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Table of contents

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← Previous issue Next issue →

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Preface

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PREFACE

The Faculty of Engineering of Universitas Negeri Semarang, Indonesia organized the 11^{th} EIC. The conference this year, with the theme "Applied Green Technology for Environment Conservation Through Continuous Engineering Innovation," was successfully held on September 22nd, 2022. This year's annual conference was also held digitally through Zoom meeting and streamed on YouTube like in the previous year due to the effects of COVID-19 and government travel limitations.

The Academic Vice Rector of Universitas Negeri Semarang launched the conference and provided a quick overview of the institution. Next, in the plenary session, four keynote speakers from Taiwan, Malaysia, and Indonesia gave their speeches. Each of them spokes for 45 minutes, followed by a 15-minute Q&A period. Each speaker attended the Zoom meeting in order to present their speech. Also, this session was facilitated by knowledgeable and skilled moderators from the Faculty of Engineering at UNNES. From the beginning of the opening ceremony to the conclusion of the plenary session, more than 900 attendees enthusiastically joined a Zoom meeting.

Following the plenary session, nine Zoom meeting rooms were assigned to the 128 presenters from Indonesia, Malaysia, Thailand, and Taiwan depending on the contents of the manuscript in order to hold a parallel session presentation. A moderator ran the presentation and the Q&A session in each room. Presenters were allotted 10 minutes for their presentation and 5 minutes for questions and answers. All of the presenters and participants in each room had excellent discussions thus increased participants' understanding of the subject delivered. Idea sharing was also promoted through the sessions.

The committee, partner, keynote speakers, presenters, participants, and everyone else who helped make this virtual conference a success were all thanked deeply despite the pandemic circumstances. Without any notable issues, all of the attendees joined in and participated throughout the entire session. The best presenter from each parallel room was named at the conclusion to recognize their tremendous effort in organizing the presentation. All keynote speakers, presenters, and conference attendees received a certificate from the committee following the conference as identification of their involvement.

This document is a compilation of the 53 presenters' accepted manuscripts. It presents the findings from research as well as concepts, data, and applications pertaining to green technology theory, design, development, implementation, testing, and evaluation. In this proceeding, various engineering-related subjects are presented. The following areas are where green technology is used:

1) Biodegradable Materials
2) Biomass Conversion
3) Biotechnology and Bioprocess
4) Disaster Resilience Infrastructure
5) Energy Efficiency
6) Energy Management System
7) Environmental Monitoring
8) Green Chemicals
9) Green Construction
10) Green Materials

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11) Green Technology in Building
12) Green Technology System
13) Green Transportation
14) Intelligent Control System
15) Natural Disaster Mitigation
16) Renewable and Sustainable Materials
17) Renewable Energy
18) Renewable Resources
19) Sustainability in the Built Environment
20) Sustainable Architecture
21) Waste Treatment

The goal of this proceeding is to contribute to the advancement of green technology. Also, we wish everyone reading this proceedings pleasure and success in expanding an understanding of engineering research. We value everyone's dedication and hard work and anticipate that the conference will be even more successful the following year.

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All papers published in this volume have been reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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Waste Treatment

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Determination of the optimum organic coagulants dosage in tofu industrial wastewater treatment

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Abstract. The research aim was to analyze the optimum dosage of moringa seed and tamarind seed as an organic coagulant in removing tofu wastewater pollutants using coagulation, flocculation, and sedimentation reactors. The first step is the manufacture of coagulant by processing the organic coagulant raw materials into powder and filtered using a 50 mesh filter and dried. The second step is to determine the dosage of coagulant using 4 variations of pH 5,6,7,8 using NaOH solution, and coagulant dosages obtained 2,3,4,5 gr/L. The third stage is an experimental test using the squenching batch reactor (SBR) method with TSS and COD parameter analysis. The effects confirmed that the coagulant of moringa seed had better ability than tamarind seed in removing TSS and COD, with the highest percentage reduction in TSS and COD at 3 gr dose of moringa seed. In addition, removal of TSS and COD using moringa seed or tamarind seed as coagulant was the most optimum at neutral pH 7-8. However, the treatment of tofu wastewater using either moringa seed or tamarind seed as coagulant using the coagulation-flocculation-sedimentation method in one reactor is not able to remove pollutants to meet the quality standards, so further treatment is needed.

