Biosorption Potentials of Moringa Oleifera Seed in Textile Effluent Treatment

I. Aminu, M. D. Garba, Z. Y. Abba

Abstract - Textile industries produce effluents that are highly complex and are characterized by high BOD, COD, suspended solids, total dissolved solids, turbidity etc. In this study, coagulation using Moringa oleifera seed was used to reduce the suspended and colloidal materials responsible for turbidity of the wastewater. The seed powder was used as a natural coagulant to reduce turbidity, COD, pH, TDS, BOD, conductivity and absorbance of textile effluent. The tests were carried out using textile effluent with conventional test apparatus. Various results were obtained by increasing dosage of M. oleifera seed powder from 4g to 18g. Optimum dosage for reduction of COD, BOD, TDS, turbidity, conductivity and absorbance was determined, it was observed that the highest dose which is 18g has a greater efficiency in terms of reduction of the parameters tested with pH of 6.36, COD 9 mg/L, BOD 3mg/L, conductivity 60 µS/cm, TDS 160 mg/L, turbidity 0 NTU and absorbance of 0.044. The seed from Moringa oleifera plant shows high potential in industrial textile effluent treatments.

Keywords - Biological Oxygen Demand (BOD), Coagulation, Moringa Oleifera, Textile effluent, Water treatment.

1 INTRODUCTION

The problem of drinking water contamination, water conservation and water quality management has assumed a very complex shape [1]. Attention on water contamination and its management has become a need of the hour because of its far reaching impact on human health [2].

Ground water has historically been considered as reliable and safe source of water protected from surface contamination by geological filters that remove pollutants from water as it percolates through the soil [3]. Pollution of fresh water occurs due to some reasons like excess nutrients from sewage, wastes from industries, mining and agriculture [4]. Groundwater is threatened with pollution from the sources of domestic wastes, industrial wastes, run-off from urban areas, suspended and dissolved solids, organics and pathogens. Other potential sources of groundwater contamination are waste water treatment lagoons, mine spills, urban and rural garbage, earthen septic tanks, refuse dumps, barnyard manures etc.

Textile industry is considered as one of the highly polluting industries in the world. Textile process employs variety of chemicals depending upon the nature of raw material and products. Environmental problems by these industries are mainly caused by the discharge of effluents [5]. The wastewater generated by the textile industry is rated as the most polluting among all industrial sectors considering both volume of effluent discharged and effluent composition [6]. The resultant effluents of textile industry typically contain natural and artificial treated fibres, dye, and used materials (especially colouring materials). Textile effluents are highly coloured and saline; contain non-biodegradable compounds, and result in high biological and chemical oxygen demand (BOD, COD) of the waste water. It also contains heavy metals such as chromium, zinc, copper and mercury, and sometimes oils, greases, and waxes.

In view of growing awareness of pollution problems, dispersal of organic contamination in the environment is becoming a matter of concern. Ever increasing use of chemical and related compounds in chemical industries summons an urgent need of methods for their effective removal from water and wastewater. Traditional methods for dealing with textile wastewater consist of various combinations of biological, physical and chemical methods. Adsorption using activated carbon is one of the most common methods used [7]. However, this method is expensive due to the high cost of commercial activated carbon [8]. The removal of particles and organic matter from wastewater is often achieved by coagulation [6]. Coagulation-flocculation is one of the simplest and cost effective methods for industrial wastewater treatment to reduce the turbidity, BOD and COD content of the wastewater [9].

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Increased population and modernized civilization trend gave rise to blooming of textile sectors in Nigeria. However, due to lack of proper water treatment systems in some communities in Nigeria, a simple and relatively cheap treatment method like coagulation-flocculation using Moringa oleifera seed will provide a good and promising option for treating the effluent water before discharged.

The seed from Moringa oleifera tree can be used to purify water. In this work, the powdered seed is used as a coagulant to purify effluent from a textile industry. As a tropical multipurpose tree, Moringa oleifera is commonly known as miracle tree because of its wide variety of benefits that cover from nutritional issues to cosmetics. Among many other properties, Moringa oleifera seed contain a coagulant protein that can be used either in drinking water clarification or wastewater treatment. It is said to be one of the most effective natural coagulants and investigations on these kind of water treatment agents is growing nowadays [10].

