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APPLICATION OF MORINGA SEEDS COAGULANT TO TREAT WASTEWATER FROM CHICKEN SLAUGHTERHOUSE INDUSTRY

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Abstract

Liquid waste generated by the chicken slaughterhouse industry results in an increased concentration of organic matter decomposes in the environment. High organic matter content can be achieved by the coagulation-flocculation method. This study aims to determine the removal efficiency of turbidity, BOD, COD, and TSS in the reactor. A dose of 250 mL with a coagulation speed of 100 rpm 1 minute and a flocculation speed of 25 rpm 10 minutes with a variation of settling time of 1.5 hours, 2 hours, and 2.5 hours of moringa seeds were investigated to find reduction levels of turbidity, BOD, COD, and TSS. This study showed that moringa seed coagulants were able to reduce the BOD concentration by 87.74% with an initial level of 662 mg/L to 101.01 mg/L in 2.5 hours, a COD concentration of 61.43% with an initial level of 2240 mg/L to 864 mg/L at 2.5 hours, the TSS concentration was 77.78% with an initial level of 360 mg/L to 80 mg/L at 2.5 hours while the turbidity value was 87.73% with an initial level of 441 NTU to 54.1 NTU. Moringa seeds could be effectively used to reduce the parameters of turbidity, TSS, BOD, and COD.

Keywords: bio coagulant, chicken slaughterhouse, *moringa seeds*, gradient velocity, wastewater

Introduction

Along with population growth each year, the knowledge and awareness of the community to consume nutritious food increases. The chicken slaughterhouse industry can increase people's economic growth, but on the other hand, chicken slaughterhouse industry also produces waste. Chicken meat is of the largest protein producers of animal protein from livestock which has good quality and is more in demand by consumers it is easy to digest, can be accepted by most people and the price is more economical compared to other types of meat (Kholifa, Dharma & Situmeang, 2016).

The increased demand from chicken meat for consumption has resulted in increased wastewater from chicken slaughterhouse production activities. Liquid waste generated by chicken slaughterhouses causes the concentration of organic matter that decomposes in the environment to increase. Organic matter is the main pollutant from chicken slaughterhouse wastewater. There are two types of waste produced by chicken slaughterhouses, namely solid waste and liquid waste, of the two types of waste, the waste that has the greatest impact on the environment is liquid waste (Al Kholif, 2015). Liquid waste that is not processed and directly disposed of into water bodies results in eutrophication and is hazardous to health due to the presence of bacteria that attack humans through polluted waters (Ardiansyah, 2015). The contribution of organic matter in the effluent comes from fat, blood, dissolved protein and solid materials.

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Therefore this study aims to test the effectiveness of moringa seeds as a natural coagulant for treating chicken slaughterhouse wastewater. Moringa seed is a natural coagulant that can be used as an alternative in environmentally friendly wastewaster treatment. The active substances in moringa seeds cause destabilization of colloidal particles (liquid waste) which occurs with a mechanism called bridge between particles where in this mechanism, positively charged ions or colloids used come from polymers.

Research Methodology

Preparation Biocoagulant

Moringa seeds were baked in the oven at 105^{o}C and destroyed with a blender. The refined moringa seeds were sifted using an 80 mesh sieve weighed as much as 1 gram and dissolved in NaCl using a magnetic stirrer for 15 minutes. The dissolved moringa seeds were then filtered using filter paper and the filtrate was obtained.

Determination of doses

This study used a sample volume of 500 mL with 7 variations of volume doses of 0, 5, 10, 15, 25, 35, and 250 mL Rapid mixing was carried out with a fast stirring speed of 100 rpm and a stirring time of 2 minutes, then continued with slow stirring at a speed of 25 rpm for a stirring time of 20 minutes, then sedimentation was carried for 30 minutes.