1. Introduction

Tofu industry activities require a lot of clean water to be used in the soybean washing process, especially in the soybean boiling process for making tofu. The water used for washing and processing the tofu becomes wastewater with a high organic matter content (BOD) so, it cannot be discharged directly into the waters because it will pollute the aquatic environment. Tofu industrial wastewater has high organic matter content, pollutant content in the range of 1,940-4,800 mg/l COD, 1,070-2,060 mg/l BOD and 2,100-2,850 mg/l TSS, while the pH value ranges from 4.5-5.7. Tofu wastewater has the potential to pollute the environment if it is disposed directly into the surrounding environment without being treated first, where the waste comes from water residue during the production process which does not dispose in accordance with applicable standards. Tofu residue in the clotting process because of the error operation and a yellowish cloudy wastewater impact to the bad smell[1].

One way to treat tofu wastewater is use the organic coagulants, because organic coagulants, in addition to reducing pollutant levels, can also be used as feed ingredients. Because of its high protein content, tamarind seeds can be used as an organic coagulant, high protein can act as a natural polyelectrolyte [10]. Several studies related to reducing COD and turbidity levels in tofu waste by using organic coagulants, among others, [2] concluded that the optimum deposition time in jar test equipment was 50 minutes with a turbidity removal of 89.42%, TSS 98.73%, and COD is 69.58% at a coagulant

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dose of 3,000 mg/L and pH 4, as well as tofu industrial wastewater and a coagulant particle size of 50 mesh. Research [3] stated that organic coagulant of Moringa seed powder was more effective than inorganic coagulant of aluminum sulfate (alum) powder in treating wastewater from the tofu industry. Based on research by [4] that the combination of Moringa seed coagulant and flamboyant seeds can reduce COD levels by 61%, BOD 55.1%, and TSS by 65%.

Research [6] in [5] stated that natural coagulant (moringa seeds) has an active substance that is able to absorb wastewater particles, that is why it can be used as a substance to treat the wastewater. Research [5] cites the content of Moringa seeds that play a role in the coagulant reaction is protein. Proteins that dissolve in water have amino groups that are cations (positive ions), so they can bind to negative particles contained in wastewater so that larger clumps of particles are formed.

The essence of this research is the treatment of tofu industrial wastewater in order to find an alternative to simple tofu wastewater treatment using organic coagulants of moringa seeds and tamarind seeds where this study conducted to analyze the ability of moringa seeds and tamarind seeds as organic coagulants in removing waste pollutants. liquid tofu using coagulation, flocculation, and sedimentation reactors.

2. Research Method

2.1 The Manufacture of Organic Coagulants

Manufacture of moringa seed into organic coagulant begins with the ripe of moringa fruit being peeled and the seeds taken, then the seeds that have been obtained are peeled back from their shells. Dry the seeds for 30 minutes in furnace at 105°C temperature or under the sun for 3-5 days to reduce the moisture content. The dried moringa seeds were ground, then sieved with 50 mesh and 70 mesh sieves to obtain a fine powder size of Moringa seeds [7]. Moringa seed powder that has been finely dissolved is then dissolved, which is 1 gram of Moringa seed powder with 20 ml of distilled water. The process of making coagulant from tamarind seeds consists of grinding tamarind seeds with a blender, filtering tamarind seeds and also drying using an oven. The ripe tamarind seeds are separated from the flesh and then cleaned using water. The clean seeds and shells will be blended into powder and then filtered with filter paper, after filtering with filter paper, the tamarind seeds will be dried at 105˚C for 30 minutes in furnace. After that determination its weight by weighing the powder.

2.2 Determination of Coagulant Dose and pH

The determination of the coagulant dose was carried out before the wastewater sample was treated. The pH variations used were pH 5,6,7 and 8 using NaOH solution with concentrations of 0.297 gr/l, 0.541 gr/l, 0.675 gr/l, and 0.891 gr/l for each increase in pH variation. The dosage variations of coagulant used were 2 gr/l, 3 gr/l, 4 gr/l, and 5 gr/l with coagulation speed of 200 rpm for 3 minutes, flocculation speed of 120 rpm for 14 minutes, and sedimentation for 60 minutes.

2.3 Experimental Test for TSS and COD Removal using Squenching Batch Reactor

Analysis of initial content of tofu liquid waste was measured to be compared with regional and national industrial waste quality standards before entering the experimental test stage. Organic coagulants with concentrations of 2 gr/L, 3 gr/L, 4 gr/L, and 5 gr/L were added to wastewater with pH 5 at the experimental test stage. Then the jartest test was carried out for three minutes at a speed of 200 rpm continued by a speed of 120 rpm for 14 minutes. Analysis of TSS and COD parameters conducted to determine the optimum coagulant dose. Repeat tests for the parameters of Turbidity, TSS, COD, and BOD were carried out with variations of pH 6, 7, and 8 to determine the effective pH of the parameter removal. The TSS test was carried out based on the method of gravimetric, refer to the national standard. COD measurement using closed reflux method refers to SNI 6989.02:2019.

