PROGRESS IN ENGINEERING APPLICATION AND TECHNOLOGY
e-ISSN: 2773-5303

PEAT

Vol. 5 No. 1 (2024) 571-575
https://publisher.uthm.edu.my/periodicals/index.php/peat

The Effectiveness of *Anadara Granosa* (blood clam shell) and *Meretrix Iyrata* (white hard clam shell) as Natural Coagulant for the Removal of Turbidity from Synthetic Wastewater

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DOI: https://doi.org/10.30880/peat.2024.05.01.061

Article Info

Received: 27 December 2023
Accepted: 17 January 2024
Available online: 15 June 2024

Keywords

Kaolin solution, *Meretrix Iyrata* shell, *Anadara Granosa* shell, Natural coagulant, Jar test

Abstract

Natural coagulant is one of the alternative methods in minimizing the usage of chemical coagulant in water treatment. The natural coagulant use in this study which will be these two types of clams, which is *Anadara Granosa* (blood clam shell) and *Meretrix Iyrata* (white hard clam shell). This natural coagulant that was used in the research study is to lessen environmental pollution and support sustainable development by avoiding or lessen the usage of chemical coagulation such as alum. The water parameters such as coagulant dosage and settling time were manipulated in the conventional Jar test experiment to analyze the efficiency of the *Anadara Granosa* powder and *Meretrix Iyrata* powder at the end of the study. Results obtained shows that blood clam shell powder with dose of 5g/L, with settling time 60 minutes in initial turbidity of 200 NTU are the ideal values. Blood clam shell powder produced the highest turbidity removal efficiency of 72.1%, 64.6% and 58.4% in settling time 15, 30 and 60 minutes respectively. These findings indicate that the blood clam shell (Anadara Granosa) powder can be used as natural coagulants to remove the turbidity from synthetic wastewater.

1. Introduction

Water pollution is an international issue because it impacts the availability of safe drinking water, sanitation and agriculture. Grey water produced by household activities increases the entire water pollution load. Synthetic turbid water can be use as representative of grey wastewater. Coagulation is a common procedure in water treatment for removing suspended particles. Coagulants are substances added to water that assist in the development of larger and settleable particles known as flocs. These flocs are then easily removed from the water using methods like sedimentation or filtration [1]. Chemical coagulants such as aluminium sulphate (alum) or ferric chloride are frequently used in traditional water treatment methods. The use of chemical coagulants, on the other hand, raises questions about their possible health and impact on the environment. As a result, there is increased interest in investigating natural coagulants produced from organic sources [2].

Natural coagulant is one of the alternative methods in minimizing the usage of chemical coagulant in water treatment. Based on the title, the natural coagulant use will be these two types of clams, which is clam blood shell and white hard clam, where it will be compared to find the best calm shells between them. This natural

coagulant that will be used in the research study is to lessen environmental pollution and support sustainable development by avoiding or lessen the usage of chemical coagulation such as alum. These two natural coagulants will be used to remove the turbidity in the water [3].

Anadara granosa, sometimes known as the blood cockle, is a type of clam found near the coast. Chitosan, found in its shells, can be extracted and used as a natural coagulant. Chitosan produced by *Anadara granosa* shells has showed promising coagulation effectiveness in studies [4]. Another clam species with potential coagulation characteristics is Meretrix lyrata, popularly known as the white hard clam or Asian hard clam. *Meretrix lyrata* shells contain organic chemicals that can coagulate, making them a possible natural coagulant [5]. Despite a lot of research on natural coagulants, there is still a need to investigate and compare the effectiveness of various sources for wastewater treatment, including clam shells. The study's goal is to examine and contrast the coagulation effectiveness of *Anadara granosa* (blood clam shells) and *Meretrix lyrata* (white clam shell) in removing turbidity from wastewater. The study intends to provide knowledge about sustainable and eco-friendly ways to grey water treatment by studying the efficiency of these natural coagulants.

