only a BOD reduction efficiency of 74.5% is obtained; BOD of 75.4% and TSS of 84%.

Based on several studies that have been conducted, the researchers tried to treat tempe industrial wastewater using bioremediation technology, namely by regulating the length of the incubation process and the effluent flow rate so that the output of waste that meets the quality standards of waste such as BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand) and TSS (Total Suspended Solid) in accordance with the requirements for waste quality standards based on East Java Governor Decree no 45 of 2002 concerning Quality Standards for Liquid Waste for Industry or Other Activities in East Java. The purpose of this research is to provide information to the small industries of tempe in the area East Surabaya how to treat liquid waste easily and simply so that in groups they can process their waste before it flows into the river.

RESEARCH METHODOLOGY

Materials and tools

The main material of this research is to use tempe industry wastewater in the area East Surabaya, cow dung as a bioactivator or source of microorganisms, reagents for BOD, COD, TSS analysis. While the equipment used is pretreatment equipment, microscopes, fermentors, pH meters, glass ware, digital scales, thermometers and hot plates.

Research Procedure

Making a starter of 1kg of fresh cow dung dissolved in 10 liters of water is allowed to stand for 3 weeks while observing the development of the number of microbes, then filtering is done and the filtrate is stored for a starter. For each trial run 200 ml starter was used mixed with 800 ml of waste media.
Wastewater that will be processed is acidified by adding lime water then allowed to stand for a day so that changes in pH of 6.6 to 7.6 are then filtered with gauze.
Starter that has been taken is taken 1 liter to be inserted into reactor I (RI) which has a volume of 4 liters in anaerobic state. Then reactor II (R II) and reactor III (R III) are prepared, each having a volume of 4 liters with different heights so that waste can flow overflow from the reactor to the reactor. The effluent inflow velocity is adjusted according to plan, with the reactor I residence time, reactor II and reactor III also adjusted.
The residence time for facultative ponds is set for 2 days
Sample analysis is carried out in the initial wastewater that has undergone neutralization and deposition, leaving reactor I, reactor II, reactor II and finally coming out of the facultative pool. The parameters analyzed were COD, BOD, TSS and pH.

Table 1. Summary of Experiments

Experiments	Model I	Model II
Natural acidification	1 day	1 day
Precipitation after	0.5 days	0.5 days
neutralization with lime	1 liter	1 liter
Initial starter used in RI	1 liter / day	2 liter
Influent flow rate days	4 days	2 days
Time of stay in reactor I (RI)	4 days	2 days
Time of stay in reactor II (II)	2 days	1 day
Time of stay in reactor III (RIII)	2 days	2 days
Residence time in facultative pool	13.5 days	11,5 days
Total time		

RESULTS AND DISCUSSION

Characteristics of Liquid Waste Before Experiencing Treatment

Waste water that is stabilized from the small tempe industry has actually been mixed with household waste taken in the front of the craftsmen's house, turbid colored rather white and seen very fine particles, foamy particles and smells great.

Turbid colored waste is caused because it contains a lot of starch which comes from washing and stripping soybeans as well as from the former washing water of process equipment and due to household activities. The existence of foam in many wastes is caused by the use of bath soap, detergents, shampoo from household activities. Because these ingredients contain a lot of surfactants which are surface active substances so they can cause foam. The unpleasant odor in waste is caused by the process of decay from contaminants from the tempe production industry which contains many organic compounds and household activities by microorganisms in the water.

Table 2. Comparison of Tempe Production Industrial Liquid Waste with Quality Standard of Industrial Liquid Waste.

Parameter	Tempe industrial liquid waste (mg/ L)	Industrial wastewater quality standards (mg/ L) max
BOD	1742,2	150

COD	3239,1	300
TSS	2500,6	100
pH	5,42	5 – 9

From table 2 it can be seen that the BOD, COD and TSS values in the waste are far above the permitted threshold, are of low quality waste so that the waste must not be disposed of directly into the river. Before being discharged into rivers, wastewater must undergo treatment in order to meet the liquid waste quality standards.