Speed gradient

Velocity gradient and detention time need to be calculated from the speed variations that have been used using the formula.

$$G = \sqrt{\frac{P}{\mu \, . V}} \quad (1)$$

$$P = Cd \, . A \, . \rho \frac{v^3}{2} \quad (2)$$

$$GTd = G \times Td \quad (3)$$

Where:

P = Power for water (N.m/s)

A = Surface area (m^3)

ρ = Density of water (kg/m^3)

v = speed (m^2/s)

μ = Absolute viscosity (N.detik/m^2)

Cd = Drag coefficient

Reactor

Stirred tub with a batch system with a reactor capacity of 45 liters. The bio coagulant solution was put into a tub containing samples of chicken slaughterhouse wastewater and coagulation and flocculation were carried out with a certain stirring speed and stirring time. After stirring, sedimentation was carried out with variation in settling time.

Efficiency Removal

$$\text{Efificiency}(\%) = \frac{C_{inlet} - C_{outlet}}{C_{inlet}} x100\% \quad (4)$$

Information :

C *inlet* = Concentration *inlet*

C *outlet* = Concentration *outlet*

Determination of Coagulant Volume

Moringa seeds were first dissolved with 1 M NaCl solution. In this study, 10 mg of moringa seeds were dissolved in 100 mL of NaCl solution to obtain a biocoagulant solution. The following is the calculation of the moringa seed bio coagulation used:

$$V_1 \; M_1 = V_2 \, M_2 \quad (5)$$

$$V_1 \times 1000 \text{ mg/L} = 500 \text{ mL} \times 500 \text{ mg/L}$$

$$V_1 = 250 \text{ mL}$$

Results and Discussion

Analysis of Characteristic Chicken Slaughterhouse Wastewater

The chicken slaughterhouse liquid waste used in this study is chicken slaughterhouse wastewater originating from Micro, Small and Medium Enterprises (MSMEs) Pulogadung, East Jakarta by sampling and examining samples to determine levels of polluted parameters in duplo. The results of the analysis of the characteristics of wastewater can be seen in **Table 1.**

Table 1. Initial Characteristic of Chicken Slaughterhouse Wastewater

Parameters	Units	Concentration	Quality Standards*	Information
BOD	mg/L	662	100	Not qualified
COD	mg/L	2240	200	Not qualified
TSS	mg/L	360	100	Not qualified
Oil and Grease	mg/L	58.1	15	Not qualified
NH_3-N	mg/L	0.115	25	Qualified
pH	-	6.46	6 - 9	Qualified

*Wastewater Quality Standard Regulation of the Minister of Environment of the Republic of Indonesia Number 5 of 20214 concerning the Quality Standard of Wastewater from Animal Slaughterhouses.

From Table 1, it can be seen that the results of the analysis of the initial characteristics of chicken slaughterhouse wastewater have parameters that exceed the quality standards of the Minister of Environment of the Republic of Indonesia Number 5 of 2024 concerning Quality Standards of Slaughterhouse Wastewater, namely BOD content of 662 mg/L, a COD content of 2240 mg/L, TSS content of 360 mg/L and oil and fat content of 58.1 mg/L. The high levels of TSS, BOD and COD are caused by the high content of organic compounds.

The BOD/COD ratio can indicate the biodegradability of wastewater, the greater the ratio, the lower the biodegradability of wastewater. The BOD/COD ratio in this study was 0.29 or <0.3 so that wastewater is classified as non-biodegradable. Non-biodegradable wastewater can be treated using the coagulation-flocculation method and can be treated using a biological process, but the decomposition process will be slow because microorganisms as decomposers require acclimatization.

