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Reducing COD and Detergent Levels Using Activated Bentonite in Laundry Wastewater

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***Abstract*—** *Laundry activities can have a negative impact, caused by liquid waste from the washing process, which has the potential to cause pollution to the environment, especially receiving water bodies. So, it is necessary to treat laundry wastewater to reduce this pollution. This experiment aims to reduce detergent and COD levels in laundry waste using activated natural bentonite and determine the performance of using activated natural bentonite in reducing detergent and COD levels in laundry waste. In this research, active bentonite was used to reduce detergent and COD levels in laundry waste with a mass variation of active bentonite of 0.2; 0.4; 0.6; 1.2; and 1.4 grams. From the results of research that has been carried out, the COD content in laundry wastewater before adding bentonite was 1913.757 mg/L and the detergent content was 516.05 mg/L, so the active bentonite content COD was added resulting in an optimum reduction of 78.08%. by adding 0.8 grams of active bentonite to 50 mL of laundry waste. Meanwhile, the optimum decrease in detergent levels was 28.63% with the addition of 1.2 grams of active bentonite to 50 mL of laundry waste. From the results obtained, active bentonite can reduce COD and detergent levels effectively.*

***Keywords*—** *Active bentonite, COD, detergent, laundry waste*.

I. INTRODUCTION

In the province of East Kalimantan, especially in the city of Samarinda, every year there is an increase in the number of residents coming from various cities in East Kalimantan, they are students who are continuing their studies in the city of Samarinda, so there will automatically be an increase in the need for goods and services.

Currently, the term laundry is well known, namely a service that offers complete washing facilities for clothes, carpets, dolls, and ironing. This laundry service is very helpful for most students in the city of Samarinda. This laundry service provides quite a large benefit to the economy. It could be said that this business entity can reduce the number of unemployed and improve people's living standards.

In recent years, similar businesses have emerged that use local franchises and agency systems that can provide services at affordable prices. So services that previously could only be enjoyed by upper-class people can now also be enjoyed by lower-middle-class people.

This is where the combination of cheap services and ironing services is created, which is now known as laundry, namely the ironing washing business. The laundry business is a trusted service business. To gain consumer trust, quality work results are needed that are reliable, tested, and measurable. However, on the other hand, this laundry activity has a negative impact, which is caused by the generation of liquid waste from the washing process, which has the potential to cause pollution to the environment, especially the receiving water bodies.

One component that can have a bad impact on the environment comes from detergent because every laundry business uses detergent. Detergents are dangerous for the environment because they can dissolve materials and are carcinogens. Apart from causing health problems, the detergent content in drinking water will cause an unpleasant odor and taste. There are two measures used to see the extent to which chemical products are safe in the environment, namely toxicity and biodegradability. Alkyl Benzene Sulfonate in the environment has a very low biodegradable level, so this detergent is categorized as 'non-biodegradable'.

Wastewater or waste water is an event, the entry or inclusion of solid, liquid, or gas, in the form of sediment or solid, suspended solids, dissolved, as colloids, emulsions that

causes the water in question to be separated or thrown away [21]. Meanwhile, according [19], waste water is residual material that is dirt from the community and households and also comes from industry, groundwater, surface water, and other waste. Thus, this wastewater is general waste.

One way to find out the extent of the pollution load in wastewater is to measure COD (Chemical Oxygen Demand). The higher the COD value, the higher the pollution load in the liquid waste [13].

By considering the existing problems, it is necessary to think about appropriate processing or technology to reduce the level of danger posed by laundry activities. So this research will discuss the problem of reducing detergent and COD levels with the addition of bentonite.

II. RESEARCH METHOD

Research Tools and Materials

The tools used in this research were a furnace, oven, hot plate, magnetic stirrer, beaker, analytical balance, two-neck flask, measuring pipette, volumetric pipette, spatula, cardigan, separating funnel, and spectrophotometer. Meanwhile, the materials used in this research were laundry wastewater, natural bentonite, distilled water, HCl, Ag(NO)3, sulfuric acid, K2Cr2O7, and filter paper no. 42, methylene blue, NaOH, chloroform, and phenolphthalein indicator.

