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Textile Effluent Treatment Using Moringa Oleifera

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Abstract:
The textile industry occupies a unique place in our country. During textile wet processing, a large volume of wastewater is released. Though various physico-chemical and biological treatment methods are employed for the removal of organic contaminants present in the textile wastewater, these methods lack in achieving effective treatment at lower cost. In this research work, the extract of Moringa oleifera seeds was used as a coagulant to treat raw textile waste water. The efficiency of Moringa oleifera seed extract towards turbidity and COD removal was studied at various pH and coagulant dosage. The results showed a higher efficiency in color, turbidity, and alkalinity and COD removal. Color removal was found to be pH independent. Further, cost analysis revealed that the Moringa oleifera seed extract is comparably better than commercially available color removing resin.

Keywords: *COD removal, moringa oleifera, natural coagulant, textile effluent*

1. Introduction

Textile industries are one of the most common and essential sectors in the world. On the other hand, high volume of water consumption and varying wastewater characteristics are the factors that have caused a sustained effort to find appropriate technologies to treat textile industry wastewater (Ghebremichael, K.A., 2004).

Major pollutants in textile wastewaters are high suspended solids, chemical oxygen demand, heat, color, acidity, and other soluble substances (Adel Al –Kdasi et al., 2005). The waste water generated during these processes is discharged into the water streams. So, the toxic pollutants which are present in that effluent gets mixed up with the water streams and pose threat to both environment and human beings. They are one of the largest of water users and polluters (Nemerow, N.L., 1978).Therefore, need arises to focus our attention on treating the textile effluent before its disposal.

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The removal of dyes from textile effluent can be carried out through several chemical and/or physical methods. One of the most popular processes in effluent treatment is coagulation. The uses of synthetic coagulants are not considered as suitable due to health and economic considerations. Natural macromolecular coagulants are promising and have attracted the attention of many researchers because of their abundant source, low price, multi-purposeness and biodegradation. This paper concentrates on the treatment of textile waste water using natural coagulant obtained from *Moringa oleifera* seeds. *Moringa oleifera* belongs to the family *Moringaceae* which is a single genus family of shrubs and trees cultivated across the whole of the tropical belt and used for a variety of purposes (Jahn S. A. A., 1986). This tree is resistant to dryness and grows in arid and semiarid areas and hence it is called as a miracle tree (Ali, E.N., 2004). The main objective of this work is to use the *Moringa oleifera* seeds as a natural coagulant for the treatment of Textile effluent.

2. Materials and Methods

2.1. Raw Effluent Characterization

Textile industries are major sources of industrial effluents (Ghoreishi S.M. and Haghighi R., 2003) due to the nature of their operations, which requires high volume of water that eventually results in high wastewater generation. Characterization of textile

process effluent streams is very important to develop strategies for water treatment and reuse (R.O. Yusuff, J.A. Sonibare., 2004). The effluent was characterized and the following table shows the values of various parameters like pH, TDS, conductivity, chloride, alkalinity, turbidity and COD. The effluent characteristics are shown in Table 1.

S. No	Parameters	Values
1.	pH	9
2.	Total dissolved solids (TDS)	3507 mg/l
3.	Conductivity	7290 µs
4.	Chloride	1921.39 mg/l
5.	Alkalinity	1920 mg/l
6.	Turbidity	52 NTU
7.	COD	815 mg/l

Table 1: Effluent characteristics

2.2. Preparation of Moringa oleifera Seed Extract

The coagulation solution was prepared with *Moringa oleifera* seeds removed from recently harvested dry seed pods. The seed coat and wings were removed and the seeds were ground to powder using domestic blender. Then the powder was sieved through 600µ stainless steel sieve. 1M NaCl Solution was prepared. 2g of *Moringa oleifera* seed powder was mixed with 50ml NaCl solution and shook well using hands and filtered the solution using what man no.42 filter paper. Then the extract was diluted 10 times with 1M NaCl solution. Thus the coagulant compounds were extracted by adding Sodium Chloride solution to the powdered seeds.

