Performance Assessment of *Moringa oleifera* in Clarification of Surface Water

Meenakshi M, B M Manjunatha, N T Manjunath

***Abstract*—Water is one of the basic needs for survival, in addition, to food, shelter and clothing. Nowadays there were no appropriate low cost technologies available for the treatment of water. In rural areas those people who were living in extreme poverty are presently drinking contaminated water, because of lack of knowledge of proper drinking water treatment and they cannot afford costly chemical coagulants. Therefore this present study is carried to provide information on low cost household treatment using natural seeds like *Moringa oleifera.*In the present study, the efficiency of natural seed powder to treat the surface water has been studied and optimum dosage in case of coagulation and optimum depth in case column study was determined. The surface water sample collected and treated with *Moringa oleifera* which is a natural seed and analyzed for pH, turbidity, TSS, TDS, total hardness and calcium hardness. There was reduction of concentration of all the parameters with increase in coagulant dosage. 150 mg/l was the optimum dosage for parameters pH, turbidity, TSS, TDS and for total hardness and calcium hardness the optimum dosage was 200 mg/ in case of coagulation. In case of column studies, the water sample can be better treated with adsorbent quantity equivalent to 2cm depth compared to 1cm and 3cm for *Moringa oleifera*.**

***Index Terms*—Adsorption, Coagulation, *Moringa oleifera(MO)*, Natural Coagulant.**

I. Introduction

Moringa oleifera is commonly called as drum stick. Drum stick is consumed as food material in all over India. But many people don't know the important traditional use of *Moringa oleifera*. The drum stick can also be used to purify the turbid water. Usually most of the people in rural areas when they get turbid water, immediately the only method which comes their mind is to purify the turbid water is that boiling the water and filtering the water by passing through a clean cloth. But adopting this method is not economical which consumes lot of cooking gas which is privilege in most Indian homes [1]. The best alternative way to treat the turbid water is adding small amount of *Moringa oleifera* seed powder to water. The drum stick seed particles which acts as polyelectrolyte bind to dirt and make heavy sediment then allow the sediment dirt down. Using of drum stick seed powder to treat the turbid water is economical method which suits for rural areas [1]. In this present work deals with the study of behaviour of *Moringa oleifera* in clarification of turbid water and reduction in water quality parameters, so that it can be suggested for the treatment of water in the undeveloped rural areas. The use MO to purify the turbid water has an added advantage over the chemical treatment of water because it is biological and has been reported as edible [2]. To overcome problems of chemical coagulants usage of natural coagulants has increased for the treatment of turbid water and these found to be more sustainable and economically viable alternative [3]. Naturally occurring coagulants are generally presumed safe for human health [2]. Many research people carried out on studies of natural coagulants in treatment of turbid water, they found that most of the coagulants were extracted or produced from microorganisms, plants or animals [4]. One of these best alternatives is *Moringa oleifera* seeds. Its seed contain 1% active polyelectrolyte's that neutralise the negatively charged colloid in dirt water. This protein can be therefore nontoxic natural polypeptide for sedimentation of mineral particles and organics in the purification of drinking [2].

Moringa oleifera seeds possess antimicrobial properties reported that a recombinant protein in the seed is able to flocculate gram-positive and gram-negative bacteria cells. In this case, microorganisms can be removed by settling in the same manner as the removal of colloids in properly coagulated and flocculated water [2].

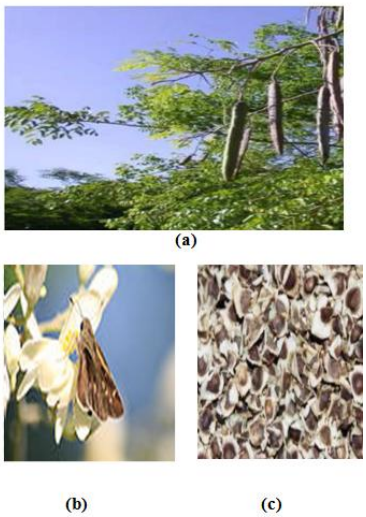

Figure 1 (a) Fully Grown MO Tree (b) Flower of MO (c) Seeds of MO Coated with Seed Coat [1].

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II. MATERIALS AND METHODS

A. Surface Water

The surface water was collected from Chikkayagati pond which is located at chitradurga district Karnataka.The type of sampling adopted in this study was grab sampling, consists of a single sample taken at a specific time. Samples were collected in the plastic cans and the characterization of surface water samples were conducted immediately after the sample arrived to laboratory. Care was taken not to introduce errors during sampling and storage, where contamination results from improperly cleaned sampling devices and sample containers.

