2nd International Conference Eco-Innovation in Science, Engineering, and Technology
Volume 2021
http://dx.doi.org/10.11594/nstp.2021.1404

NST PROCEEDINGS

OPEN ACCESS

Conference Paper

Shrimp Cracker Wastewater Treatment with Aerobic Microorganism and Aeration Method

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ABSTRACT

In this study, the effect of aeration time and the ratio of activated sludge and wastewater volume on the decrease in BOD (Biological Oxygen Demand) and levels of COD (Chemical Oxygen Demand) has been successfully investigated. The activated sludge and wastewater were collected from the shrimp cracker industry. This shrimp cracker liquid waste was processed by aerobic method, which started with the wastewater treatment process (with an activated sludge acclimatization process) and closed with an aeration process. The best result was achieved by the ratio of the volume of activated sludge to wastewater 1:2, where an aeration time of 4 hours COD levels can decrease by 82.9% with the final result of 471 mg/l. Moreover, at 10 hours of aeration, the BOD level decreased by 48.9%, with the final result of 442 mg/l. It shows that aerobic biological processes can reduce the levels of BOD and COD present in the liquid waste of shrimp crackers.

Keywords: Aeration, activated sludge, liquid waste treatment.

Introduction

The development of the economic sector is supported by several aspects in Indonesia, one of which is the industrial sector, which can affect the quality of human life. The more industries, the more pollution. It is caused by fewer facilities to handle and manage the waste. As a result, the environment around the factory becomes polluted, especially the water environment will be disturbed by the presence of the liquid waste industry. It will also decrease in water quality its around. Pollution, according to Decree of the State Minister for Population and Environment No. 02/MENKLH/1988, is a substance or other component that is in the air or water and change the composition of the water or air due to human activities or processes naturally, resulting in water quality or the air decreases (Tedjasaputra, 2012). Water pollution is caused by water factory production waste. Own liquid waste is a by-product of the industrial production process that can no longer be used and negatively impact the environment. Therefore, the wastewater was considered to have no economic value (Supriyatno, 2000).

When a physical or chemical process cannot treat liquid waste, it must be treated with a biological process. Treating waste through biological means can be carried out in three ways: aerobic, anaerobic, and processing in a facultative way. In general, biological waste treatment aims to break down organic matter in wastewater using biochemical oxidation (Tedjasaputra, 2012). In aerobic wastewater treatment, the aeration technique needed for microorganisms used can work stably. Aeration technique is a method used to add oxygen supply to the wastewater. The added oxygen was a method to break down wastewater pollutants, resulting in the concentration of substances pollutant can be reduced (Sugiharto, 2008).

How to cite:
Utami, L. I., Pratama, A. N., Aji, P. M., & Fauziyah, N. A. (2021). Shrimp cracker wastewater treatment with aerobic microorganism and aeration method. *2nd International Conference Eco-Innovation in Science, Engineering, and Technology*. NST Proceedings. pages 20-24. doi: 10.11594/ nstp.2021.1404

Activated sludge is a microorganism that plays a role in the decomposition of organic substances contained in wastewater. An important component that supports sustainability. The life of these microorganisms was the supply of air that provided and the presence of nutrients for microorganisms (Tedjasaputra, 2012). These microorganisms were generally bacteria, viruses, and protozoa (Droste & Gehr, 2018). The aerobic bacteria in the activated sludge process include Halis-comenobacter hydrossis filamentous organisms, Sphaerotillus natans, flock-forming Zoogloea ramigera, and nitrifying bacteria Nitrosomonas and Nitrobacter (Gerardi, 2006). From the previous research. The analysis often used to find out wastewater quality was BOD and COD analysis. Biological Oxygen Demand (BOD) was the oxygen level needed by microorganisms to decompose pollutants in wastewater (Sari et al., 2013). COD (Chemical Oxygen Demand) level analysis was required to determine the equivalent oxygen level of organic matter, which was in the wastewater where the oxygen can be oxidized chemically (Tchobanoglous et al., 2002). At the same time, the processing and utilization of sludge and wastewater from the shrimp cracker factory have no reported before.

This research aims to reduce BOD and COD levels in liquid waste prawn crackers and determine the effect of aeration time. In this work, we processed the sludge and wastewater from the shrimp cracker factory by aerobic microorganism and aeration method. The ratio between volume activated sludge with wastewater against degradation BOD and COD levels.

Material and Methods

In this study, the materials used include liquid waste of shrimp crackers and activated sludge (extracted from the cracker factory), sugar, and calcium hydroxide. In processing sludge and wastewater, we use our tools which are designed as shown in Figure 1.