3. Result and Discussion

3.1. Color Removal

After the characterization of the effluent, the prepared coagulants from the *Moringa oleifera* seeds were added to the effluent to determine the effectiveness of the extract over the textile effluent. The result shows that the extract removes the turbidity and color from the textile effluent as shown in Fig: 1. Removal efficiency of up to 98.75%, for color, was reached using 0.2g *Moringa oleifera* seed powder. The use of *Moringa* seeds has an added advantage over the chemical treatment of water because it is biological and has been reported as edible (Francis Kweku Amagloh and Amos Benang, 2009).

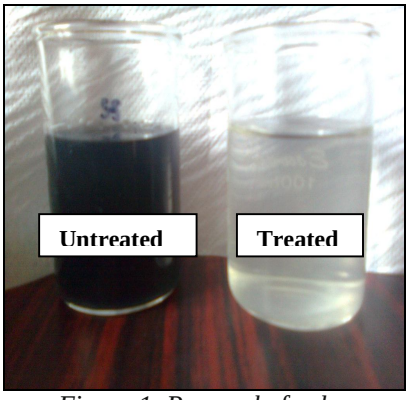

Figure 1: Removal of color

3.2. Characterization and Comparison

The treated effluent is characterized and the values of various parameters (pH, Total Dissolved Solids, conductivity, chloride, alkalinity, turbidity and COD) are compared with the raw effluent. The comparison is shown in Table 2.

S. No	Parameters	Untreated Effluent	Treated Effluent
1.	pH	9	8.24
2.	TDS	3507mg/l	1778 mg/l
3.	Conductivity	7290 µS	2145 µS
4.	Chloride	1921.39 mg/l	673.55 mg/l
5.	Alkalinity	1920 mg/l	900 mg/l
6.	Turbidity	52 NTU	4 NTU
7.	COD	815 mg/l	65 mg/l

Table: 2 Characteristics of untreated and treated effluent

3.3. pH Optimization

The seed extract was added to the effluent with 4 pH values (3, 5, 7 & 9).The results were observed under UV-Spectrophotometer. The spectra analysis graphs for different pH ranges are given in Fig.2. The result shows that there is no variation with respect to pH. It simply implies that the pH doesn't play any role in the treatment and the extract is able to treat the textile effluent of different pH ranges.

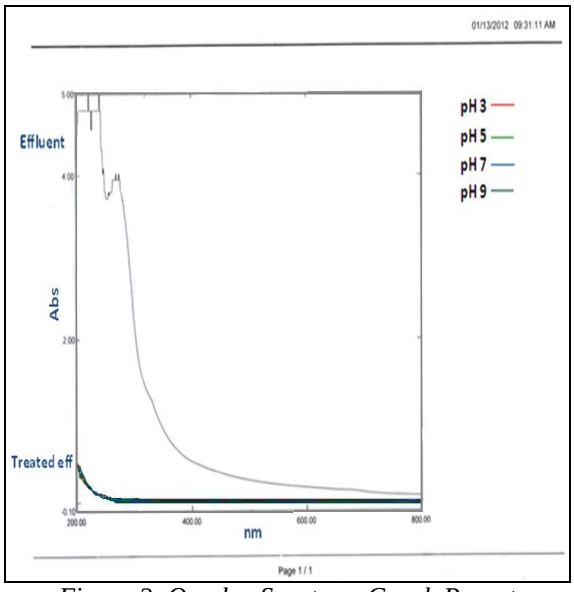

Figure 2: Overlay Spectrum Graph Report

3.4. Alkalinity Testing

Textile waste water is having higher concentration of $CaCO_3$.It makes the waste water alkaline. The result of the experiment shows that Moringa seeds have the ability to reduce the alkalinity. Removal efficiency was found to increase with increasing dosage of *Moringa oleifera* as shown in Fig 3. The reduction of alkalinity is shown in Table 3.