2 MATERIALS AND METHODOLOGY

2.1 Sample Collection

In this work, Moringa oleifera seed was used as a natural coagulant for treatment of textile effluent. The seeds were collected from Jogana, Kano state, Nigeria.

Figure 1. Moringa Oleifera pods

Figure 2. Moringa oleifera shelled seeds

The effluent sample was collected in plastic containers from a textile industry located at Challawa Industrial Estate Kano State, Nigeria, at the point of discharge. The container was previously cleaned by washing in non-organic detergent, rinsed with tap water and finally rinsed with deionised water prior to usage. The sample collected was immediately used for the study. The initial characteristics of the untreated effluent are shown in table 1. Physical and chemical parameters tested were pH, conductivity, turbidity, Total Dissolved Solids (TDS), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). It is evident that treatment of this effluent is necessary before discharging into sewers.

TABLE 1
CHARACTERISTICS OF EFFLUENT SAMPLE BEFORE ANALYSIS

S/NO.	PARAMETER	VALUE
1.	pH	4.8
2.	COD (mg/L)	222
3.	BOD (mg/L)	79
4.	Conductivity (µS/cm)	3002
5.	TDS (mg/L)	1000
6.	Turbidity (NTU)	63
7.	Absorbance (□max)	1.003

2.2 Sample Treatment

The seeds were removed from the pods manually, dried and the external shells were removed [10]. The kernel was ground to a fine powder by using mortar and pestle. 100g of the seed powder was soaked in 500ml of 99% N-hexane and allowed to stay at room temperature for the period of 48 hours with stirring from time to time using a magnetic stirrer. The defatted cake was obtained by filtering the raffinate using Whitman filter paper and then allowed to dry [7]. The dried sample was stored under laboratory condition for the coagulation experiment.

2.3 Effect of Moringa oleifera in Textile Effluent Treatment

Different weights of the coagulant (dried sample of Moringa oleifera seed powder) were obtained for the coagulation experiment. 4g, 6g, 8g, 10g, 12g, 14g, 16g, 18g of the seed powder were weighed and dissolved in 200ml each of the effluent sample in conical flask which was agitated for the period of 30 minutes at room temperature, allowed to settled for 15 minutes, filtered through the Whitman filter paper, from which different clear effluent samples were obtained. The sample in each case was then tested for pH, conductivity, turbidity, total dissolved solids, COD and BOD, to study the effect of the coagulant dosage on the coagulation [10].

3 RESULTS AND DISCUSSION

To determine the optimum condition for the performance of the coagulant, dosage was varied from 4g to 18g for each parameter tested since insufficient dosage or overdosing would result in poor performance of the coagulant. The results obtained after treatment of the textile effluent using different dose of Moringa oleifera seed coagulant are presented in Table 2 and Figs. 3 to 9. The result indicated that certain doses of the coagulant resulted in a poor performance and some gave a good performance. A dose of 18g gave the optimum result for all parameters tested as shown in table 2. Before treatment of the effluent, high values of different physicochemical parameters used for the research were obtained as seen in Table 1 such as turbidity which is found to be 63 NTU, COD 222 mg/L, BOD 79 mg/L, pH 4.8, TDS 1000 mg/L, absorbance (at 640nm wavelength) of 1.003 and conductivity of 3002 (µS/cm).

The pH was measured before and after treatment, Fig. 3 shows that the pH of the sample increases gradually with increase in the coagulant dose. A pH of 6.36 was obtained for coagulant dose of 18g which indicates that the effect of the coagulant is satisfactory in the reduction of the acidity of the effluent.

Initially the COD of the effluent was found to be 222 mg/L. From the result obtained, optimum dosage of 18g reduces the COD to 9 mg/L and BOD to 3 mg/L as shown in Figs. 2 and 3 respectively. This reduction in COD and BOD was due to the reduction in the level of the microorganisms present. However, a sharp reduction was obtained even at 10g dosage.