B. Moringa oleifera

The procedure for the preparation of *Moringa oleifera* seed powder is given below,

- High quality pods, those which were new and not infected with disease and insects were selected.
- Seeds were opened from pods and then dried in sun light for 48hr to remove any moisture content if present.
- Hulls and wings from kernels were removed manually to increase the effect of powder as coagulant and to reduce to waste sludge formation.
- The seed kernels were ground to a medium fine powder in grinder and sieved to get particles of size 600µm. Fine powder was used as coagulant for analysis [5].

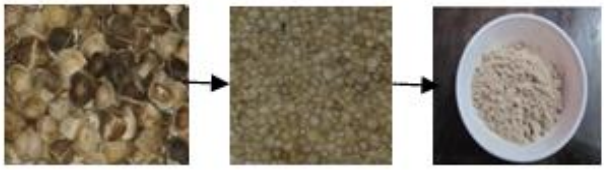

Figure 2 Preparation of *Moringa oleifera* seed powder.

C. Physico-chemical methods of analysing the surface water

Table 1 physico chemical methods.

Si. No.	Parameters	Method
Physical parameters		
1	pH	pH meter
2	Turbidity	Nephelometer
3	TSS	Spectophotometer
4	TDS	Water quality analyzer
Chemical parameters		
5	Total Hardness	Titration
6	Calcium hardness	Titration

D. Treatment Procedure Adopted

In the present work two methods were adopted to treat the turbid water and they are coagulation method and column method.

- **Coagulation test**

Jar test is most widely used experimental methods for coagulation-flocculation. A conventional jar test apparatus will be used in experiments to coagulate sample of water using MO. It will be carried out as a batch test; the jar test apparatus involves the use of stirring device. The stirrer consists of six paddles those which are capable of rotation with the different speed. In this method six beakers of 1 liter capacity are placed, which were dosed with different amount of coagulant and run the apparatus for 45 minutes at a speed of 110 rpm then the stirred sample allowed settle floc for 1-2 hours depending on the foc size formed then the supernatant was taken to analyzed [1]. Before operating jar test, sample is mixed homogenously, then analyze for the initial concentration of the parameters such as pH, turbidity, suspended solids, dissolved solids, total solids, hardness [1]. Then samples are tested for desirable parameters after the jar test, then the results are plotted on graphs.

Figure 3 Schematic view of conventional jar test apparatus.

- ***Column study***

Column study was carried out as continues flow test, here adsorbent act as filter bed and it clarifies the turbid water. The column which is adopted for our experiment has dimensions of 20 cm height, 3.2 cm dia and effluent collection pipe has diameter of 0.7 cm. In order to prevent the entry of adsorbent into the effluent the bottom of the column plugged with glass wool into the column.

Water to be tested was fed into column by burette. Flow from the burette so adjusted that the constant ponding depth of 5cm was maintained above the adsorbent in the column. In this method the depth of adsorbent is varied for 1cm, 2cm and 3cm. The treated water samples were collected at the bottom of column through effluent pipe and were analysed for various parameter.

Figure 4 Typical picture view of experimental set up.

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III. RESULTS AND DISCUSSIONS

The initial characteristics of surface water for the selected area and experimental results after treatment with jar are studies are tabulated in table 2 and 3 respectively and the results of column studies are drawn in figure 5

- **Initial Characteristics of Surface Water of Chikkayagati Pond**

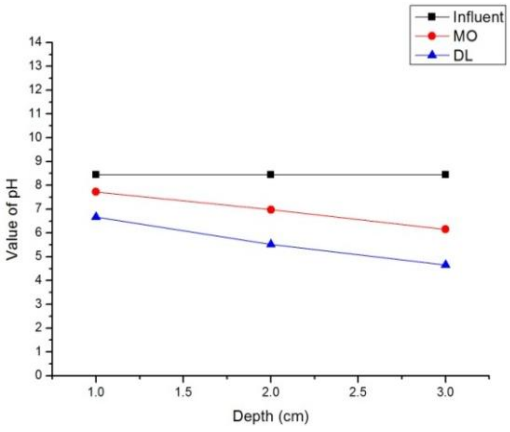
The surface water samples were analyzed in Environmental Engineering laboratory, Department of Civil Engineering Davanagere Karnatakaand the analysis results are summarised in table 2.