2. Materials and Methods

2.1 Material and preparation of synthetic wastewater

Anadara granosa and *Meretric lyrata* were obtained by purchasing from nearby wet market. Various types of clam shells can be used but, in this country, these two types are the most can be found either in the market or by the beach. Synthetic turbid water used in this study was kaolin solution. It was used to replaced grey wastewater as its representative for the experiment. To prepare the kaolin solution, kaolin powder was use with distilled water for all parameters stated. The kaolin suspension was made by dissolving 10g of kaolin powder in 1L of distilled water. The suspension was then stirred slowly by using magnetic hot plate stirrer with 300 rpm for 1 hour to make sure it achieved uniform dispersion of kaolin particles [6]. Then the suspension was allowed to stand for 24 hours to allow the kaolin to completely hydrate. This suspension was used as a stock solution to prepare water samples of three different turbidity for jar test experiment.

2.2 Jar test

A conventional jar test experiment was use to coagulate sample of synthetic wastewater using natural coagulant such as the clam shells. Turbidity reduction was one of the most important performance parameters [7]. The two types of shells are then will be compare with each other for the efficiency of them in removing turbidity. This experiment were carried out as a batch test, applying a set of three beakers and three-spindle steel paddles [8]. The substance will thoroughly mix before running the jar test. It will run by increasing the dosage of the natural coagulant (1, 2 and 3 g), settling time (15, 30 and 60 minutes) and turbidity of 200 ml kaolin solution (100, 150 and 200 NTU) to analyse the effect of each variable on coagulation process in removing the turbidity [9]. Then, all beakers were placed on a flat surface for 15 minutes so that the floc can settle down at the bottom of the beakers. The procedure of jar test was then repeated by adjusting the dosage of coagulant and turbidity of kaolin solution.

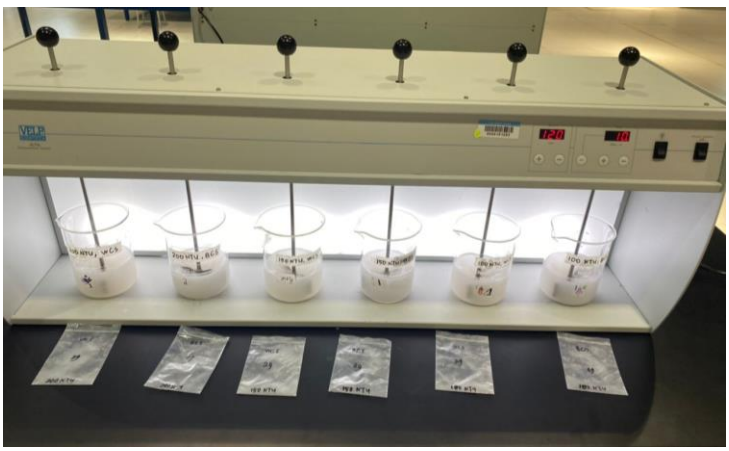

Fig. 1 *Jar Test method*

Progress in Engineering Application and Technology Vol. 5 No. 1 (2024) p. 571-575

2.3 Equation for Turbidity Removal Efficiency, TRE

In this study, after every parameter tested with following minutes, the samples will be measured their final turbidity and compared with initial to calculate the efficiency of turbidity removal. Turbidity measurements will be conducted using turbidimeter (TL 2300) and the efficiency will be calculated with formula of turbidity removal efficiency (TRE), as shown in Eq. 1 below.

$$TRE\ (\%) = \frac{T_i - T_f}{T_i} \times 100 \quad \text{Eq. 1}$$

T*i*: Initial turbidity of kaolin solution
T*f*: Final turbidity of kaolin solution