Waste Characteristics after undergoing treatment

From the observation of tempe industrial wastewater after undergoing treatment with model I and model II, it appears that there are significant changes compared to liquid waste before undergoing treatment. Waste that has undergone treatment looks clear and does not appear to be floating particles, yellowish-colored and odorless. Reduction of organic compounds in liquid waste according to Suriawiria, U (1996) says that contamination of complex organic waste can be degraded by enzymes produced by anaerobic bacteria so that it becomes simpler organic compounds with how to form sugar, amino acids, fatty acids and so on which subsequently with the aerobic process will form carbon dioxide gas and water as the end result of the fermentation process. The reduction of organic waste pollution due to the activity of anaerobic bacteria and aerobic bacteria can be read from the results of observations through waste quality indicators including decreasing levels of COD, BOD, TSS and pH.

Table 3. BOD Measurement Results from Model I and Model II

NO	BOD (mg/ L)	Model I	% decrease	Model II	% decrease
1	Initial	1742,2		1742,2	
2	Neutralization and deposition	1315,36	24,50	1313,97	24,58
3	Reactor I (R I)	835,8	52,03	790,96	54,16
4	Reactor II (R II)	544,8	68,73	485,20	72,15
5	Reactor III (RIII)	308,3	82,30	257,85	85,50
6	Facultative	122,5	93,00	137,64	92,10

After experiencing treatment both with model I and model II, there was a significant decrease in BOD. Waste with an initial BOD value of 1742.2 mg / L in the pretreatment and sedimentation process appears to be formed from the formation of fine solids due to the addition of lime milk, but in this process the value of the decrease in BOD value is still very small because at this stage there is no erosion of the degradating bacteria starter. At the effluent flow rate of 1 liter per day passing through reactor I, reactor II and reactor III and facultative ponds with a total processing time of 13.5 days and live bacteria anaerobically there was a decrease in the total BOD value of 93.0%. Whereas at the effluent flow rate of 2 liters per day by passing through reactor I, reactor II and reactor III and facultative pond with 11, 5 days there was a decrease in BOD value of 92.10%. The decrease in BOD indicates the presence of bacteria that degrade organic contaminants in waste such as starch, fat, detergent protein and so on. The microbiological process that occurs in the reactor occurs anaerobically where several groups of bacteria are involved in the process of breaking down organic complex compounds into simpler organic compounds, namely methane. The overall decomposition of waste can be described in the following reaction (Said, Heri, 1999).

Organic compounds $\longrightarrow$ CH4 + CO2 + H2 + NH3 + H2S

Besides bacteria there are also some fungi and protozoa that are involved in anaeroric decomposition, but bacteria are the most dominant working microorganisms. With the generation of CH4 in the degradation of organic compounds can reduce BOD in the decomposition of mud.

Table 4. COD Measurement Results from Model I and Model II

NO	COD (mg/ L)	Model I	% decrease	Model II	% decrease
1	Initial	3239,1		3239,1	
2	Neutralization and deposition	2328,59	28,11	2328,92	28,10
3	Reactor I (R I)	1439,78	55,55	1335,48	58,77
4	Reactor II (RII)	966,87	70,15	803,95	75,15
5	Reactor III (RIII)	537,8	83,40	583,04	82,00
6	Facultative	266,4	91,78	233,22	92,80

The effluent COD value of wastewater in both mode I and model II has significantly decreased and this proves that the degrading bacteria used can decompose dissolved organic contaminants in liquid waste. A low COD value is an indicator of organic reductants such as starch, fat, protein, low detergent. COD value is the amount of oxygen needed so that the organic contaminants present in liquid waste can be oxidized through a chemical reaction, the more oxygen that is consumed the worse the quality of the liquid waste is. The initial COD effluent value of 3239.1 mg / L decreased up to 91.78%, with a value of 266.4 mg / L for model I and a decrease of 92.80% with a value of 233.22 for model II. The smaller the COD value, the better the quality of waste because organic residues contained in the small waste.

