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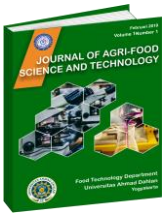

Analysis of COD (Chemical Oxygen Demand) on Liquid Waste of Cheese Production in PT. XYZ, Yogyakarta with Iodometric Titration Method

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ABSTRACT

PT. XYZ is one of food industry engaged in milk processing, organic cheese and creamer in Yogyakarta. Cheese production produces a large volume of liquid waste that it is used as natural fertilizer. Liquid waste of PT XYZ was not handled properly and pollute the environment. This research evaluates liquid waste using COD analysis. This study aims to determine the COD (Chemical Oxygen Demand) value of liquid waste produced by PT. XYZ and compared these results with the quality standards of liquid waste set by the government in Indonesia before being disposed of into the environment. Based on the results of the study, the average COD value of liquid waste produced by PT. XYZ is 97.28 mg / L. This result shows the COD value of liquid waste in PT. XYZ has met the quality standards in accordance with the Regulation of the Minister of Environment Number 5 of 2014 that the maximum limit of COD value in liquid waste is 100 mg / L.

1. INTRODUCTION

PT. XYZ is an industry engaged in milk processing, organic cheese and creamer. Currently, cheese enthusiasts in Indonesia continue to increase from 0.105 ounces / capita / year, in 2014 to 0.252 ounces / capita / year in 2017 (Ministry of Agriculture, 2018). Based on these data, it can be estimated that the demand for cheese will continue to increase every year. This increase is one of the business opportunities that profitable to develop.

Liquid waste in cheese making process called whey is a by-product or liquid waste that is yellow in color and contains some organic matter. Whey has a pH of 6.21, lactose 5%, protein 0.53%, and contains several types of minerals such as sodium, potassium,

calcium, chloride and zinc. Serums that are not processed properly can cause contamination problems because this waste is easily contaminated with bacteria (Nuriliani, 2010).

Organic loads require proper processing management as it can impact the environment and human health. Pollutants and bacteria in wastewater can cause heavy damage to water resources, which then results in further damage to humans and other animals, so that the handling of waste released to the environment becomes a serious problem for the industry (Rilo S, *et al*., 2015). The waste to be disposed require to fulfil the standard norms of effluent disposal. Therefore, the industry must have proper processes related to waste treatment, wastewater characterization, vigilance studies, proper unit planning, and processes for waste treatment (Rohmana *et al*., 2021).

The important of following the waste treatment standard is also to find out the safety of wastewater. Analysis of waste quality can be carried out by using biological and chemical indicators. Biological indicators describe the relationship between the behavior of a community in nature and its environment. Meanwhile, chemical indicators are carried out by analyzing BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand) and DO (Dissolved Oxygen) (Nuraini, et al., 2019). In this study, COD analysis or often called Chemical Oxygen Demand is used, which is the amount of oxygen needed to chemically oxidize organic matter in water (Lumaela, et al., 2013).

The advantage of COD analysis is that it is easy to do, it only takes ±3 hours while the BOD takes 5 days. The accuracy (reproducibility) of the COD test is 2 to 3 times higher than the BOD test, the interference of toxic is being limited. Meanwhile, the disadvantage of the COD test is that it cannot distinguish between actual substances that are not oxidized (inert) and biologically oxidized substances (Situmorang et al., 2014). The method used in this study is iodometric titration. Iodometric titration is one of the methods of quantitative analysis of volumetrics by oxidimetry and reductiometry through the titration process. Oxidimetric titration is a titration against a solution of a reducing agent (reductor) with a standard solution of an oxidizing agent (oxidizer). In indirect iodometric titrations, sodium thiosulfate is used as a titrant with an indicator of amylum solution.

Sodium thiosulfate will react with iodine solution produced by the reaction between analyte and excess KI solution. The amylum indicator be added when the titration is close to the equivalent point because the amylum can form a stable complex with iodine. The reason for using the iodometric titration method is the titrate and titrant immediately react, the addition of kanji at the beginning of the titration, the end point color is easier to observe from colorless to blue (Padmaningrum, 2008).

Based on the description above, the author is interested in determining the level of Chemical Oxygen Demand (COD) in liquid waste samples contained in PT. XYZ, Yogyakarta. And then the results of the COD analysis will be evaluated whether it has met the quality standards for liquid waste based on the Regulation of the Minister of Environment Number 5 of 2014.

2. MATERIALS AND METHODS

2.1. Materials

Equipment used in this study were erlenmeyer, beaker glass, waterbath, burette, statif, drip pipette, measuring pipette, red and green propipet. The materials used in this study were liquid waste cheese, aquadest, H_2SO_4, $K_2Cr_2O_7$, KI, $Na_2S_2O_3$, amilum, and aluminium foil.