3. Results and Discussion

3.1 Effect of coagulant dosage on turbidity removal

The effect of the dosage (g/L) of two type of clam powder can be observed that the dosage has given some impact towards the turbidity removal from the synthetic water used, which is kaolin solution. There were big changes happen when using the clam shell powder as natural coagulant, especially when using blood clam shell (BCS) powder. The effect of coagulant dosage was taken at 5, 10 and 15 g/L. Throughout the experiment, for BCS, the turbidity of the kaolin solution decreases as the coagulant dosage increases. The initial turbidity of the kaolin solution is 200 NTU. However, when the coagulant starts to add into the kaolin solution, the turbidity of the synthetic wastewater used drops rapidly. At the end of experiment, final percentage turbidity for each dosage has drop to 72.1%, 68.8% and 67.4% for dosage of 5, 10 and 15 g/L respectively. The amount of coagulant used basically controls the number of flocs formed because the coagulant's charges neutralize the wastewater particles and require them to stick together [10]. Because wastewater particles have very little energy, a small dosage will neutralise them, resulting in weak and small flocs. In this experiment, the optimal coagulant dosage is 5 g/L, with 72.1% turbidity removal efficiency as shown in Figure 1.

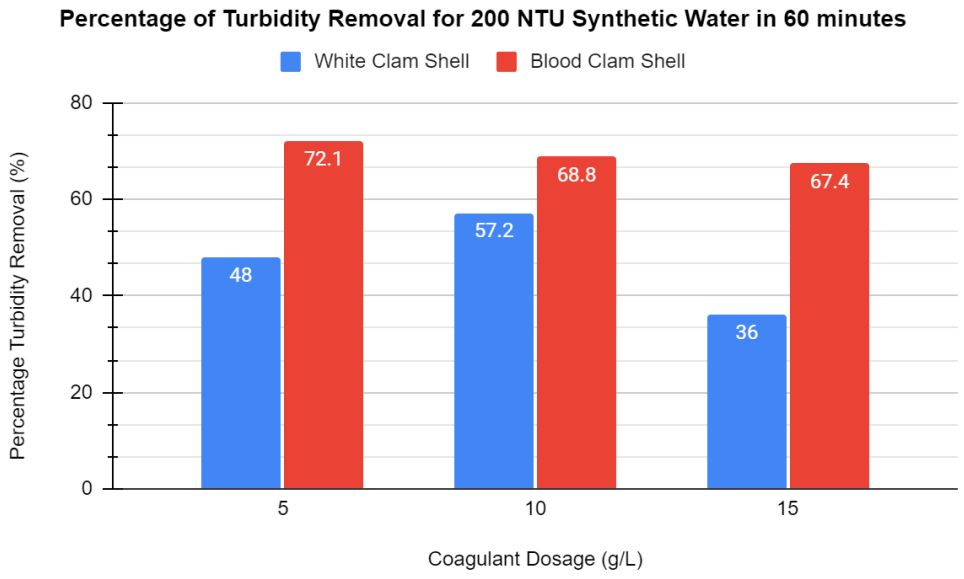

Fig. 1 *Effect of coagulant dosage on turbidity removal*

3.2 Effect of settling time on turbidity removal

The effect of the settling time (minutes) of this study can be observe that increasing the experiment time positively affected the coagulation process on using both type of clam shell powder. Based on Figure 2, effect of settling time have been observed. The effect of settling time was taken at 15, 30 and 60 minutes. Initial turbidity is 200 NTU for 1g (5g/L) of coagulant dosage. Throughout the experiment, for BCS, the percentage of turbidity removal of the kaolin solution increase as the settling time increase. When the experiment is at 15 minutes, the percentage turbidity removal is only 58.4%. Then, after 30 minutes, the turbidity removal started to increase to 64.6% and followed by 72.1% at 60 minutes. The increase in turbidity removal efficiency uncovered as a function of extraction time could be related to the extraction of other organic matter, which could have affected the coagulation processes [11]. The turbidity removed has achieved below the limit value of Standard B from regulation (100 NTU) before it can be discharge to the river, which is 83.2, 70.9 and 55.9 NTU for 15, 30 and 60 minutes respectively.

Using white clam shell powder (WCS) is not effective, proven by the experiment conducted in this study. WCS results is not achieve the value below standard limit, which is 100 NTU. As shown in Figure 2, the percentage turbidity removal for WCS is very low which is 1%, 3% and 48%. The result achieved by this study is 198 NTU, 194 NTU and 104 NTU for settling time 15, 30 and 60 minutes respectively. All of them did not meet the limit from regulation for Standard B before it can be discharge to environment. The difference in the final efficiency of using natural coagulant could be due to the characteristics and turbidity of water used or amount of active coagulant components present [12].