Research Path

The research was carried out in the Research Laboratory of the Chemical Engineering Department of the Samarinda

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State Polytechnic and the testing was carried out at the Samarinda Industrial Research and Standardization Center. Natural bentonite, which functions as an adsorbent, is activated with an acid solution, then the activated natural bentonite is put into laundry waste and an adsorption process is carried out to reduce detergent and COD levels from the research results. Laundry waste comes from Jalan Ciptomangunkusumo Samarinda Seberang. This laundry place is capable of washing up to ± 6 times a day. Assuming that in one wash you use 10 L of water and ± 40 grams of detergent.

Schematic Diagram of Work Procedures

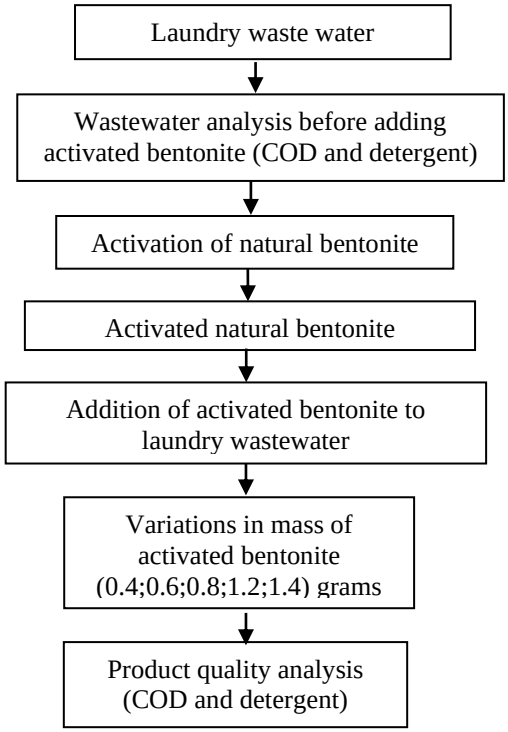

Fig. 1. Research Flow Diagram

Work procedures

- Activation of natural Bentonite
  a. Crushing and sieving natural bentonite at 140 mesh size
  b. Soak 200 grams of adsorbent in 400 mL of 6 N HCl for 4 hours
  c. Filter and wash the mixture until the pH of the filtrate is the same as the pH of distilled water
  d. Dry the residue in a kiln at 550°C for 4 hours
- Adsorption Process
  1. Take 50 ml of laundry waste into a beaker and weigh the activated natural bentonite with a mass variation of 0.2; 0.4; 0.6 ; 1.2;1.4 grams
  2. Then stir for 1 hour with a stirring scale of 5
  3. After stirring for 1 hour, the waste is filtered to separate it from the bentonite
  4. Take the filtrate and analyze the COD and detergent levels

COD (Chemical Oxygen Demand) Analysis Procedure

1. First wash the test tubes and lids that will be used with a solution of 20% sulfuric acid in water
2. Pipette 2.5 ml of each sample, then put it in a test tube
3. Add 1.5 ml of K2Cr2O7 to each sample.
4. Through the inside edge of the bottom of each test tube, insert 3.5 ml of sulfuric acid reagent.
5. Close the test tube tightly with the lid. Then it is placed in a rotating tool to homogenize the solution.
6. Turn on the heater and leave it until the temperature rises to 150°C and the timer shows 120 minutes, then insert all the tubes into the heater hole, then press the start button. After 2 hours the heater will turn off automatically
7. After 2 hours, move the test tube to a rack to cool quickly
8. Clean the bottom of the blank test tube insert it into the photometer and look for the zero
9. Take another test tube and fill it with the blank solution.
10. Measure mg/L with a spectrophotometer.
11. Compare the measurement results with the sample.

