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COD REMOVAL PERFORMANCE USING MORINGA SEEDS POWDER AS BIOCOAGULANT IN ABATTOIR WASTEWATER TREATMENT

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Abstract

High COD levels in abattoir wastewater might cause negative impact to the environment, hence it must be lowered before being discharged into the environment. The seeds of moringa plant (Moringa oleifera) contains quite high levels of protein compounds, makes it potential as biocoagulant in coagulation-flocculation process for wastewater treatment. The objective of this research is to discover the potential of biocoagulant from moringa seeds powder in decreasing COD levels on abattoir waste water treatment. The research was performed with biocoagulant dose variations 0 g; 0.5 g; 1 g; 1.5 g; 2 g; and 2.5 g, utilizing rapid mixing at 120 rpm, and slow mixing at 30 rpm with duration 2 and 30 minutes respectively. The result showing that the optimum dose obtained at 2 g, with percentage of decreation by 93.97%. Based on the research, it is concluded that the biocoagulant derived from moringa seeds can perform effectively in COD removal of abattoir wastewater treatment.

Keywords: *Moringa seeds powder, Biocoagulant, Coagulation-flocculation, Abattoir wastewater.*

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1. Introduction

The existence of organic matters in abattoir wastewater can cause negative impacts for the environment if being dumped without being treated beforehand. The existence of organic matters will increase the COD value in the water and might cause the dissolved oxygent value to be declined. Therefore, before being dumped to the environment, the abattoir wastewater should be treated with a proper treatment process, hence it can reach the quality standard that given by Ministry of Environment of Indonesia. The 45th Appendix of the regulation document (*Regulation of Minister of*

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Environment of the Republic of Indonesia No. 5, 2014) giving quality standar of COD level that can be tolerate in abattoir wastewater, which is 200 mg/L.

One of the method that can be used to treat COD level in abattoir wastewater is coagulation-flocculation method, which utilizing rapid mixing, slow mixing and addition of coagulant agent. Rapid mixing is being used for homogenization and destabilization process, and slow mixing is being used to coagulate the colloid substances in the treated water or wastewater, hence the mass and size will get larger to make it easier to be settled.

Biocoagulant is a natural based coagulant agent that derived from either animals or plants. The usage of biocoagulant is considered to safer and more eco-friendly than chemical based coagulant (Kurniawan et al. 2020). Chemical based coagulant such as PAC and aluminium sulphate may produce a residual product from the treatment process and cause a negative impact for health and environment, while residual product from biocoagulant is safer (Amran, 2018). The substance that being utilized from biocoagulant are proteins, tannins, polysaccharide etc. Moringa seeds contains a quite high amount of proteins, up to 47.031% (Adesina et al., 2021). On another research conducted by Liang (2019), moringa seeds contains 40.34% of proteins. The high amount of proteins in moringa seeds makes it potential to be utilized as biocoagulant for treating wastewater such as abattoir wastewater.

On previous research by Desta & Bote (2021) which also using biocoagulant that derived from moringa seeds to treat domestic wastewater, showing that moringa seeds biocoagulant gave a good performance in COD removal (59.99%). Nabila et al. (2024) found out in their research that biocoagulant that derived from moringa seeds effectively reducing COD level in chicken abattoir wastewater (61.43%). The result of of the research conducted by Askar & Dakhil (2023) also showing that biocoagulant which derived from moringa seeds has a good effectiveness in reducing COD level in treating raw water for drinking water (77.39%).

In this research, the experiment was being conducted to discover the potential of moringa seeds powder as biocoagulant in COD removal for treating abattoir wastewater. The performance of moringa biocoagulant in decreasing COD level then being used to determine the optimum dose of the biocoagulant, hence it can be applied in larger scale of abattoir wastewater treatment.

