EXPERIMENTAL STUDY ON TEXTILE WASTEWATER PURIFICATION BY NATURAL COAGULANTS

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Abstract - ***The textile industry is known for producing significant amounts of wastewater, which can be highly contaminated with dyes, chemicals, and other pollutants which affects the land and soil that leads to land pollution and soil degradation.In response to the environmental impact of this wastewater, there is a growing need for sustainable and cost-effective treatment methods. Coagulation is one of the effective method usually chemical coagulants are widely used but in our natural cogulants are used for the purification of textile wastewater. The main aim of this experiment is to reduce the environmental impact by purifying the textile waste water using natural coagulants i.e moringa seeds, casava powder and alum (chemical coagulant for more effectiveness and compared to other chemical coagulants alum produce low sludge) and using the purified water for other various purposes such as gardening,washing and other domestic purposes .In this starategy after coagulation the water is carried out to the step filtration and as a final step neem and lemon peel as disinfectants. The experiment was carried out by changing the pH, turbidity, total solids, dissolved oxygen, hardness according to the permissible parameters. The removal efficiency of turbidity after coagulation is 70% and after filtration turbidity removed upto 90%, and after disinfection the removal efficiency of Turbidity, Colour, Odour, pH, Total hardness, Total Solids, and Dissolved solids are 99.7%, 95%, 99.6%, 92.6%, 90.5%, and 99.512%.***

Keywords— Textile wastewater, natural coagulants, Moringa seeds, Cassava, Neem leaves, Lemon peel.

1.INTRODUCTION

The textile industry is known for producing significant amounts of wastewater, which can be highly contaminated with dyes, chemicals, and other pollutants. In response to the environmental impact of this wastewater, there is a growing need for sustainable and cost-effective treatment methods. One potential solution is the use of natural coagulants for the purification of textile waste water. This process is crucial for the production of clean and safe drinking water and for the treatment of industrial wastewater. The coagulation process involves the addition of a coagulant to the water, which destabilizes the suspended particles and forms larger aggregates called flocs. These flocs can then be their effectiveness in coagulation. However, the use of these chemical coagulants can raise concerns about the potential health and environmental impacts of residual chemicals in the treated water. In contrast, natural coagulants offer an environmentally friendly alternative. Natural coagulants, derived from plant materials, have been found to be effective in the coagulation process. Examples of natural coagulants include chitosan, Moringa oleifera seeds, and tannins from various plants. Moringa oleifera seeds, for instance, contain cationic proteins that can bind to negatively charged particles in water, allowing them to clump together and be easily separated. Chitosan, derived from the shells of crustaceans, has also been shown to be effective as a natural coagulant due to its positively charged nature. Using natural coagulants is beneficial as they are generally biodegradable, pose fewer health risks, and have minimal environmental impact compared to traditional chemical coagulants. Additionally, natural coagulants can be easily sourced, making them an attractive option for water treatment in resource-limited settings. It is important to note that the effectiveness of natural coagulants can vary depending on water quality and the specific application. Research and testing are necessary to determine the most suitable natural coagulant for a particular water treatment scenario. Overall, the use of natural coagulants presents a promising sustainable approach to water treatment, providing a safer and more environmentally friendly option for coagulation in water treatment processes. This project aims to explore the effectiveness of natural coagulants in removing pollutants from textile waste water, thereby reducing its environmental impact. Through this research, we hope to contribute to the development of sustainable methods for treating textile waste water, ultimately leading to a cleaner and healthier environment.

2. MATERIALS AND METHODOLOGY

2.1 Materials

Moringa Oleifera Moringa seeds are used as a natural coagulant due to their cationic proteins and peptides. These proteins can bind with negatively charged particles in water, causing them to clump together. This process, known as coagulation, leads to the formation of larger particles that can be easily removed through sedimentation or filtration. Moringa seeds are considered an effective and environmentally friendly alternative for water treatment in certain regions where they are readily available. Figure 1 depicts the Moringa Oleifera and cassava.

Figure 1 Moringa Oleifera & Cassava

Cassava

Cassava powder is sometimes used as a natural coagulant in water treatment processes due to its high content of cationic starch. The positively charged starch particles help bind impurities and suspended particles in water, facilitating their removal. It acts as a coagulant by destabilizing colloidal particles, allowing them to aggregate and settle.