3. Results and Discussion

The characterization of tofu waste water taken by composite grab from the tofu production of one of the public kitchens of the tofu industry can be seen in Table 1. This characterization serves to assess the level of biodegradability of wastewater.

Table 1. Initial Characteristics of Tofu Wastewater

Analysis	COD (mg/L)	BOD (mg/L)	TSS (mg/L)	Turbidity (NTU)	pH
1	2880	2133	682	952	4,3
2	3040	1878	644	950	
3	3040	1971	661	947	

In **Table 1**, the result showsthat the levels of COD and BOD are very high, with a ratio of BOD:COD above 60%, this shows that tofu wastewater is dominated by high organic matter, and has the potential to be reused as liquid fertilizer or animal feed. According to [8], tofu industrial wastewater has high organic content, mainly protein and amino acids. The existence of these organic element causes the tofu wastewater contains high BOD, COD, and TSS. The pH level in tofu wastewater is very low ranging from 4-5, so that in the treatment of tofu wastewater it is necessary to increase the pH level to a neutral pH. In general, tofu wastewater has a pH value ranging from 4-5. The tofu wastewater used has an initial pH of 4.3, this is in accordance with previous studies and indicated that there was no addition of acidic substances at the beginning of the production process.

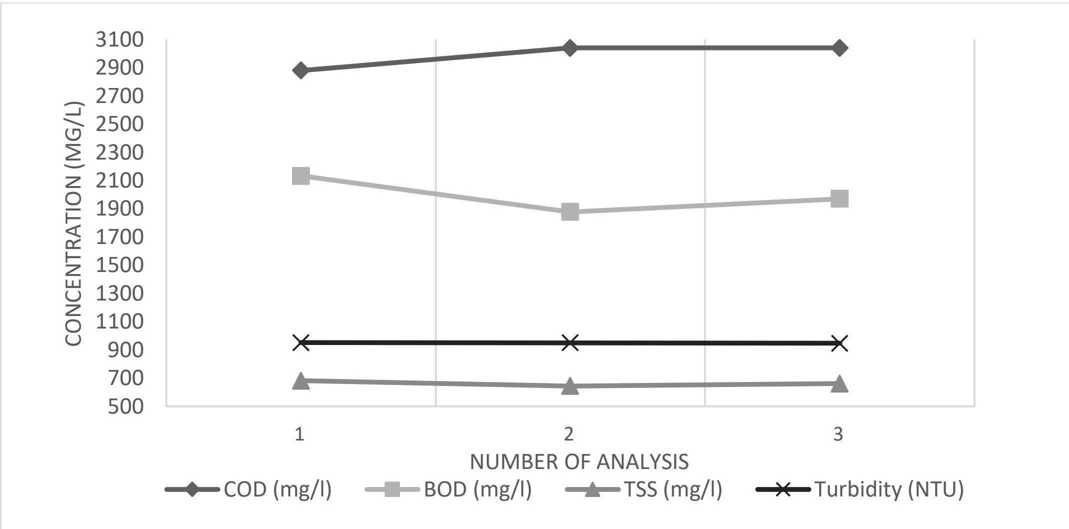

Figure 1. Initial Characteristics of Tofu Wastewater at pH 4,3

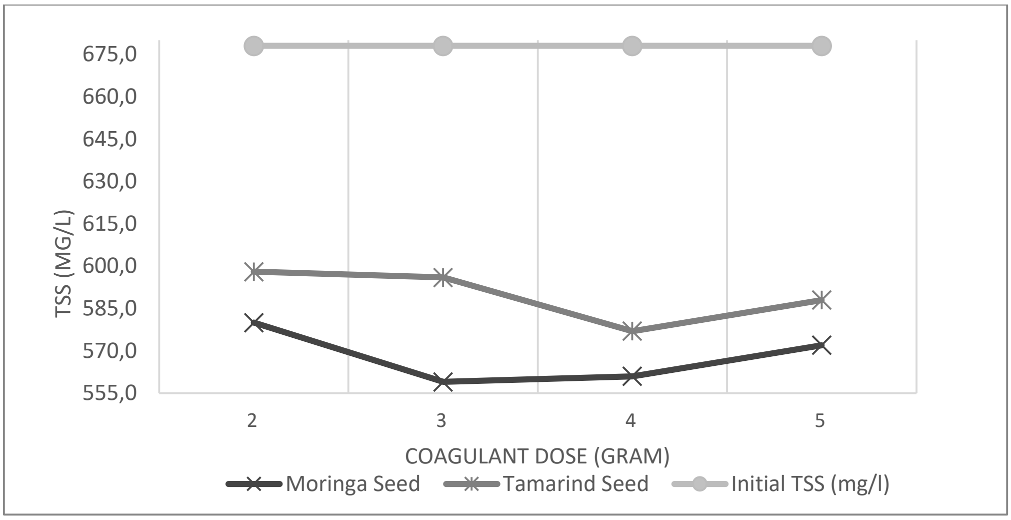

Figure 2. The Removal of TSS with Organic Coagulant Variation Dose at pH 5