Fig. 4 shows that the conductivity of the samples varies by varying the coagulant dosage. Conductivity is directly linked to the concentration of ions in the water and tells much about the purity of water. In this study, the coagulant shows that it is a good water treatment agent by reducing the conductivity from 3002 to 60µS/cm for the optimum dosage of 18g which almost reaches that of pure water.

The total dissolved solids (TDS) as shown in Fig. 5 reduce to 160 mg/L due to the coagulation activity of the Moringa oleifera seed.

The initial characteristics of the effluent show that it was turbid but after coagulation it became clear. A clear effluent was obtained with 18g optimum dosage as shown in Fig. 6. The figure shows that the turbidity of the treated sample reduced relatively by increase in dosage of the coagulant when compared with the untreated sample. Turbidity influences the dose of coagulants required for their purification and sanitation. The degree of turbidity depends upon the concentration or dispersion of the suspended matter and the light absorption properties of the suspension.

Absorbance, as seen in Fig. 7 reduces by increasing the coagulant dosage which has a direct relationship with colour. The initial blue colour of the effluent disappeared after coagulation with 18g optimum dosage.

TABLE 2
CHARACTERISTICS OF THE EFFLUENT SAMPLES AFTER TREATMENT USING DIFFERENT DOSES OF MORINGA OLEIFERA SEED COAGULANT.

S/NO.	PARAMETER	DOSAGE							
		4g	6g	8g	10g	12g	14g	16g	18g
1.	pH	3.85	3.98	4.65	4.39	4.49	5.38	5.49	6.36
2.	COD (mg/L)	1182	740	243	77	56	31	29	9
3.	BOD (mg/L)	422	264	87	28	20	11	10	3
4.	Conductivity (µS/cm)	2240	2030	170	150	130	100	90	60
5.	TDS (mg/L)	3600	2800	2300	900	390	360	250	160
6.	Turbidity (NTU)	31	16	14	12	9	0	0	0
7.	Absorbance (□max)	0.281	0.134	0.116	0.065	0.063	0.061	0.057	0.044

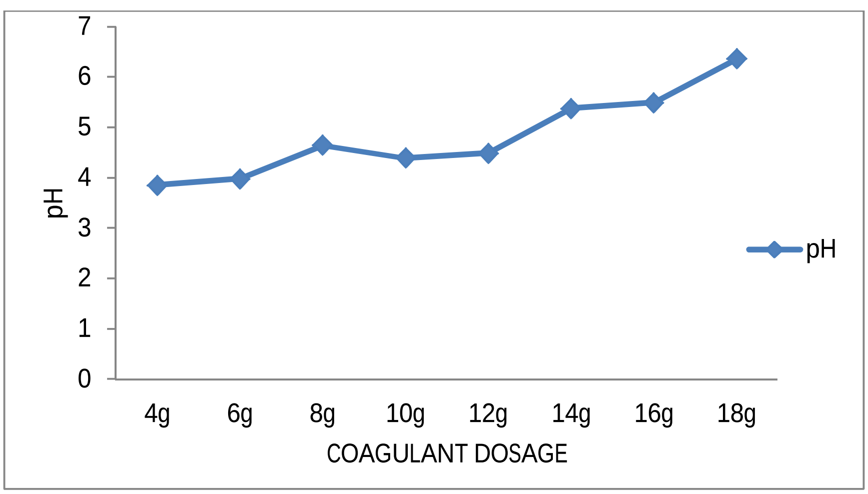

Fig. 3. Variation of pH with coagulant dosage (g) in 250ml of effluent sample.