Determination of Coagulant Doses Volume

Determination of coagulant dose in the coagulation-flocculation process is urgently needed to maximize wastewater treatment. The optimum dose of coagulant affects the destabilization of colloidal particles in wastewater. Variations in the coagulant dose are required to determine the coagulant dose used to remove BOD, COD and TSS parameters in wastewater. Variations in dose volume used are 5 mL, 10 mL, 15 mL, 25 mL, 35 mL, 50 mL, and 250 mL. The effect of the volume of biocoagulant solution on the turbidity of chicken slaughterhouse wastewater during the coagulation-flocculation process can be seen in **Table 2.**

Table 2. Effect of Biocoagulant Solution Volume on Turbidity Removal

Doses		Result
Concentration	Volume	
(mg/L)	(mL)	(NTU)
0	0	303
10	5	299
20	10	297
30	15	286
50	25	281
70	35	277
100	50	270
500	250	186

The initial turbidity of the wastewater was 441 NTU and then coagulants were added at different doses to obtain different turbidity reductions. The higher the dose of coagulant used, the better the turbidity removal obtained. High levels of turbidity in water require the right dose of coagulant so that when the process of settling colloidal particles in turbid water takes place properly.

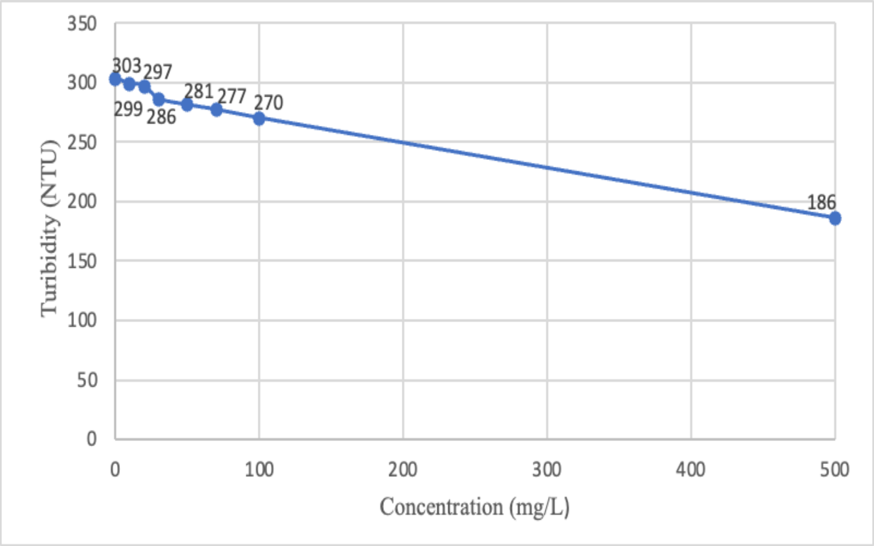

Figure 1. Effect of Biocoagulant Solution Volume on Turbidity Removal

Figure 1 shows the effect of bio coagulant solution volume on turbidity removal based on the table and figure above, the greatest turbidity removal was found at a coagulant dose of 250 mL at a concentration of 500 ppm with a coagulation stirring speed of 100 rpm for 2 minutes of coagulation stirring and a flocculation stirring speed of 25 rpm for 25 minutes. The turbidity parameter at a dose volume of 0 or without the addition of biocoagulant has decreased, this is because there is a gravitational force that causes the particles to fall and settle.

The turbidity parameter at a dose volume of 0 or without added biocoagulant has decreased, this is due to the gravitational force which causes the particles to fall and settle. The removal of 71% turbidity with a concentration of 1 M extractor solution is the most optimum removal value, this is according to research by (Madrona et al., 2012) Moringa seeds extracted using 1 M NaCl can reduce turbidity by 99.8%. Moringa seed coat contains water-soluble protein molecules with a low molecular weight. This protein has a positive charge when dissolved in water. The protein will work like a synthetic material that has a positive charge so that it can be used as a synthetic polymer coagulant.

Analysis of Allowance for BOD, COD, TSS, and Turbidity with Stirred Reactor

This stirred reactor has a capacity of 45 liters and is made of acrylic. The reactor used is a reactor with a batch system. A batch reactor is a process in which all the reactants are introduced at the beginning of the process simultaneously and the products are removed at the end of the process. The optimum conditions for the coagulation process in the use of the reactor are 100 rpm for 1 minute and 18 rpm flocculation process for 10 minutes with a dose of 250 mL biocoagulant. To obtain the optimum floc settling time, variations of the settling time were carried out in the sedimentation process for 1.5 hours, 2 hours and 2.5 hours. Variation of settling time was carried out after the chicken slaughterhouse wastewater was processed using a stirred reactor to obtain the efficiency of BOD, COD, TSS and turbidity removal parameters as shown in **Table 3**.