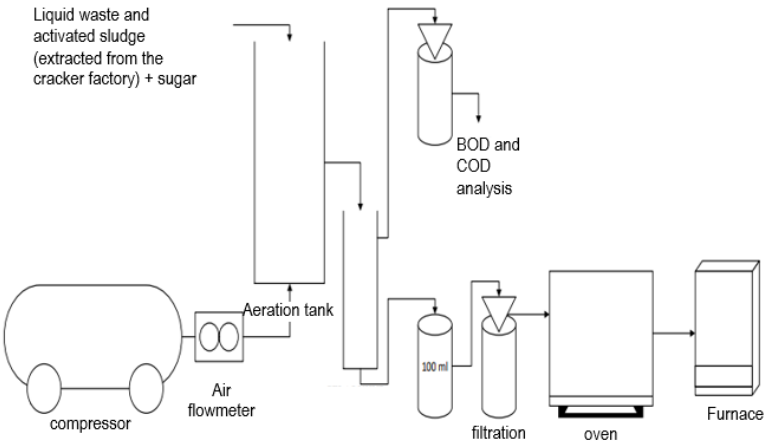

Figure 1. Design of equipment to process the sludge and wastewater equipment from the crackers factory

Methods

Activated sludge preparation

New shrimp cracker liquid waste taken from the factory was immediately analyzed to identify the initial levels of BOD, COD, and pH. If the pH value was still too acidic, then Calcium hydroxide can be added up to a pH value of 7. Then the acclimatization process was carried out against microorganisms, where activated sludge was put into an aeration tank as much as 3000 ml and added liquid waste of shrimp crackers as much as 3000 ml with the addition mechanism gradually. Furthermore, sugar as nutrition was also added. Then, we started the compressor with the air supply discharge (5000 ml/minute) so that it occurred aeration process in the tank and left it for 24 hours for microorganisms to adapt. After 24 hours, activated sludge and wastewater precipitated are separated. Finally, acclimatized activated sludge was ready for use in the waste treatment process.

Waste water treatment

Shrimp cracker wastewater treatment process was begun by adding activated sludge then acclimatized to 3000 ml added wastewater according to the ratio variable volume and aerated for 2,4,6,8 and 10 hours with the same airflow. After that water was processed, the product and activated sludge were taken as much as 600 ml and then precipitated. Part of the water was taken for BOD, and COD levels were analyzed. Stir the mixture again, then take 100 ml and filter. Put the residue in the oven at 100°C for 1 hour, then heat it in the furnace at 400°C for 3 hours. Repeat all steps above for the different ratios of activated sludge and wastewater volume and the durations in the aeration process.

Results and Discussion

The effect of the aeration time to the COD level with the various ratio of the volume of activated sludge to wastewater is shown in figure 2.

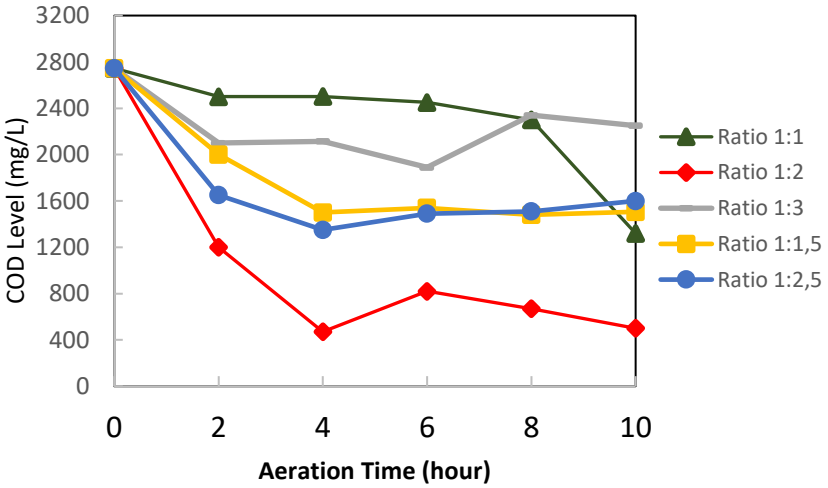

Figure 2. COD level Vs Aeration time

Figure 2 shows that the initial rate COD is 2745 mg/L and then decreases steadily over time with the length of aeration time, equal to 471 mg/L with the removal of 82.9%. The decrease in COD levels with the conditions of the ratio v/v and the best aeration time occurs at a ratio of 1:2 with 4 hours of aeration with COD results of 471 mg/L with a percent removal of 82.9%, which level is already below the wastewater quality standards. Figure 2 can present the longer the aeration time. The more time, the more COD level decreases. The same results were shown by Utami et al. (2019). Here, the results of grass liquid waste treatment by aerobic process showed that the longer the aeration process, the more the COD level decreased. And the best aeration time was obtained at a ratio of 1:2 with an aeration time of 10 hours.