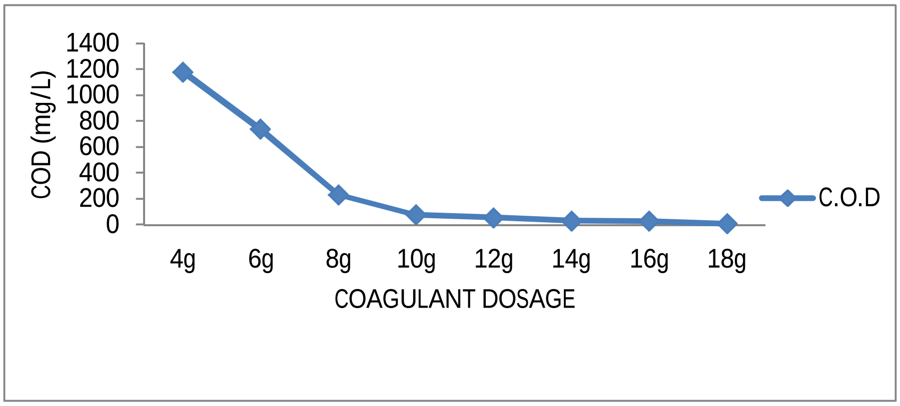

Fig. 4. Variation of C.O.D (mg/L) with coagulant dosage (g) in 250ml of effluent sample.

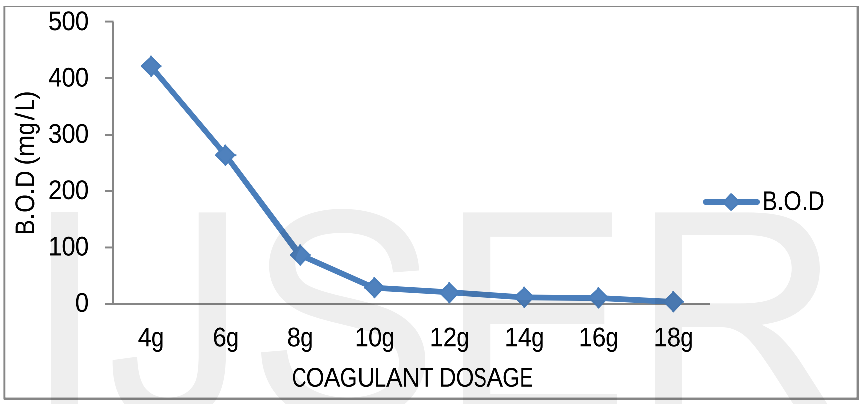

Fig. 5. Variation of BOD (mg/L) with coagulant dosage (g) in 250ml of effluent sample.

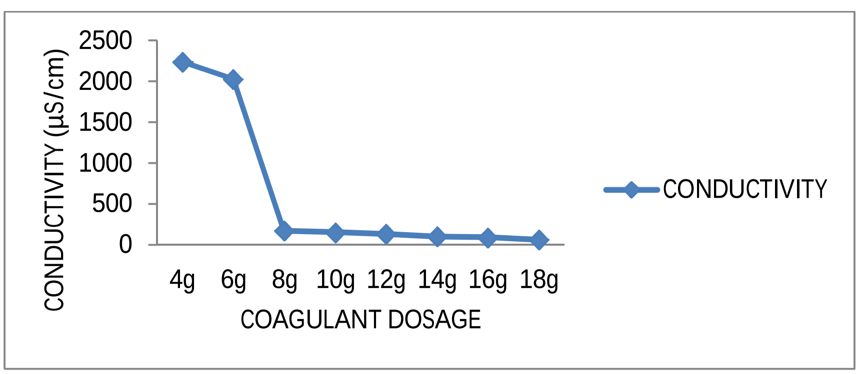

Fig. 6. Variation of conductivity (µS/cm) with coagulant dosage (g) in 250ml of effluent sample

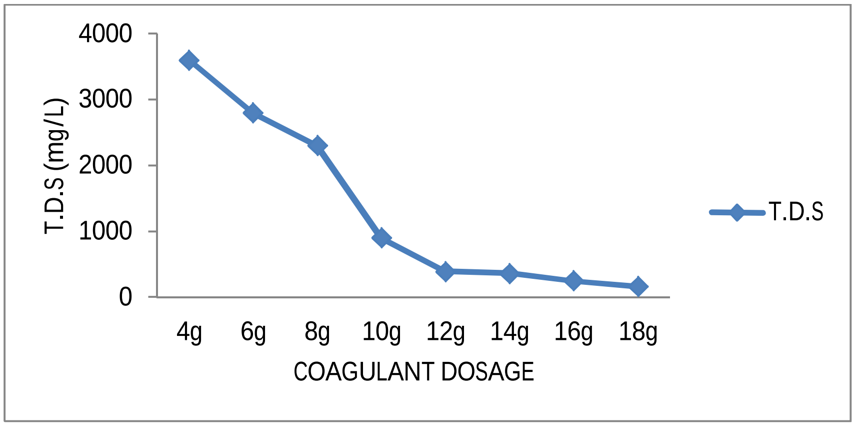

Fig. 7. Variation of TDS mg/L with coagulant dosage (g) in 250ml of effluent sample