Table 3. Results of Analysis of BOD, COD, TSS, and Turbidity Concentrations on Variation of Sedimentation Time

Sedimentation (Hour)	Concentration			
	BOD (mg/L)	COD (mg/L)	TSS (mg/L)	Turbidity (NTU)
1.5	151.52	1280	107	55.6
2	131.31	960	90	54.8
2.5	101.01	864	80	54.1

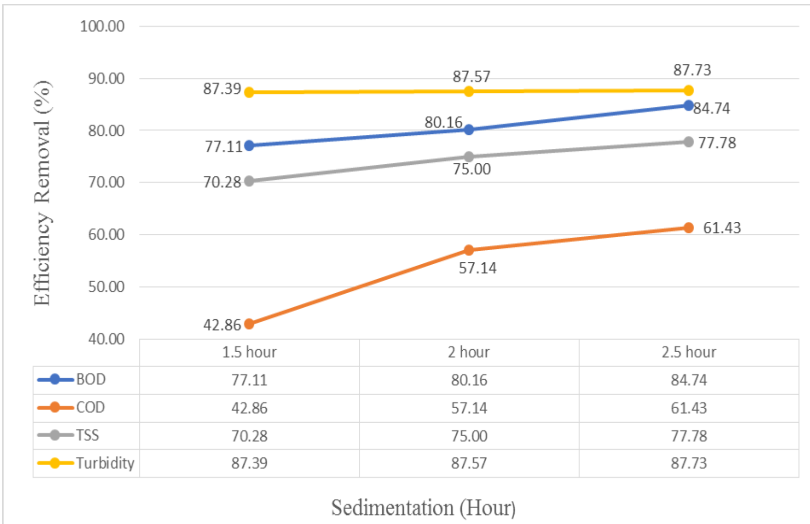

Figure 2. Correlation of Removal Efficiency of BOD, COD, TSS, and Turbidity in Optimum Doses to Variation of Sedimentation Time.

Based on the table and figure above, there are 3 variations of sedimentation time after processing in a stirred reactor with a batch system, the effluent levels of BOD, COD, TSS, and turbidity are decreasing. The lowest removal efficiency was found at 2.5 hours of settling time.

The TSS parameter with 2 variations of settling time has met the quality standard, namely 100 mg/L with a removal efficiency of 75% and 77.78% where the TSS level decreases due to sedimentation. This is following Ningsih's research (2011), namely one of the efforts to reduce the TSS parameter is sedimentation where the floc formed will cause a change in the specific gravity of suspended solids so that the settling time causes the suspended solids to settle by gravity. If the optimum coagulant concentration has been reached then the solution will be stable and will form a dense floc (Sari et al., 2016). Based on the table and figure above, it can be concluded that the longer the settling time, the greater the parameter levels set aside. TSS and turbidity parameters are directly proportional where when TSS levels are high, turbidity levels will be high and vice-versa because the TSS parameter is a solid substance present in waters which makes it difficult for sunlight to enter the waters so that it affects oxygen regeneration and photosynthesis in water (Misnani, 2010).

Conclusions

Based on the research that has been done, the results show that the optimum coagulant dose in this study is 250 mL with an optimum fast stirring speed of 100 rpm for 1 minute and a slow stirring time of 20 minutes. 1 minute with GTd 6175.66 and flocculation stirring speed of 18 rpm with flocculation stirring time of 10 minutes with GTd 7719.57 and removal efficiency in the use of the reactor for BOD parameters respectively 77.11%, 80.16%, and 87.74%, parameter COD was 42.86%, 57.14%, and 61.43% respectively, TSS parameter was 70.28%, 75%, and 77.78% respectively for turbidity parameter which was 87.39% each, 87.57% and 87.73%.

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