Research of COD and BOD Removal Efficiency in Tempeh Industrial Wastewater Treatment using Aerated Activated Sludge

L.Nurdini, Hendriyana, W.G. Nur Asti .D, A. Febriyani Putri

Abstract: ***Tempeh is the most popular food in Indonesia. The process of making tempeh requires a lot of water. The preliminary analysis of tempeh wastewater showed that the value of COD, BOD and pH are 26693 mg/l, 11204 mg/l and 3,99. This results actually do not meet the Minister of Environment regulation No.5 (2014) about quality standard of wastewater treatment for industry. The quality standard for COD, BOD and PH for tempeh wastewater are 100-300 mg/l, 50-150 mg/l, and 6-9. So, the tempeh industrial wastewater must be processed before being discharged into the environment. The aim of this study is to determine the activated sludge ability to reduce COD, BOD, and also pH value in tempeh industrial wastewater. Tempeh industrial wastewater treatment carried out in aerated batch reactor using wastewater composition 10%, 15%, and 25% (v/v) of tempeh wastewater in 500 ml as a research variables. The wastewater while the hidraulic retention time is 48 hours. The highest COD, BOD removal efficiency occured at 25% (v/v) wastewater composition each for 74,58%, 79,27%. The COD and BOD concentration after treatment are 7625,79 mg/l and 4555,7 mg/l. And pH at 25% (v/v) wastewater composition is 6,92. pH value after treatment meet quality standard of industrial wastewater from Minister of Environment regulation No.5 (2014), but COD and BOD do not meet the standards.***

Keywords : COD, BOD, Activated sludge

I. INTRODUCTION

Tempeh is an Indonesian traditional food made from soybeans. Indonesian people consume tempeh 7,47 kilograms/capita/ years in average [1]. The total domestic demand for soybean is growing every year, this is proportional to the growing number of tempeh producer in Indonesia. Indonesia is currently the largest tempeh producer in the world, 80% of soybeans demand used for tempeh production and the rest of them used for other food needs. This causes Indonesia become the largest soybean market in asia [2]. Water use in tempeh production is very important, especially in washing process, boiling process, and soaking process of soybean [3]. This series of the processes produced tempeh wastewater. If, it does not treated properly, it may caused water pollution. Furthermore, it produces smell odors and bothering human activity.

Generally, tempeh wastewater has a high BOD value. In this research, tempeh wastewater sample taken from one of tempeh home industry in Cimahi. It produces 250 liters tempeh wastewater everyday. The source of tempeh wastewater comes from soybean soaking process, because this proces is one of the processes that produced high BOD value. Table-I showed the characteristic of tempeh wastewater from those industry. All the tempeh wastewater parameter exceeded the wastewater quality standard in the Regulation of Indonesian Ministry of Environment No.5 2014 [4]. According to the Table 1, it is strongly recomended to treat the tempeh wastewater before it can be discharged into the enviroment.

The aim of this research was to analyzed BOD removal efficiency, COD removal efficiency, and MLSS concentration in tempeh wastewater treatment using activated sludge. Activated sludge is one of the most widely used conventional wastewater treatment technologies to treat wastewater with high organic substance [5]. Organic substance in wastewater are treat biologically by microbial activity grow suspended in the reactor. There are two mechanism for treating sludge with activated sludge, the first is physical-chemical absorption, the second is the process of absorbing organic pollutants into biomass particle become CO_2 and H_2O by microbial activity [6].

Table- I: Tempeh Wastewater Characteristic

No	*Parameter*	*Wastewater from Soybean Soaking Process*	*Standar Quality of Wastewater*
1	BOD (mg/l)	11.204	50
2	COD (mg/L)	26.693	100
3	TSS (mg/L)	356	200
4	pH	3.99	6 - 9

II. MATERIALS AND METHODS

Tempeh wastewater, activated sludge, glucose, NPK fertilizer, urea fertilizer, reactor, aerator dan rotameter. Tempeh wastewater concentration 5%, 10% dan 25% from 500 mL activated sludge.

A. Activated Sludge Acclimization

Activated sludge is prepared before being used in the treatment process. Seeding is carried out for three weeks by providing glucose, NPK fertilizer, and urea as nutrients. The first thing to

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prepare is to make the liquid medium, this made from glucose, NPK fertilizer, and urea dissolved in 1800 mL aquadest and 200 mL tempeh wastewater.
The second, adding 10 grams sediment and the liquid medium into reaktor, and then aerated.

In this research, the equipment experiment of tempeh wastewater treatment showed in Figure 1. The experiment carried out in batch operation. The ratio of tempe wastewater and activated sludge are 5%, 10%, and 25% from activated sludge volume. Feeding is entered gradually during the experiment. The air continously inserted into the reactor through an aerator. The rotameter installed to control the rate of air entering the reactor. The hidraulic retention time in the reacor is 48 hours. The parameter analysis of tempeh wastewater treatment is BOD, COD, and MLSS.

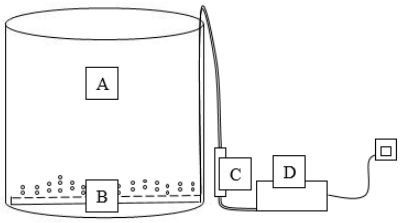

Fig. 1. The Eaquipment of Experiment : (A) Reactor, (B) Aerator Stone, (C) Rotameter, (D) Aerator

III. RESULT AND DISCUSSION

A. Activated Sludge Acclimization

Before treating tempeh wastewater, the activated sludge must be growed. Seeding carried out for three weeks by providing glucose, NPK fertilizer, and urea fertilizer for growth nutrition. Figure 1 shows an increase in MLSS concentration during the seeding process for three weeks (21 days). In the third week the MLSS concentration reached 10100 mg/L. Seeding process is carried out under neutral pH condition [5]. This provides environmental conditions that support th egrowth of activated sludge. The air flow rate 1.1 lpm, and the F/M ratio 0,21. The F/M ratio in the process is in the range which indicate the microbes are in a hungry condition, thus increasing the efficiency of wastewater treatment [5].