Table 2 Initial Characteristics of Surface Water of Chikkayagati Pond.

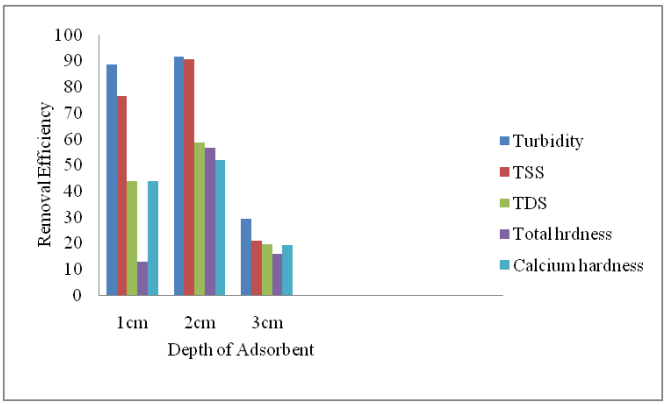
Sl No.	Parameters	Unit	Value of Concentration
01	pH	-	8.45
02	Turbidity	NTU	786
03	TSS	mg/l	639
04	TDS	mg/l	510
05	TS	mg/l	1149
06	Total hardness as $CaCO_3$	mg/l	140
07	Calcium hardness as $CaCO_3$	mg/l	110

Table 3 Results of experimentation of coagulation studies.

Coagulant used : Moringa *oleifera*												
Water sample : Chikkayagati pond												
Sl. no	Parameters	Initial	Final concentration and efficiency with different dosage of coagulants									
			50 mg/l		100 mg/l		150 mg/l		200 mg/l		250 mg/l	
			c_e	E	c_e	E	c_e	E	c_e	E	c_e	E
1	pH	8.45	7.28	-	7.23	-	7.05	-	6.99	-	7.14	-
2	Turbidity	786	105	86.64	68.2	91.32	61.30	92.20	89.60	88.60	96.2	87.76
3	TSS (mg/l)	639	94	85.28	82	87.16	58	90.92	75	88.26	108	83.09
4	TDS (mg/l)	510	290.1	43.13	245.3	51.91	178.2	65.05	279.5	45.29	351.8	31.10
5	Total hardness (mg/l)	140	111	20.71	91	35	67	52.14	40	71.42	70	50.12
6	Calcium hardness (mg/l)	110	93	15.45	72	34.54	63	42.72	37	66.36	60	45.45



(a)



(b)

Figure 5 (a) Variation of pH (b) Percentage reduction of various parameters at different depth of adsorbents.

The findings of coagulation and column studies are given in table 3 and figure 5 respectively. Based on the analysis of results the following inferences have been drawn.

Dosage of coagulants, *Moringa oleifera* was found to have significant influences on removal of various pollutants considered for study. The increase in removal of turbidity, TSS and TDS with increase in coagulant dosage form 50 mg/l to 150 mg/l was observed further with increase in coagulant dosage decrease in removal efficiency has been recorded. On the other hand with respect to total hardness and calcium hardness the maximum removal efficiency with *Moringa oleifera* dosage 200 mg/l has been recorded. The results of column studies revealed that, the water sample can be better treated with adsorbent quantity equivalent to 2 cm depth compared to 1 cm and 3 cm depth. Under the optimum conditions of column studies the maximum removal of 91.45 % [turbidity], 90.45 % [TSS], 58.72 % [TDS], 56.42 % [total hardness] and 51.81 % [calcium hardness] were recorded. Further the higher removal efficiencies were observed with coagulation studies.

The removal efficiencies were recorded for turbidity, TSS, TDS, total hardness and calcium hardness were respectively 92.20 %, 90.92 %, 65.05 %, 71.42 % and 66.36 %, under the optimum working conditions.

Even though better efficiencies were recorded with coagulation studies, confirmative and precise conclusion like, supremacy of coagulation studies compared to column studies could not be arrived at this is due to absence of data like saturation capacity of adsorbents, regeneration potential of adsorbent etc. such a confirmation requires further in depth studies which is the limitation of present study.

IV. CONCLUSIONS

Based on the analysis and results of the present study it is conclude that within the statical limitations the pond water can be better treated by using coagulant *Moringa oleifere*, the dosage of coagulant being 200 mg/l.

It is concluded that to compare the efficiency of column and coagulant studies in depth investigations are required on the factors like saturation and regeneration capacities and potential of adsorbent.

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