S. No	Dosage(ml)	$CaCO_3$(mg/l)
1	0.1	900
2	0.2	900
3	0.3	950
4	0.4	1050
5	0.5	1150

Table 3: Reduction of alkalinity

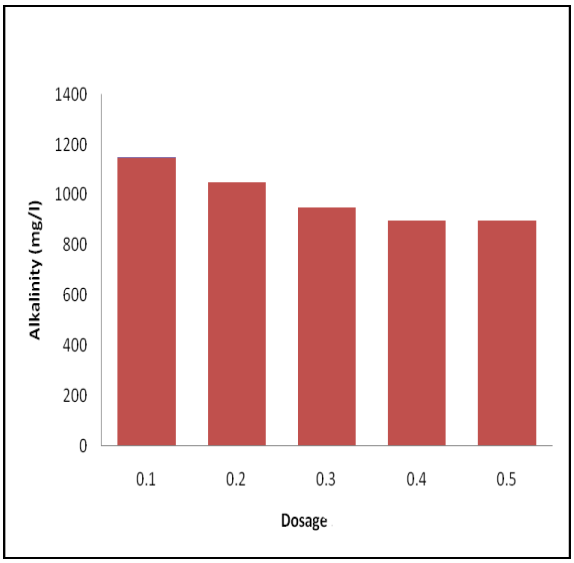

Figure 3: Dosage Vs Alkalinity

3.5. Dosage Optimization and Turbidity Removal

Varying doses of the seed extract were added to the effluent and kept for one hour. The mixture was then filtered through Whatman No.42 filter paper. The result shows that the higher turbidity removal efficiency (92%) was reached with the dosage of 0.4 ml as shown in Fig 4. The reduction of Turbidity is shown in Table 4.

S. No	Dosage(ml)	Turbidity (NTU)	Turbidity Removal (%)
1	0.1	24	54
2	0.2	19	63
3	0.3	11	79
4	0.4	4	92
5	0.5	4	92
6	0.6	6	88
7	0.7	6	88
8	0.8	9	83
9	0.9	12	77
10	1.0	16	69

Table: 4 Reduction of Turbidity

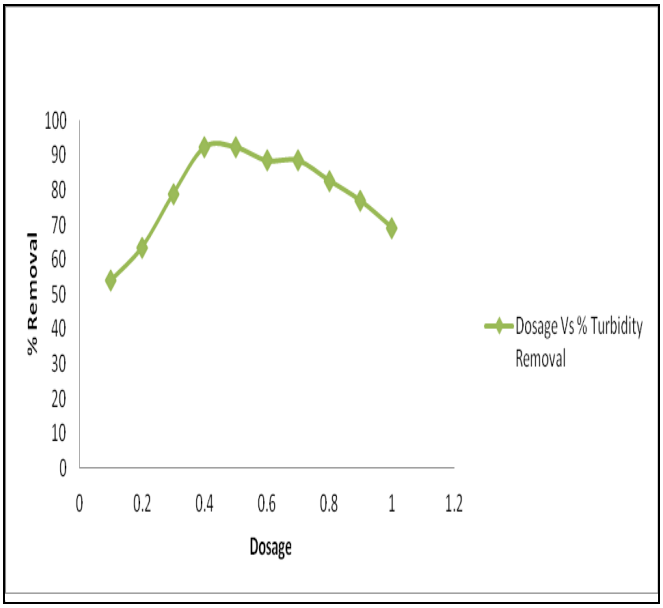

Figure 4: Dosage Vs % of Turbidity removal

3.6. pH Optimization and COD Removal

The pH of the effluent was adjusted to 3, 5, 7, 9&11. A constant quantity (0.5 ml) of extract was added to the effluent of different pH ranges. The result shows that the higher COD removal efficiency (92%) was reached with the sample of pH 5 as shown in Fig 5.The reduction of COD with respect to pH is shown in Table 5.