Detergent Analysis Procedure

1. Measure 100 ml of the test sample in duplicate and put it in a 250 ml separating funnel
2. Add 3 drops to 5 drops of phenoltaline indicator and 1 N NaOH solution drop by drop into the test sample until a pink color appears, then remove it by adding 1 N H2SO4 drop by drop.
3. Add 25 ml of methylene blue solution to each
4. Add 10 ml of chloroform each, and shake for 30 seconds, while opening the lid of the funnel to release the gas
5. Leave it until phase separation occurs, and shake the separating funnel slowly, if an emulsion forms, add a little isopropyl alcohol until the emulsion disappears
6. Separate the bottom layer (chloroform phase) and collect it in another separating funnel
7. Re-extract the water phase in a separating funnel by repeating steps 3-5 2 times and combining all the chloroform phases
8. Allow phase separation to occur and shake gently
9. Remove the bottom layer (chloroform) through glass wool and collect it into an Erlenmeyer
10. Measure with a spectrophotometer at a wavelength of 652 nm and record the absorption

III. Research Results And Discussion

Research Result

Variations in Active Bentonite Mass in Laundry Waste

TABLE 1. Variations in Active Bentonite Mass in Laundry Waste.

No	Massa Bentonit Aktif (gram)	Parameter Uji		%Penurunan COD	% Penurunan deterjen
		COD (mg/L)	Deterjen (mg/L)		
1	0	1913,757	516,05	-	-
2	0,4	1331,346	478,76	30,43 %	7,23 %
3	0,6	883,867	453,72	53,82 %	12,08 %
4	0,8	419,481	423,37-	78,08 %	17,96 %
5	1,2	535,263	368,36	72,03 %	28,63 %
6	1,4	587,531	443,52	69,30 %	14,05 %

Source: Research Results

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Discussion

The process of activating natural bentonite by acid treatment using HCl at a concentration of 6 N causes natural bentonite to experience dealumination and deionization. The dealumination process is carried out to reduce the Al content in the bentonite structure. Because high Al will reduce stability at high temperatures. Acid activation also causes decationization which causes an increase in the surface area of natural bentonite, due to reduced impurities covering the bentonite pores. The increased surface area is expected to increase the ability of natural bentonite in the adsorption process. Then proceed to the calcination process, namely the heat treatment process of natural bentonite at a relatively high temperature which aims to evaporate the water molecules that are chemically bound in the bentonite pores thereby increasing its surface area. This process takes place in a furnace for 4 hours and at a temperature of 550 °C.

In this research, a comparison was made between variations in the mass of natural bentonite that had been activated and the volume of waste, namely: 0.2 grams: 50 mL. From this research, it can be seen how much efficiency there is in reducing COD (Chemical Oxygen Demand) and detergent levels in laundry waste.

Decrease in Chemical Oxygen Demand Levels (COD) on Laundry Waste

The presence of Chemical Oxygen Demand (COD) content in laundry wastewater is caused by the use of detergents, softeners, and the use of other chemicals in the process of washing clothes, blankets, carpets, or dolls which have a higher surface tension compared to water so that the oxygen supply in the water is disturbed, and in the end this will cause the dissolved oxygen content in laundry washing wastewater to decrease.

In this research, bentonite was used to reduce levels of Chemical Oxygen Demand (COD) in laundry waste, where the waste comes from the laundry place on Jl. Ciptomangunkusumo Samarinda Opposite. In this research, the oxidizing agent used was K2Cr2O7. If a body of water has a high COD figure, this indicates that the water is polluted and has a high content of organic substances. The large amount of organic substances will result in a reduction in the dissolved oxygen content in the water.

Before analyzing the COD content, laundry waste is first filtered so that there are no sediments when analyzed using a spectrophotometer. When adding activated bentonite, 50 ml of laundry waste is taken, and then activated bentonite is added with a mass variation of 0.4; 0.6; 0.8; 1.2, and 1.4 grams. Then stir for 1 hour. This stirring process aims to evenly contact the activated bentonite with laundry waste so that the adsorption process takes place well.

The adsorption of organic substances by activated bentonite causes organic compounds in laundry waste to decrease so that the amount of oxygen needed to oxidize organic substances is less than if there was no treatment of laundry waste before measuring COD.

Based on Table 1, it can be seen that the COD of laundry waste before being treated with active bentonite has a greater COD value compared to laundry waste that has been treated with active bentonite, namely 1913.757 mg/L. The addition of active bentonite to waste by stirring has been proven to reduce COD. Based on the results in Table 1, the COD value decreases with increasing active bentonite mass.