Alum

Alum, or aluminum sulfate, is commonly used as a coagulant in water treatment. Its efficacy lies in its ability to form aluminum hydroxide flocs when added to water. These flocs attract suspended particles and impurities, causing them to clump together and settle. Alum's positive charge neutralizes the negative charges on particles, promoting coagulation and facilitating the removal of impurities during water treatment processes.

Neem

Neem is utilized in the treatment of wastewater due to its natural properties, such as antimicrobial and antifungal attributes. Neem extracts contain compounds like azadirachtin, which can help control the growth of bacteria and fungi in wastewater. Neem is employed as a biopesticide, helping to reduce microbial contamination in water. Additionally, it may contribute to the removal of certain pollutants through its bioactive components. However, the effectiveness of neem in wastewater treatment can vary based on specific conditions and contaminants present

Figure 2 Alum & Neem extracts

Lemon Peel:

Lemon peel contains natural compounds like limonene, which possess antimicrobial properties. When added to purified wastewater, it may help disinfect by inhibiting the growth of certain microorganisms, contributing to a more thorough purification process. Lemon peel also contains citric acid, which has additional disinfectant properties. The acidity can create an environment less favorable for bacterial growth. Additionally, the pleasant fragrance of lemon can help mask any residual odors in treated wastewater. Figure 3 depicts the sample of lemon peel.

Figure 3 Lemon peel

2.2 Collection of wastewater

The Textile industry wastewater has been collected from Sandhya Textile, at S.N.D road, Tiruchengode, Namakkal.In that industry, the capacity of waste water produced everyday maximum 50 litres. We collected 4 of sample every day.

2.3 Filteration

In filteration, there will three layers to get more pure water after coagulation process. Those layers are Coarse aggregate, Fine aggregate, and Charcoal one liter of Jar with depth of 90mm, 55mm, 30mm.

2.4 Disinfection

This process is taken after filteration, where lemon peel and dry neem leaves are used in open air under sunlight.

3. EXPERIMENTAL PROCEDURE

3.1 Coagulation:

In Coagulation, intially by taking different ratios to remove turbidity of 2 natural coagulants (Moringa seeds powder and Cassava powder) and chemical coagulant (Alum). Table 1 depicts the amount of materials used in this study.

Table 1 Materials used in this study

S.no	Moringa seed s powder	Cassava powder	Alum
R1	1g	1.5g	0.6g
R2	1g	1.5g	0.7g
R3	1.5g	2g	0.8g
R4	1.5g	2g	-

In this we found 3rd ratio get more effective after coagulation while compare to others. Figure 4& 5 illustrates the sample before and after coagulation.

Figure 4 Sample before Coagulation

Figure 5 Sample after coagulation

With this effective ratio R3, the coagulation process is carried out for 4L of textile wastewater for initial 40 mins at high speed (120 rpm), 20 mins at midium speed (60rpm) and 10 mins at low speed (30 rpm). After coagulation, sedimentation is done for 2 hours at room temperation. After sedimentation the turbidity of the wastewater is reduced, the removal efficiency of Turbidity, Odour, colour and pH is 70%,5%, 25% and 60%.

3.2 Filtration:

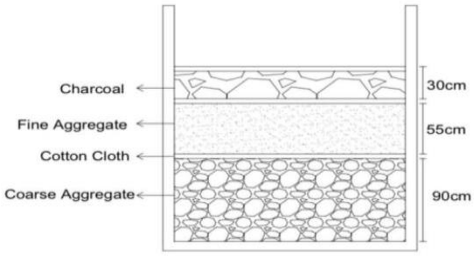

Figure 6 Filtration setup

After sediments of Sludge, the sample is collected by filter with filter paper in another jar, and then the 4L of sample is filled into filtration setup for 24hrs. After filtration the water sample is collected in another jars. The efficiency of Turbidity, pH, colour and odour are reduced to 90%, 75%, 85% and 85%. By filtration controlled of Turbidity and Odour is carried. In this filtration, inlet of wastewater of 4L and outlet of wastewater is 3.4L which is the waste water is collected upto 85% in 17 mins from filtration. Figure 7 shows the collected water.

Figure 7 Final Collected Water

3.3 Disinfection:

After filteration, 1/4 of lemon peel and 5 leaves of dry neem in 1L of sample and keep in open air under sunlight for 3 hrs. Then collect sample and then filter by using filter paper. Then proceed for futher test parameters like Turbidity, pH, Total solids, Total Hardness and Dissolved oxygen. Figure 8 depicts the sample after disinfection.