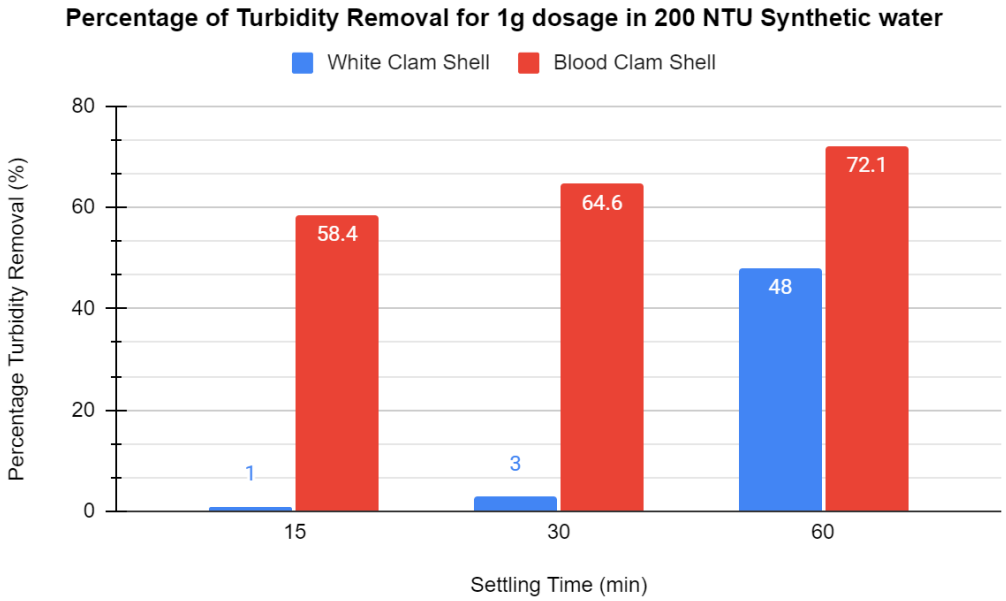

Fig. 2 *Effect of settling time on turbidity removal*

4. Conclusion

The aimed for this study have been achieved. The efficiency of blood clam shell and white hard clam shell as natural coagulants for the reduction of turbidity from synthetic wastewater (kaolin solution) was investigated. This study's investigation is to comply with the growing need for sustainable and environmentally friendly alternatives in water treatment procedures. This research had yielded a valuable insight, as from the objectives, which is to investigate the efficiency of the best clam shells among the two types as a natural coagulant in the removal of turbidity from water. The results showed that only blood clam shell had coagulation potential, successfully lowering turbidity in kaolin solution. In this research, the highest turbidity removal by using BCS is 72.1% at 60 minutes. In the beginning, initial turbidity is 200 NTU, then reduce to 55.9 NTU, which showing that the reduction of turbidity is effective if we use BCS as natural coagulant. Compared to using WCS, the turbidity did not show an effective reduction which is it decrease from 200 NTU to 104 NTU. In fact, the effects of coagulant dosage (5, 10, 15g/L) and settling time (15,30, 60 minutes) on performance of turbidity removal from synthetic wastewater were determined in this study. The efficiency of turbidity removal was evaluated between these specified parameters, and the best values for each investigated parameter were found. BCS powder with

dose of 5g/L, with settling time 60 minutes in initial turbidity of 200 NTU are the ideal values. BCS powder produced the highest turbidity removal efficiency of 72.1%, 64.6% and 58.4% in settling time 15, 30 and 60 minutes respectively. The coagulation efficiency was discovered to be controlled by factors such as dosage and settling time, with various ideal conditions revealed in the blood clam shell. These findings indicate that the blood clam shell (*Anadara Granosa*) powder can be used as natural coagulants with specific application conditions.

Acknowledgement

The authors would like to thank the Universiti Tun Hussein Onn Malaysia and Faculty of Engineering Technology, for its support until making this research a success.

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