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Tamarind Seed and Pineapple Leaf as Natural Coagulant in Municipal Waste Water Treatment

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ABSTRACT

Municipal wastewater consists of used water and waste from homes, businesses, and institutions. This wastewater is collected and treated at municipal treatment plants to remove harmful contaminants before it is released back into the environment. As urban populations grow and industrial activity increases, treating municipal wastewater becomes a significant environmental challenge. Traditional methods often use chemical coagulants, which can harm the environment and human health. There is a rising interest in sustainable alternatives, such as natural coagulants. Natural coagulants are organic materials from plants or microorganisms that can effectively coagulate and flocculate particles in wastewater. These coagulants reduce the negative environmental impacts associated with chemical alternatives. To use natural coagulants, wastewater impurities must be identified and tested. Since these impurities can be harmful to human health as well as the environment, recognizing them helps to select the most appropriate treatment options. The process of collecting and preparing natural coagulants includes several steps. Coagulants are sourced from plants known for their coagulation abilities and then cleaned to eliminate impurities. Extraction methods concentrate the active coagulating agents, enhancing their effectiveness. After that, the coagulants are dried and ground into powders to make sure they work better during treatment. Proper packaging is crucial to maintain their properties until use. Two natural coagulants highlighted are tamarind seeds and pineapple leaves. Tamarind seeds contain polysaccharides and proteins that effectively coagulate wastewater. They can be ground and mixed with water to assist in settling out suspended particles. The effectiveness of tamarind seed extract depends on factors like the quality of the seeds and the characteristics of the wastewater. Pineapple leaves, containing the enzyme bromelain, can also serve as a natural coagulant. They are more sustainable than chemical coagulants because they are dried, ground, and added to water for treatment. Test results indicate that tamarind seed and pineapple leaf extracts both significantly reduce turbidity levels in wastewater.

Keywords: Tamarind seed, Pineapple leaf, wastewater, coagulants

INTRODUCTION

Municipal waste water refers to the used water and waste generated by homes, businesses and institutions within a community or municipality. It includes runoff from storms and industrial processes as well as water from sinks and showers. This waste water is collected and treated by municipal wastewater treatment plants to remove contaminants and pollutants before being discharged back in to the environment. The treatment of municipal wastewater is a major environmental challenge in urban areas with rising population and industrialization. The conventional methods of wastewater treatment often involve the use of chemical coagulants, which can have adverse environmental impacts and pose health risks. In recent years, there has been a growing interest in exploring sustainable and eco-friendly alternatives for wastewater treatment, and one such promising approach is the utilization of natural coagulants. Natural coagulants are organic substances derived from plant materials or microorganisms that have been shown to coagulate and flocculate. These substances reduce the environmental impact of wastewater treatment processes by providing an eco-friendly alternative to chemical coagulants.

METHODOLOGY

Sample collection and testing is an important stage. It helps to identify the impurities that are present in wastewater. Impurities that are present in wastewater may harm nature. It is also harmful to human health. So identifying impurities and selecting suitable treatment is necessary.

In wastewater treatment, natural coagulants are substances derived from plants or other natural sources that aid in the coagulation process. The collection and processing of natural coagulants involve several steps. Natural coagulants are identified based on their coagulation properties. They are often collected from plants, seeds, roots, or other organic materials known for their coagulating effects. This involves sourcing these materials from their natural habitats or cultivated sources. Once collected, the natural materials undergo cleaning and preparation to remove impurities and undesirable components. This step ensures the purity and effectiveness of the coagulant. The active coagulating agents are extracted from the natural materials using suitable extraction methods.

This process concentrates the coagulating compounds for optimal effectiveness. The extracted coagulants are then dried to remove moisture and ground into fine powders or granules. This enhances their surface area and facilitates their dispersion and mixing during the coagulation process. The processed natural coagulants should be packed in suitable containers. Proper packaging ensures the preservation of their properties until they are used. Overall, the collection and processing of natural coagulants involve careful sourcing, extraction and packing measures to harness their coagulating properties effectively in wastewater treatment applications. The natural coagulants selected are;

Pineapple leaf and Tamarind Seed

Tamarind seed is another natural coagulant that has been explored for wastewater treatment. Tamarind seeds contain polysaccharides and proteinaceous compounds that exhibit coagulation properties. Tamarind seeds can be ground into a powder and mixed with water to form a solution, which is then added to wastewater. The polysaccharides in tamarind seeds help to bridge and aggregate suspended particles and impurities in the water, allowing them to settle out more easily during the treatment process. This natural coagulant is particularly effective for treating turbid water and removing suspended solids. The effectiveness of tamarind seed extract, like that of any natural coagulant, can vary based on things like the quality of the seeds, the dosage, the pH, and the characteristics of the wastewater. Pineapple leaves can indeed be used as a natural coagulant in water treatment processes. The bromelain enzyme present in pineapple leaves has coagulation properties that can help in flocculating suspended particles in water, making them easier to remove. To use pineapple leaves as a coagulant, they are typically dried, ground into a powder, and then added to water to facilitate the coagulation process. This natural coagulant can be an eco- friendly alternative to chemical coagulants in water treatment.