Determination of the optimum dose of coagulant is done by varying the dose between 2-5 mg/liter. Parameters observed were TSS and COD levels. The ability to remove TSS with variation of 2-5 mg/l dosages at pH 5 can be noticed in Figure 2. The result shows that moringa seed coagulant has a better ability than tamarind seeds in removing TSS from tofu wastewater. The highest TSS reduction was obtained at a dose of Moringa seed coagulant 3 mg/liter with a TSS value of 559 mg/liter, this value did not meet regional and national wastewater quality standards to be channeled into the waters. The coagulation-flocculation process in water treatment is very dependent on the pH conditions of the raw water, therefore in this study a pre-treatment was carried out on tofu wastewater to increase the pH of the wastewater raw water by providing a 6.75 M NaOH solution with a concentration of 0.297 gr/L. to get to pH 5.

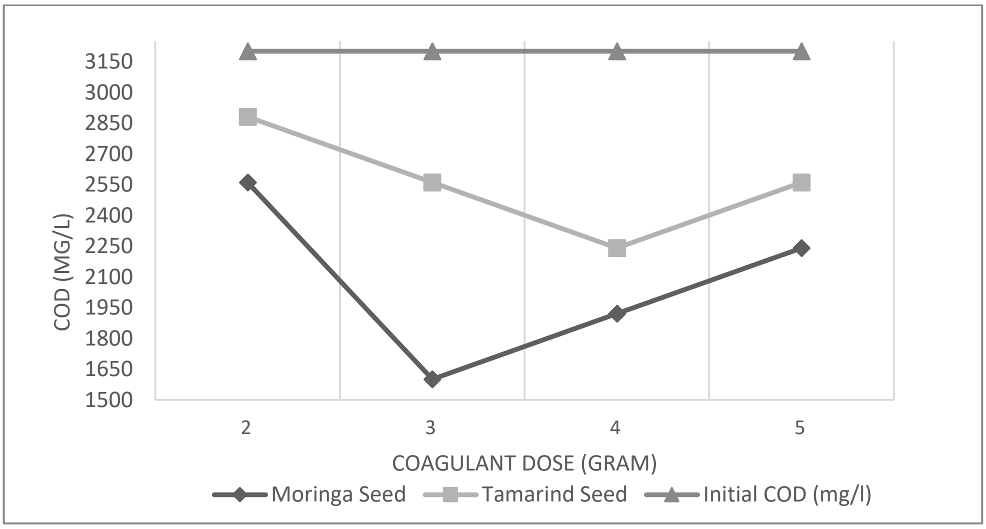

Figure 3. The Removal of COD with Organic Coagulant Variation Dose at pH 5

The ability to remove COD using moringa seeds and tamarind seeds as an organic coagulant with the range of 2-5 mg/l is shown in Figure 3. It can be seen that the highest reduction in COD levels was removed with a value of 1600 mg/l using a coagulant dose of 3 grams of moringa seeds. For tamarind seed coagulant, the optimum removal dose was 4 grams with the highest removal of COD of 1920 mg/l.

Similar to the removal of TSS, it was found that, for COD removal, moringa seed coagulant had a better removal ability in binding organic particles of tofu wastewater. This is also related to the percentage decrease in the highest TSS concentration at a dose of 3 g of moringa seeds because it is indicated that the more suspended solids are removed, the organic contents of the tofu wastewater is also removed due to the high organic content of the suspended solids in the wastewater.