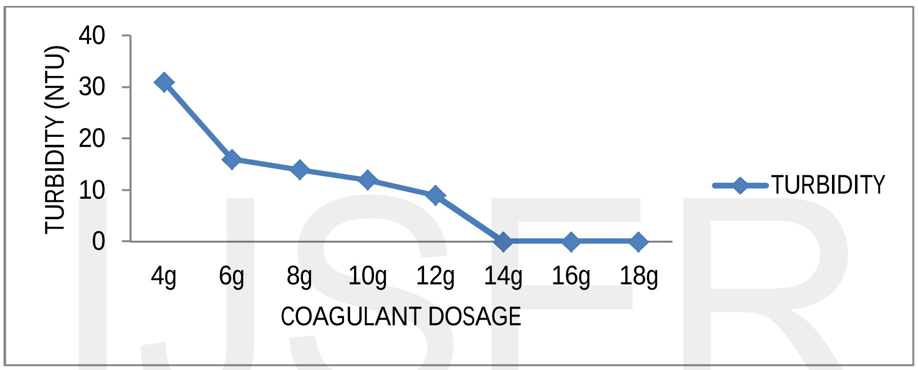

Fig. 8. Turbidity (NTU) against Dosage (g) in 250ml of effluent sample.

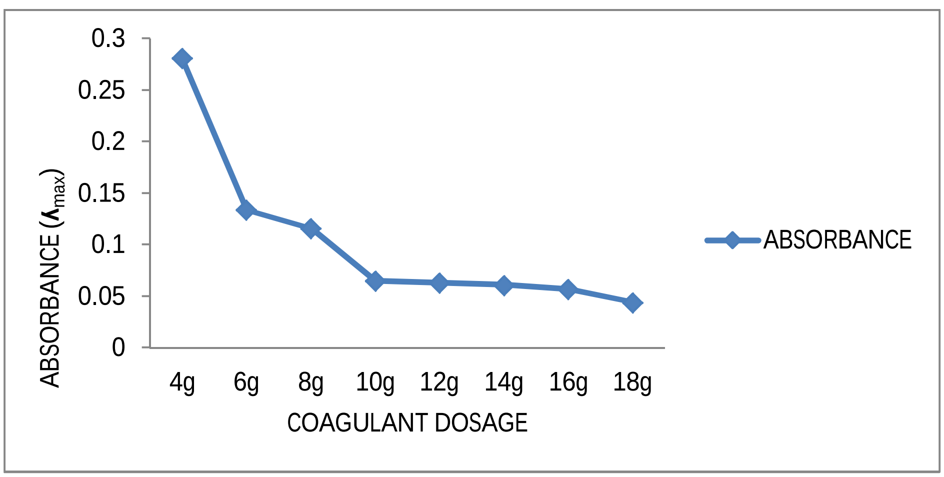

Fig. 9. Variation of absorbance (ʎmax) with coagulant dosage.

4 CONCLUSION

Coagulation-flocculation was used to treat textile effluent using Moringa oleifera seed as a natural coagulant. The results showed that Moringa oleifera seed has the efficiency of reducing COD, BOD, TDS, conductivity, turbidity and absorbance of the effluent. To determine the optimum condition for the performance of the coagulant, dosage was varied from 4g to 18g for each parameter tested since insufficient dosage or overdosing would result in poor performance of the coagulant. The optimum dosage of 18g/200ml showed a very good performance by decreasing the acidity and all the parameters tested. The blue colour of the effluent disappeared and the odour was completely removed. Hence, it is concluded that the seeds of Moringa oleifera which is a readily available plant in many parts of the world can be effectively used as a coagulant for treating textile effluents.

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