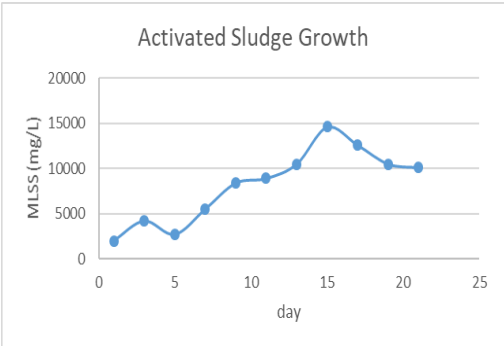

Fig. 2. Activated Sludge Growth

B. Biological Oxygen Demand (BOD)

The BOD parameter analysis of untreatead tempeh wastewater was 20851,14 mg/L. After treating the tempeh wastewater using aerated activated sludge, BOD concentration decreased (Figure 3). An increased in feed concentration showed an increase in BOD removal. The tempeh wastewater is gradually added into the aerated reactor. It is affect the wastewater treatment process, the MLSS in aeration reactor increasing and so the BOD removal efficiency increased [8]. The result showed BOD concentration exceeded the quality standard by Regulation of Indonesian Ministry of the Environment No.5 2014. This happens because of the lack of contact time between tempeh wastewater and microbes in the reactor [9].

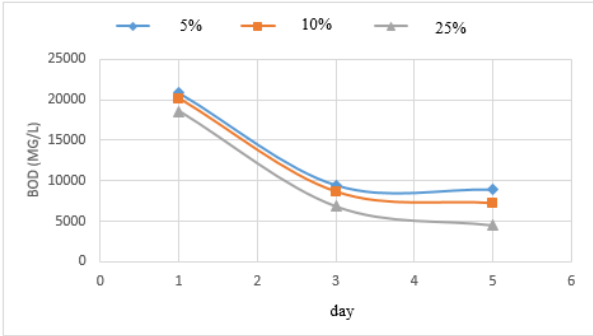

Fig. 3. Biological Oxygen Demand (BOD) Removal

C. Chemical Oxygen Demand (COD)

COD shows the oxygen contain to oxydized organic compound in tempeh industrial wastewater chemically [10]. Typically, the COD value is higher than BOD value because a lot of organic compound unoxidized biolologically [5]. Figure 4 showed sharp decline of COD degradation at the first time of the treatment. At this condition, the microbes convert the organic compound into new cells, CO_2, and also H_2O. COD effeciency at 5%, 10%, and 25% feed are 56.33%, 62.96%, and 74,58%.

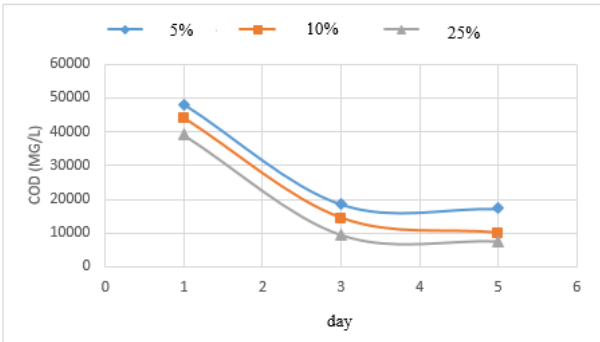

Fig. 4. Chemical Oxygen Demand (COD) Removal

D. Mixed Liquor Suspended Solid (MLSS)

Mixed Liquor Suspended Solid (MLSS) shows the concentration of organic compound and microbes in the reactor [5]. Figure 5 shows at the third day of the treatment a shock load occur. Shock load occur due to changes in the reactor condition after adding

tempeh wastewater. This result a large number of contaminant in the wastewater undegraded completely thus reducing the ability of the microbes to degrade the contaminant in tempeh wastewater. This is because the microbe takes time to degrade the organic compound in the tempeh wastewater. The MLSS value at 5%, 10% and 25% feed variation were 9500 mg/L, 8600 mg/L, and 9200 mg/L.

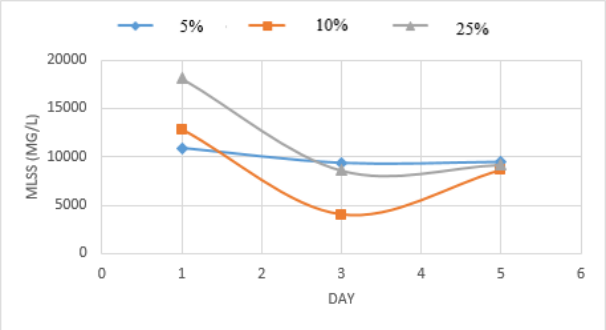

Fig. 5. Mixed Liquor Suspended Solid (MLSS) Concentration

IV. CONCLUSION

The results from experiments showed the highest BOD removal efficiency and COD removal efficiency at 25% feed of tempeh industrial wastewater 74.58% and 79.27%, and MLSS concentration at this point is 9200 mg/L. This result the exceeded the quality standard by Regulation of Indonesian Ministry of the Environment No.5 2014.

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