RESULTS AND DISCUSSION

The coagulation was done using tamarind seeds and after coagulation checked turbidity. A good approach in wastewater treatment is coagulation with tamarind seeds owing to its natural coagulant properties. Tamarind seed contains polysaccharides like xyloglucan, which have been found effective in aggregating and settling suspended particles, organic matter, and pollutants present in wastewater. The polysaccharides in tamarind seed form a gel-like structure upon hydration, aiding in the formation of flocs that facilitate the removal of contaminants through sedimentation or filtration processes.

The coagulation was done using pineapple leaf and after coagulation checked turbidity. Coagulation utilizing pineapple leaf extract presents a promising avenue for wastewater treatment owing to its abundant availability, low cost, and eco-friendly nature. Pineapple leaves contain bioactive compounds such as bromelain, which exhibit significant coagulation properties, aiding in the removal of suspended solids, organic matter, and pollutants from wastewater. The use of pineapple leaf extract as a natural coagulant not only offers an effective means of water clarification but also contributes to sustainable practices by minimizing the reliance on synthetic chemicals. Furthermore, the scalability and ease of extraction make pineapple leaf extract a feasible option for small-scale community projects as well as larger wastewater treatment facilities.

Table 3.1 Tamarind Seed Test Results (*results are under certain conditions)

Coagulant dosage in mL	Turbidity in NTU
1	11.8
2	11.2
3	10.7
4	10.7
5	10.2
6	9.5

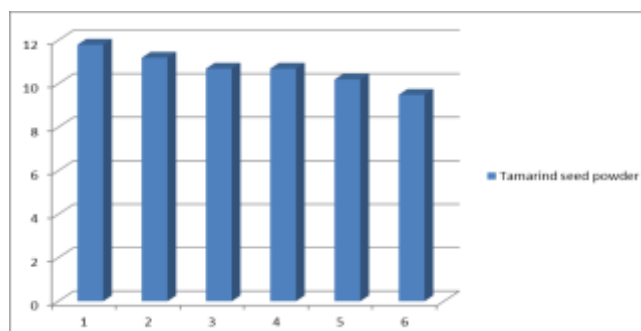


Fig 1 Tamarind seed effect on turbidity

Table 3.2 Pineapple Leaf Test Results (*results are under certain conditions)

Coagulant dosage in mL	Turbidity in NTU
1	9.8
2	8.4
3	7.9
4	6.3
5	5.7
6	5.1

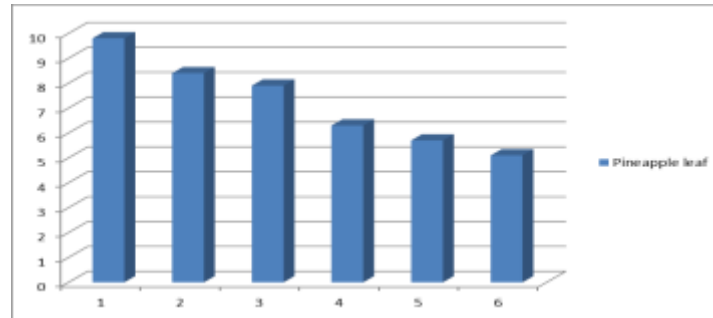


Fig 2 Pineapple leaf effect on turbidity

The test results shows that the tamarind seed powder with dosage 1mL, 2mL, 3mL, 4mL, 5mL & 6mL shows a turbidity of 11.8 NTU, 11.2 NTU, 10.7 NTU, 10.7 NTU, 10.2 NTU and 9.5 NTU respectively. The test results shows that the Pineapple leaf with dosage 1mL, 2mL, 3mL, 4mL, 5mL & 6mL shows a turbidity of 9.8 NTU, 8.4 NTU, 7.9 NTU, 6.3 NTU, 5.7 NTU and 5.1 NTU respectively shown in table.

CONCLUSION

Through this study, it has been demonstrated that natural coagulants such as plant extracts and biopolymers exhibit notable coagulation efficiency, promoting the aggregation and removal of suspended particles and contaminants from wastewater. Not only do these natural coagulants offer comparable or even superior performance to synthetic chemicals, but they also mitigate the environmental and health concerns associated with the use of traditional coagulants. Furthermore, the abundance, renewability, and biodegradability of natural coagulants underscore their sustainability and potential for widespread application in wastewater treatment systems.

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