Figure 3 shows the BOD levels with the initial liquid waste of shrimp crackers of 866 mg/L. With the addition of activated sludge and aeration time, the BOD level decreases. The drastic drop of BOD levels is shown in the ratio 1:2 with an aeration time up to 10 hours, where the levels decrease to 442 mg/L with a percent removal of 48.9%. In Figure 3. it can also be seen where the longer the aeration time, the higher the decrease of BOD level (Utami et al., 2019) reported that the longer aeration time in grass wastewater, the more the BOD level decreased. It can be caused by the more organic matter decomposed

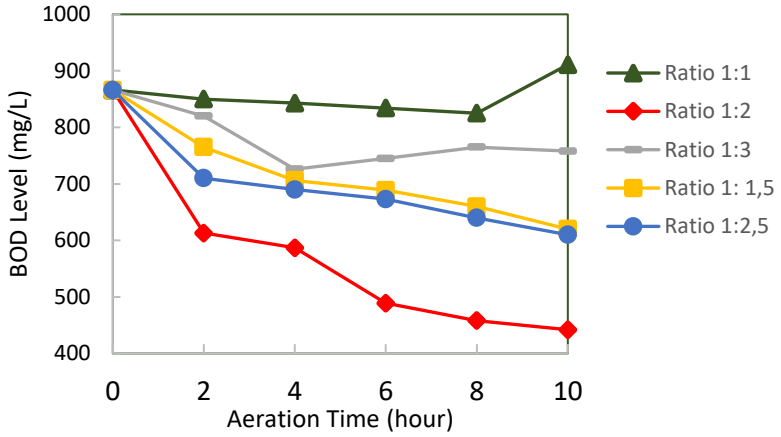

Figure 3. BOD level Vs Aeration time

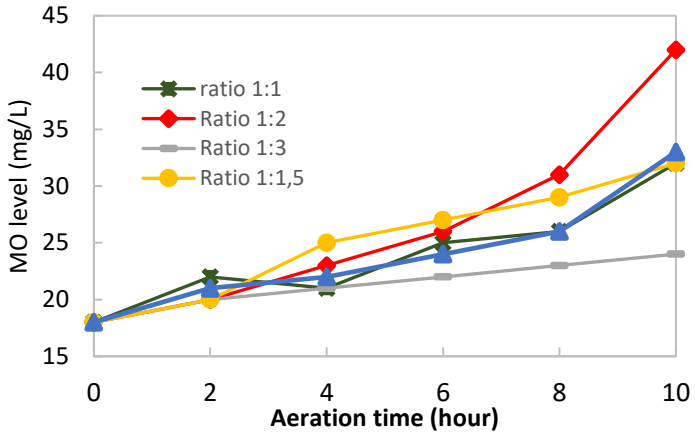

Figure 4. Microbial growth over aeration time on the sludge and wastewater from the crackers factory

Figure 4 shows where the number of initial microbial is 18 g/L. Figure 4 also shows the longer the aeration, the more development of microbes. However, each ratio has different growth. Growth the fastest microbe experienced with the ratio of 1:2 where it happened due to the balance between the number of microbes present with the amount of food available in the wastewater. The amount the highest microbial ratio was found at a ratio of 1:2 for 10 hours of aeration produces the number of microbes as much as 42.215 g/L.

Comparison between microbial growth each other can happen due to the availability of food and nutrients. When the number of microbes with the amount of food available loses far or is not balanced, then the growth of these microbes will be slow (Utami et al., 2019). Nevertheless, when the amount of food there was insufficient with the number of microbes present, the number of microbes will be limited because of the large number of microbes that can't survive.

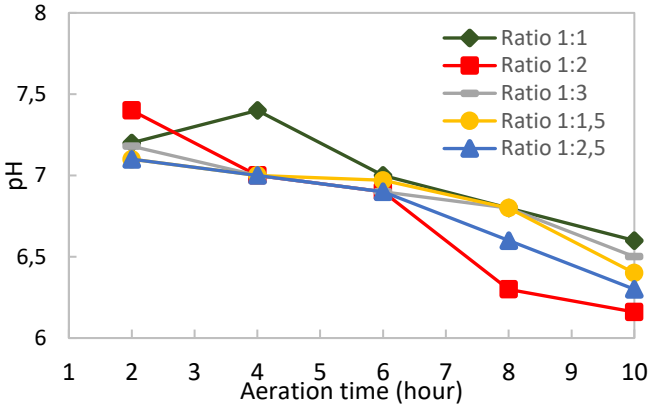

Figure 5. The pH versus aeration time on the sludge and wastewater from the crackers factory.

Figure 5. shows the effect between pH levels against the time of aeration, which was at a ratio of 1:2, the microbes experienced quite a rapid increase where it is affected by the pH in wastewater conditions. The pH in this ratio is the most acidic pH among other conditions. This condition occurs as a result of microbial metabolism that makes water conditions or their environment acidic. At a ratio of 1:2 aeration time of 10 hours obtained pH 6.16 where according to the regulation of the minister of environment live no. 5 of 2014 wastewater that is allowed discarded must have a pH of 6 – 9.

Conclusion

The liquid wastewater processing from crackers shrimp using the aeration method with the addition of activated sludge can reduce levels of BOD and COD present in wastewater. The highest COD and BOD removal percentages were 82.9% and 48.9%, respectively, at 4 hours of aeration and 10 hours with variable sludge volume ratio active with 1:2 wastewater. The highest number of microorganisms was discovered in activated sludge of 43,215 g/L with a pH value of 6.16 at a volume ratio of 1:2. Further research had to be prepared to investigate the level of BOD and COD present in wastewater with a longer aeration time and more significant time interval to obtain significant results. In addition, the addition of NPK fertilizer in addition to sugar in the acclimatization process helps microorganisms obtain nutrients.

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