2. Methodology

2.1 Field Study

The wastewater sample was taken at Regional Technical Implementation Unit of Abattoir of Banda Aceh City, which is located at Gampong Pande Village, Kuta Raja subdistrict, Banda aceh City that specialized in slaughtering water buffaloes, cows, sheeps, and lambs. The characteristic of abattoir wastewater taken from Regional Technical Implementation Unit of Abattoir of Banda Aceh City is shown by Table 1.

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Table 1. Characteristic of abattoir wastewater in Regional Technical Implementation Unit of Abattoir of Banda Aceh City

Characteristic of Wastewater	Value	Standard Discharge*	Unit
COD	3103	200	Mg/L

* *Regulation of Minister of Environment of the Rapublic of Indonesia No. 5, 2014*

Based on Table 1, COD value of abattoir wastewater was still far from the quality standard, hence it needs to be treated with a proper treatment. Abattoir wastewater before being treated is shown by Figure 1.

Figure. 1. Abattoir wastewater before treatment

2.2. Experiment Set-Up

Experiment was being conductes using jar-test method, reffering to SNI 19-6449-2000. The experiment using the dose variation of moringa seeds powder biocoagulant as follow: 0 g; 0.5 g; 1.0 g; 1.5 g; 2.0 g and 2.5 g. The dosages was later being added into beaker glasess containing 1 L of abattoir wastewater. Coagulation process was running by conducting rapid mixing (120 rpm) for 2 minutes and then slow mixing (30 rpm) for 30 minutes. After that, sedimentation process was being conducted where the process is being observed at 15, 30, 45 and 60 minutes. The experiment design is shown by Table 2.

Table 2. Experiment Design

Abattoir wastewater volume (L)	Dose Variations (g)	Rapid Mixing	Slow Mixing
1.0	0 0.5 1.0 1.5 2.0 2.5	120 rpm for 2 minutes	30 rpm for 30 minutes

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In COD level testing, SNI 6989.15-2019 which is a guideline for testing COD levels for water and wastewater was being used as reference.

2.3. Analytical Methods

After being collected, the data was being analyzed. The performance of bicoagulant was being determined by computing the percentage of removal, using an equation as follows:

$$R(\%) = \frac{C_0 - C_e}{C_0} \times 100\% \quad (1)$$

Where R is removal percentage, C_0 is COD level before coagulation-flocculation treatment and C_e is COD level after coagulation-flocculation treatment. R was being calculated for each dosage variations in the experiment and the dose that gave the highest removal percentage in COD removal, was determined as the optimum dose.

3. Result and Discussion

The result showing that each dose variations of moringa seeds biocoagulant, with rapid mixing and slow mixing process (120 rpm and 30 rpm respectively) can decrease the COD level on abattoir wastewater. Each dose gives different level of decreation and the result of the jar-test in COD removal is shown by Table 3.

Table 3. Jar-test result in COD

Dose (g)	C_0 (mg/L)	C_e (mg/L)	% Removal of COD	Quality Standard (mg/L)
0	3103	2969	13.12	200
0.5		1672	46.12	
1.0		857	72.38	
1.5		316	89.82	
2.0		187	93.97	
2.5		221	92.88	

Form Table 3, the highest COD removal was given by 2 g of moringa seeds powder biocoagulant dose, which was determined as the optimum dose. The decreation of COD level reaches 187 mg/L, fulfilled the quality standard that given (200 mg/L), with 93.97% of removal percentage. The removal caused by the interaction of positive and negative charges between the biocoagulant and the flocs consist by organic matters, which bridging the bonds between the flocs, makes the flocs clump together. Hence, the flocs getting larger and then easier to be settled by the influence of gravitational force. The removal of organic matters causing the decreation of COD level in the wastewater. The chart of COD removal is shown by Figure 2.