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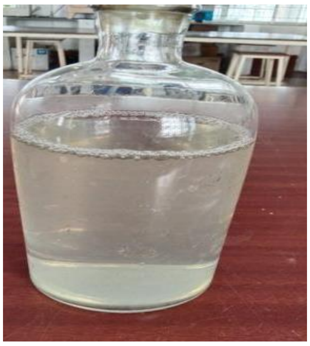

Figure 8 After Disinfection

4. Results and discussions

Results and discussions of this study are presented in the forthcoming section

Table 2 Before Treatment

Test	Coagulation	Filtration	Disinfection
Turbidity	15 NTU	8.6 NTU	4.7 NTU
pH	10.5	9.1	8.3
Hardness	-	-	120 ppm
Total solids	-	-	1500 mg/l
Dissolved oxygen	-	-	6.08 mg/l

Table 3 After Treatment

Test	Result
Turbidity	27 NTU
pH	11
Hardness	860 ppm
Total solids	3500 mg/l
Dissolved oxygen	12.7 mg/l

The conclusions on the test results before and after treatment were derived from the data shown in Table 2 and 3. In order to decrease turbidity, pH, total solids, and dissolved oxygen levels, a range of filtering methods were utilized, such as coagulation, filtration, and disinfection. The test outcomes of several techniques are depicted in Figures 9 and 10. After treatment, there was a notable change in properties of waste water. it might be used other than drinking purposes such as gardening.

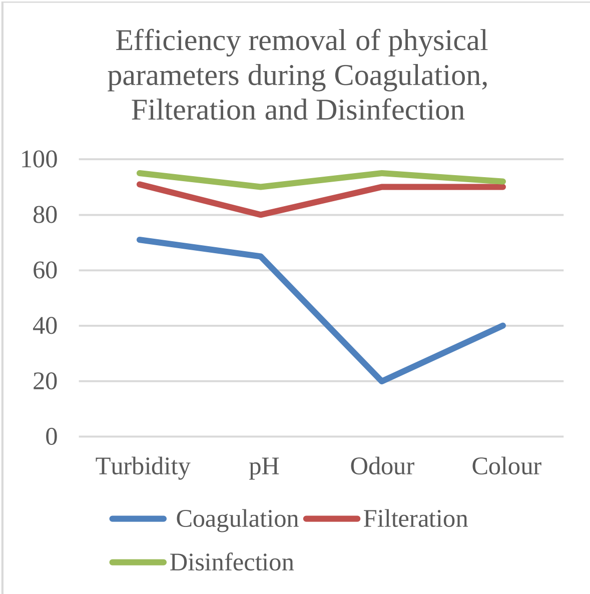

Figure 9 Summary of test results

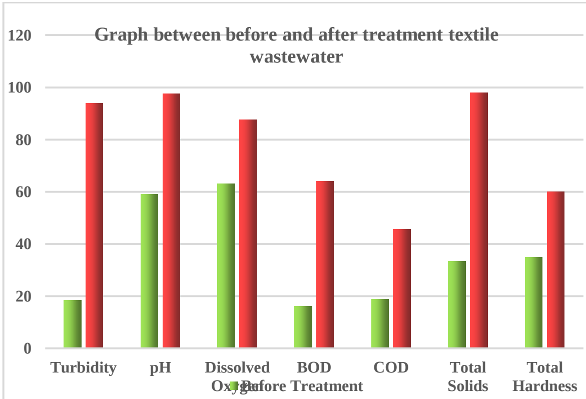

Figure 10 Test findings on before and after treatment

5. CONCLUSION

In conclusion, it is imperative to conduct research in order to get additional knowledge on the utilization of natural coagulants for the treatment of textile wastewater, with a focus on their prospective applications. It can be verified that the majority of hazardous chemicals and color from wastewater are effectively eliminated, demonstrating a significant capacity to remove typical parameters such as turbidity, pH, color, dissolved oxygen, total suspended solids (TSS), and total hardness. The treated wastewater generated by the textile industry is subsequently utilized for several purposes, including gardening, reuse in the textile industry for dyeing, and sanitation. By employing these techniques, the wastewater has been purified to a level of 85% suitable for human consumption, such as drinking, vegetation cultivation, and bathing.

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