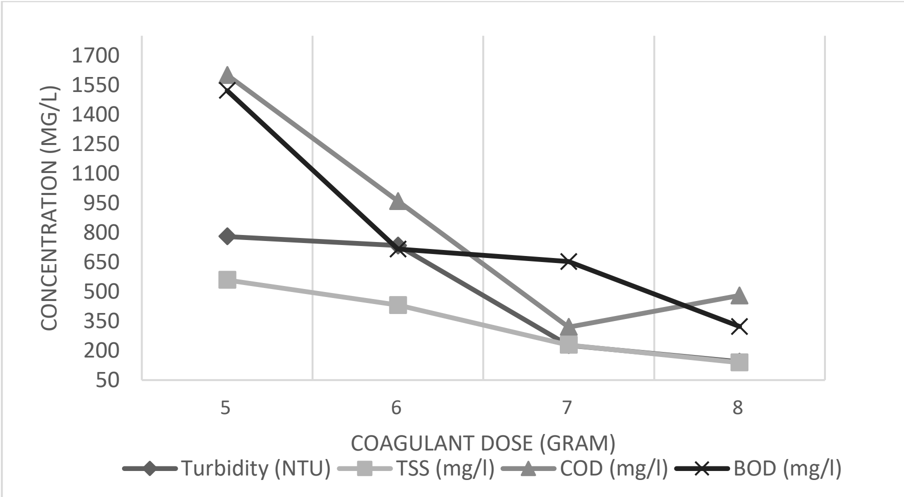

Figure 4. The relation of the pH effect on the removal of Turbidity, TSS, COD, and BOD using moringa seed coagulant 3 grams

The ability to remove pollutants from tofu wastewater on the pH of wastewater using moringa seed coagulant is shown in Figure 4. It can be noticed that the elimination of turbidity, TSS, COD, and BOD using 3 grams of Moringa seed coagulant is the most optimum at pH 7-8. According to [9] when viewed from the pH variable, the decrease in the concentration of TSS is most optimum at pH 7 because in this condition a stronger bond is possible at neutral pH conditions.

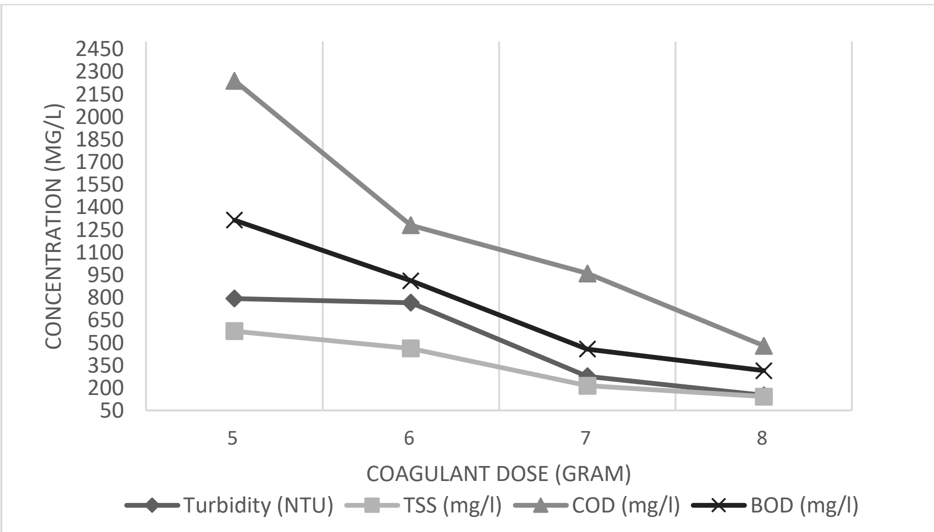

Figure 5. The relationship of the pH effect on the removal of Turbidity, TSS, COD, and BOD using Tamarind seed coagulant 4 grams

The ability to remove pollutants from tofu wastewater on the pH of wastewater using tamarind seed coagulant is shown in Figure 4.5. It can be noticed that the eliminationl of turbidity, TSS, COD, and BOD using 4 grams of tamarind seed coagulant is the most optimum at pH 8. According to [10], to achieve a high percentage of wastewater pollutant removal, in this case COD and TSS, The treatment reactor should be operated at a pH of 7.6-8.3.

4. Conclusion

The optimum dose of affixing when using moringa seed coagulant is 3 grams and when tamarind seeds are 4gr. To set aside the turbidity parameters, TSS, BOD, COD, the optimal pH for moringa seeds was 7 and for tamarind seeds was 8. The removal of COD using moringa seeds reached 71% and tamarind seeds reached 60%. The BOD allowance using moringa seeds reached 69% and tamarind seeds reached 58%. When compared between the two, the moringa seed coagulant has a better ability to remove TSS and COD parameters. For high influents, moringa seeds and tamarind seeds are very good to use because they achieve high COD and BOD removal efficiency with the value >800 mg/L for COD influent, and >1120 mg/L for BOD influent.

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