S. No	pH	COD Removal (%)
1	3	79
2	5	92
3	7	76
4	9	63
5	11	56

Table 5: Reductions of COD

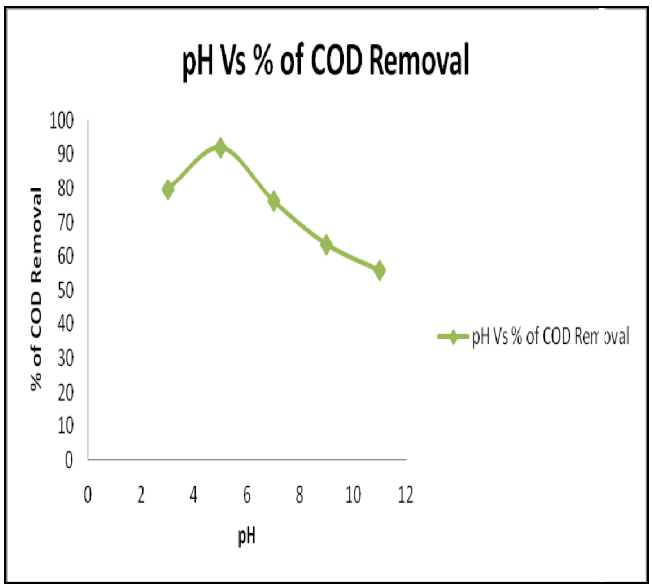

Figure 5: pH Vs % of COD removal

3.7. Dosage Optimization and COD Removal

Varying doses of the seed extract were added to the effluent and kept for one hour. The mixture was filtered through Whatman No.42 filter paper. The result shows that the higher COD removal efficiency (64%) was reached with the dosage of 0.4 ml as shown in Fig 6. The reduction of COD with varying doses is shown in Table 6.

S. No	Dosage(ml)	COD(mg/l)	COD Removal (%)
1	0.1	570	30
2	0.2	470	42
3	0.3	390	52
4	0.4	295	63
5	0.5	290	64
6	0.6	300	63
7	0.7	315	61
8	0.8	355	56
9	0.9	385	53
10	1.0	420	48

Table 6: Reduction of COD

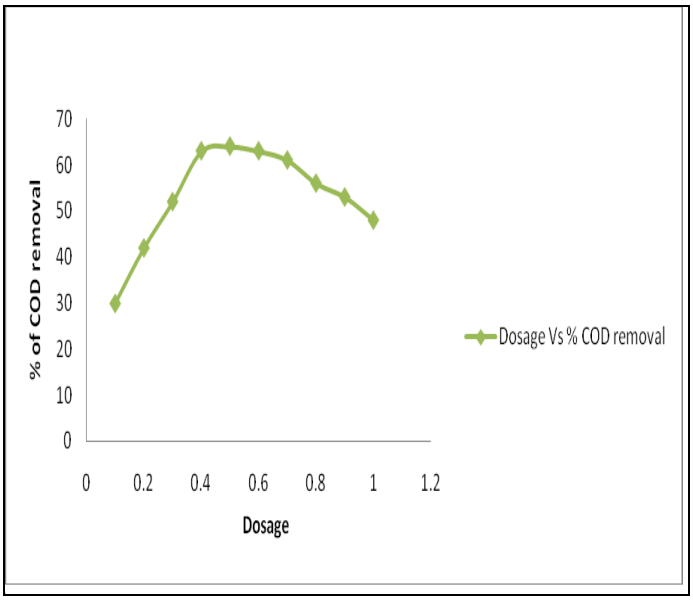

Figure 6: Dosage Vs % of COD removal

4. Cost Economics

Each *Moringa oleifera* tree can produce approximately 15000-25000 seeds and 400-1000 pod /year. The cost of commercial resin was compared with the cost of the natural coagulant obtained from *Moringa oleifera* seeds. It was found that there is 74% of reduction in the cost when the natural coagulant is used. Thus, it proves to be a cost effective method. The promotion and use of *Moringa oleifera* seed powder among the rural population will contribute in improving the living standards of vulnerable groups (the sick, the young and the aged) through the provision of clean drinking water (Nkhata, D., 2001)

5. Conclusion

Among many engineering disciplines, Textile Engineering has direct connection with Environmental aspects to be explicitly and abundantly considered. The main reason is that the textile industry plays an important role in a country like India which accounts for one third of its total export. Out of various activities in textile industry, chemical processing contributes to about 70% of pollution. In this study the suitability and effectiveness of the *Moringa oleifera* seeds in the treatment of textile waste water were determined and the effect of the coagulant on the removal of color, turbidity, alkalinity and COD was also studied. When compared to the commercial resin, the natural coagulant obtained from *Moringa oleifera* seeds is cheaper and easily available source.

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