2.2. Research Methods

This study was carried out in several steps, first diluting 2 ml of food industry waste samples with 8 ml of aquadest, then taking 5 ml of samples that have been diluted and put

into erlenmeyer. After that adding H_2SO_4 6 N 5 ml and $K_2Cr_2O_7$ 20 ml to the sample then shaken. Sample being heated using waterbath for 10 minutes, temperature of 50 ^oC and then cooling the sample solution until it reaches room temperature (25^oC). After that adding 10 ml KI solution. Erlenmeyer flask should be sheathed with aluminium foil beforehand. The solution is then titrated with $Na_2S_2O_3$ 0.1 N (Na- thiosulfate) until a straw yellow color is formed, then 10 drops of an amilum is added as indicator. The solution is then titrated again until there change in blue color to light green. The number of COD was calculated with the formula:

$$\text{COD} = \frac{(V_{\text{blanco}} - V_{\text{sample}}) \cdot N_{Na_2SO_3} \cdot 8.000}{ml_{\text{sample}}}$$

3. RESULT AND DISCUSSION

COD is the amount of oxygen (mg O_2) needed to oxidize organic substances contained in 1 litre of water sample. The oxidizer $K_2Cr_2O_7$ is used as an oxygen source. This COD test uses the principle of oxidation of organic substances with excess potassium dichromate in boiling sulfuric acid. The amount of potassium dichromate that is not reduced during the oxidation reaction will be reduced by the KI solution resulting in I_2 which will be titrated by a solution of sodium tio sulphate and amylum indicators (Situmorang et al., 2014). The test is carried out by diluting 2 ml of waste with 8 ml of aqueous. After that 5 ml of pre-diluted waste samples are introduced into the erlenmeyer. A total of 5 ml of H_2SO_4 6 N and 20 ml of $K_2Cr_2O_7$ were introduced into the erlenmeyer. The added $K_2Cr_2O_7$ has a function as an oxidizing agent, where potassium dichromate is a relatively easy mixture that can be obtained in a very pure state, while the addition of H_2SO_4 aims to make a reduction-oxidation reaction produce free oxygen which will be measured by iod titration. Then the sample is shaken to homogenize the solution.

Heating is carried out for 10 minutes using a waterbath. Heating aims to increase the speed of a chemical reaction because the high temperature triggers the kinetic energy of each molecule of the two reacting compounds, so that the reaction of two molecules will be greater, and the final compound of the reaction will be formed faster.

The solution is pre-cooled to room temperature (25^oC). Cooling is important to prevent damage before the amilum is inserted into the erlenmeyer. The amylum added due to heat will result in amylum damaged. After that added 10 ml of KI to the solution. The addition of KI must be done by enveloping the erlenmeyer with a black plastic bag or aluminium foil, this is because KI has properties that are easily oxidized when exposed to light. The solution is then titrated with 0.1 N of $Na_2S_2O_3$ (Na- thiosulfate) until a straw yellow color is formed, then 10 drops amilum was added as an indicator. The solution is then titrated again until there is a changing in blue color to light green. The addition of KI will cause a reaction between K ions and oxygen which is freed from the oxidative reaction (On). The reaction will produce free iodide ions whose amount is equivalent to the amount of On that frees the ions. The number of free iodide ions can be determined by Na-thiosulfate titration with the amylum indicator.

The reaction between the free iodide ions and the amylum indicator used will produce a dark blue color to light green. This blue color arises due to the reaction between starch molecules and iodine. Iodine enter the starch molecular structure (amilum) in the form of helix and form bonds. The bond between the molecular structure of starch and iodine produce the dark blue color. The end point of blue color indicates the titration have finished. The amount of Na-thiosulfate volume captured is equal to the number of free iods and showed the amount of oxygen contained in the waste (Suhardi, 1991).

Blanks solution created in the same way as testing samples without adding samples solution. The blanks solution formed to find out errors that arise due to the presence of

organic matter in the reagent. After research was carried out, samples of liquid waste (whey) from PT. XYZ for 5 consecutive days obtained the results of the COD value of liquid waste as in Table 1.

Table 1. *Chemical Oxygen Demand* (COD) of Liquid Waste PT XYZ

Samples	COD value (mg/L)	Mean value of COD (mg/L)	Standard (mg/L)
1	91.2	97.28	100
2	100.8		
3	91.2		
4	107.2		
5	96		

COD value standard has been set by the government to control the pollution. The quality standards of liquid waste for cheese industry businesses are included in the quality standards for milk processing liquid waste. The quality standard for milk processing liquid waste used the regulation from the Minister of Environment of the Republic of Indonesia Number 5, year of 2014. The results of the analysis obtained in Table 1 showed that the sample of the 2nd day and 4th day exceeds 100 mg/l which is the waste quality standard set by the government. However, the mean value of five consecutive days obtained safe value at 97.28 mg/l. These results are compared with wastewater quality standards according to the Regulation of the Minister of Environment of the Republic of Indonesia, Number 5 of 2014 which stipulates that the COD value in milk processing liquid waste must not exceed 100 mg/l.

COD values of liquid waste in PT. XYZ are still below the maximum limit of waste quality standards in Indonesia. According to Supriyantini et al., (2017) the high COD value is due to a decrease in organic and inorganic matter from the industrial waste. The high content of COD in this wastewater will result in a small amount of oxygen content so that there will no biota live in the wastewater (Mulyaningsih, 2013).

COD test is an approaching analysis uses chemical oxidation reaction that mimics biological oxidation (which actually occurs in nature). COD test could not distinguish the substances that are actually not oxidized (inert) and biologically oxidized substances (Alaerts & S.S, 1984). Therefore, it is necessary to test with other parameters to find out whether the waste is safe or not to be disposed of directly into the environment. To maintain wastewater quality, good and correct treatment and handling are needed.

4. CONCLUSIONS

The method of determining the COD value in cheese production liquid waste in PT. XYZ used in this study is iodometric titration. The average COD value of cheese production liquid waste in PT. XYZ is 97.28 mg/L. Based on the Regulation of the Minister of Environment of the Republic of Indonesia Number 5 of 2014, COD value in liquid waste is a maximum of 100 mg / L. Thus, the COD value of liquid waste in PT. XYZ has met the quality standards of liquid waste in Indonesia.

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