Table 5. TSS Measurement Results from Model I and Model II

NO	TSS (mg/ L)	Model I	% decrease	Model II	% decrease
1	Initial	3239,1		3239,1	
2	Neutralization and deposition	2328,59	28,11	2328,92	28,10
3	Reactor I (R I)	1439,78	55,55	1335,48	58,77
4	Reactor II (RII)	966,87	70,15	803,95	75,15
5	Reactor III (RIII)	537,8	83,40	583,04	82,00
6	Facultative	266,4	91,78	233,22	92,80

TSS value is also a parameter that can be used in determining the quality of waste. A significant decrease in the value of the TSS on the effluent can be seen in the regulation of the effluent flow velocity and the length of incubation in both model I and model II. The initial TSS effluent value of 2500.6 mg / L decreased to reach 94.95% with the treatment of model I and a decrease of 94% for model II, which showed better quality of waste, namely for model I TSS value 126.3 mg / L and model II TSS value of 100.10 mg / L. With the treatment of model I and model II, the TSS value of waste has met the standard quality standards for liquid waste that can be flowed into the river. TSS value after treatment has decreased due to enzymes produced by microbes can break down complex molecules from organic contaminants through the hydrolysis process into simpler compounds. Simple compounds resulting from the hydrolysis process are used for the metabolism of microorganisms that can produce carbon dioxide gas, water, energy and metabolic waste as sludge that easily settles causing a decrease in suspended solids in the waste and a decrease in the value of TSS, Radojevic, Vladimir (1999).

Table 6. pH Values of Model I and Model II

NO	pH	Model I	% decrease	Model II	% decrease
1	Initial	5,42		5,42	
2	Neutralization and deposition	7,49	27,79	7,46	27,34
3	Reactor I (R I)	7,87	31,13	7,85	31,00
4	Reactor II (RII)	8,13	33,33	8,02	32,42
5	Reactor III (RIII)	8,22	34,06	8,20	33,9
6	Facultative	8,27	35,93	8,29	39,32

The pH value is an indicator of the degree of acidity which is very important as a parameter of water quality because by knowing the pH value will be able to control the speed of a reaction that might occur. pH is often used as a parameter of the condition of the water. The initial pH value of the effluent is 5.42, which indicates waste in an acidic state (pH value < 7) and this situation is very disturbing to aquatic life. With the processing of model I and model II, changes in pH values of 8.27 and 8.29, which means that they are at the required threshold. The pH range required for the aquatic environment is between pH 6.5 - 8.3 in this condition the activity of aquatic plants and animals can run well. Each species has a different life tolerance to pH conditions. For the life of aquatic microorganisms including plangton generally in the range of pH 7 to pH 8.5. If the pH value is outside the range of 6.5 - 8.5, the life of aquatic creatures will be disrupted, especially microorganisms that cannot be active and may even die. The presence of carbonate compounds, bicarbonates and hydroxide compounds can increase the pH of water while the presence of carbonic acid and mineral acid acids from industrial waste can increase the acidity of a waste (Junaidi, Hatmanto, 2006).

CONCLUSION

By regulating the effluent rate and the length of time of the anaerobic process in the reactor in the treatment of tempe industry wastewater in the area East Surabaya, it is able to improve the quality of waste so that it is feasible to be discharged into the river. Based on the measured parameters, namely BOD, COD, TSS and pH of waste, the values already meet the required quality standards. The output of model I waste is the effluent rate of 1 lt / day with a processing time of 13.5 days, the original BOD value was 1742.2 mg / L to 122.5 mg / L decreased 93.0%, the original COD value was 3239.1 mg / L to 226.4 mg / L with a decrease of 91.78%, the initial TSS value was 2500.6 mg / L to 126.3 mg / L with a decrease of 94.95% and the original pH of 5.42 to 8.27 increased 35 , 93%. While the model II waste output with an effluent rate of 2 lt / day with a processing time of 11.5 days with the same quality waste BOD value decreased 92.1% to 132.62 mg / L, the COD value decreased 92.8% to 233 , 22 mg / L, the TSS value decreased 96.0% to 100.10 mg / L while the pH value increased 39.32% to 8.29. The outputs from the two research models have met the required quality standards for waste based on the Governor of East Java No. 45 of 2002 concerning the quality standards of liquid waste for industry or other business activities in East Java, Indonesia. It was concluded that model II research was more effective because with an effluent rate of 2 lt / day and with a processing time of 11.5 days it can produce output that meets the standard.

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