When adding 0.4 and 0.6 g to 50 mL of waste, the COD value decreased to 1331.346 and 883.867 mg/L respectively. The optimum reduction in COD when adding 0.8 g of active bentonite was 419.481 mg/L. The research results as shown in Table 1, can be seen in the following graph:

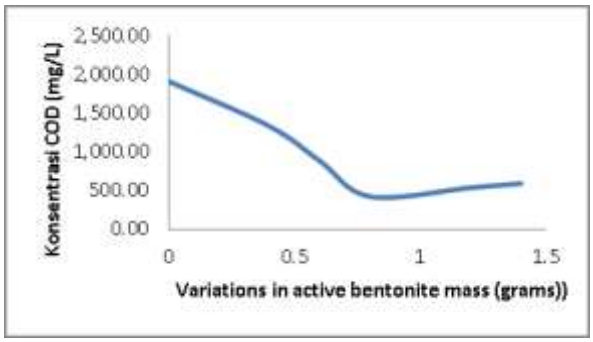

Fig. 2. Graph of the relationship between active bentonite mass and COD

From the graph above, it can be seen that the decrease in COD levels with the addition of active bentonite decreases further with the addition of a bentonite mass of 0.4; 0.6, and is optimal with the addition of 0.8 grams of active bentonite.

From the picture above it can be seen that the reduction in COD levels with the addition of active bentonite resulted in a decrease in COD levels of up to 78.08%. In active bentonite, it can be seen that the optimum reduction occurs when adding 0.8 grams to 50 ml of laundry waste.

Detergent content in laundry waste

The presence of detergent in laundry waste can cause pollution to water bodies because it cannot be decomposed due to its very complex chemical composition. Detergent is a cleaning agent that is a mixture of several chemicals, namely surfactants as surface active agents, builders, and fillers, as well as additives such as fragrances, dyes, and bleach. Building materials (builders) usually use phosphate, citrate, acetate, or silicate compounds. Bentonite acts as a substitute for phosphate, which is a building block in detergents and can act as an anti-caking agent by absorbing excess liquid ingredients in detergent powder formulations.

In this research, active bentonite was used to reduce detergent levels in water. Variations in bentonite mass that are the same as COD analysis. With the addition of 0.4 and 0.6 g, detergent levels decreased from 516.05 mg/L to 478.76 and 453.72 mg/L. The decrease in optimum detergent when adding 1.2 g of active bentonite was 368.36 mg/L. The research results as shown in Table 1, can be seen in the following graph:

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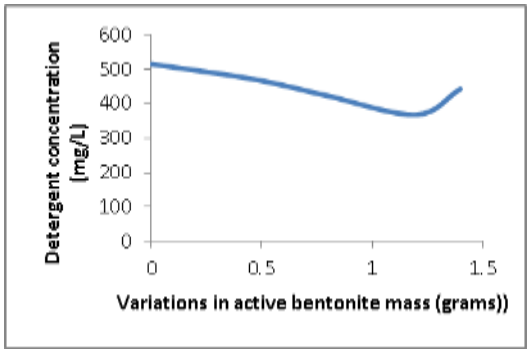

Fig. 3. Graph of the relationship between active bentonite mass and detergent

The increase in detergent levels when adding 0.6 and 0.8 grams of natural zeolite was because one of the detergent contents that function as a builder in detergents can be bentonite. So, when the bentonite is read on the spectrophotometer it is not read as an absorbent but as a detergent (MBAS). As is known, bentonite can be used as a builder in detergents because it can reduce detergent production costs and is environmentally friendly because it is free from phosphates which are difficult to degrade. So the addition of bentonite mass affects reducing detergent levels. In active bentonite, it can be seen that the optimum reduction occurs when adding 1.2 grams of active zeolite, namely 28.63% in 50 ml of laundry waste.

IV. Conclusion

From the research that has been carried out, several things can be concluded regarding the use of bentonite in the laundry waste processing process to reduce detergent and COD content, as follows:

a. When adding active bentonite, COD levels experienced an optimum decrease of 78.08% with the addition of 0.8 grams of active bentonite to 50 mL of laundry waste. Meanwhile, the optimum decrease in detergent levels was 28.63% with the addition of 1.2 grams of active bentonite to 50 mL of laundry waste.

b. Active bentonite is quite efficient in reducing COD levels compared to detergents. This is because bentonite detergent can form builders. So, it can be read as detergent on the reading on the spectrophotometer

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