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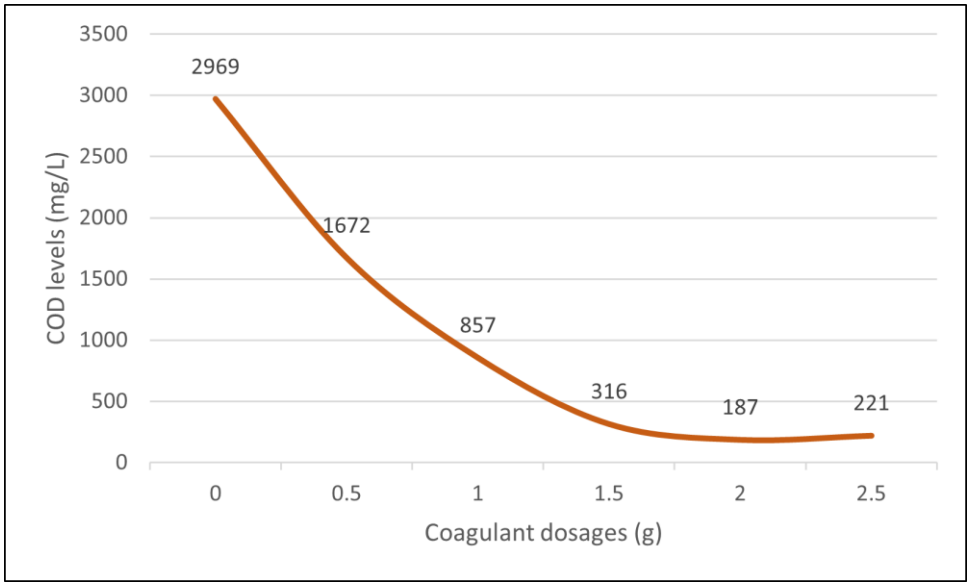

Figure 2. COD removal chart

From Figure 2, optimum dose is shown at 2 g of moringa seeds powder biocoagulant dose. Further addition of the dose will cause the reincrease of COD level and makes it unable to fulfill the quality standard. Similar result was being shown by the research conducted by Kinanti et al. (2023), which using rain tree seeds powder as biocoagulant for abattoir wastewater treatment. It is being suspected that this is happens by the origin characteristic of moringa seeds as an organic matter. When exceeding the optimum dose, biocoagulant that derived from organic matters might cause the COD level in the wastewater to be reincreased, but this hypothesis still needs further investigation. Abattoir wastewater after treatment is shown by Figure 3.

Figure 3. Abattoir wastewater after treatment (from left to right: dose of 0.5 g; 1.0 g; 1.5 g; 2.0 g and 2.5 g of moringa seeds powder biocoagulant)

Compared to the previous similar research using biocoagulant that derived from moringa seeds for treating various type of wastewater, the performance of COD removal in this research can be considered as good. Not only fulfill the quality standard given by the Indonesian Government, the percentage of COD removal is also high. The

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comparison between COD removal in this research and the other researches is shown by Table 4.

Table 4. Comparison of wastewater and % removal of COD using biocoagulant derived from moringa seeds

No.	Wastewater	% Removal of COD	Reference
1	Chicken abattoir	61.43	Nabila et al. (2024)
2	Raw water (river)	77.39	Askar & Dakhil (2023)
3	Pharmaceutical Industry	94.63	Maharani et al. (2021)
4	Laboratory	96.36	Pujiastuti et al. (2022)
5	Soft drink industry	88	Aras et al. (2021)
6	Tofu Industry	54.4	Nora et al. (2023)
7	Laundry	88.82	Harahap et al. (2022)
8	Abattoir	93.97	Output of This Study

4. Conclusion

The result shows that moringa seeds powder biocoagulant can acts very well as a coagulant agent during COD treatment process for abattoir wastewater, with 120 rpm of rapid mixing and 30 rpm of slow mixing. The optimum dose obtained at 2 g of dose, with removal percentage 93.97%. from the result, we can conclude that biocoagulant derived from moringa seeds is effective as an alternate coagulant agent in treating organic matter that affecting COD value in abattoir wastewater.

For further research, pH optimization and varying rapid mixing speed can be conducted to give a better result. Extraction process to produce moringa seeds extract also can be conducted as an effort to reduce the slude production in the coagulation-flocculation process.

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