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Influence of Homemade Coagulants on the Characteristics of Surface Water Treatment: Experimental Study

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***Abstract*- The main objective of this work is to evaluate the coagulation efficiencies of natural coagulants on certain physio chemical characteristics like turbidity, pH, Colour and Total solids. In this study five different powdered coagulants obtained from Drumstick seeds Tamarind seeds, Neem seeds, Banana peel and sweet potato were used and compared against commercial coagulants like Alum and Lime. The best coagulant performance is found by comparing the optimum coagulant dosage, settling time, rate of settling, removal efficiency, clarity &cost. Application of these natural coagulants is recommended for rural people who rely on low quality water sources**

Keywords- Coagulation, Natural Coagulants, Turbidity, Removal Efficiency, Treatment Process

I. INTRODUCTION

Poor management and over exploitation of water resources denies the access of safe drinking water and safe sanitation particularly in remote areas which is about more than 20% of people according to WHO (2009 survey). As a result, 1.8 billion people die annually from diarrheal diseases. Taking care of the environment and mankind is a global challenge, water management and waste water treatment is also a part of it. Most commonly faced problems in waste water treatment is due to pH, turbidity, color and total solids. There are many treatment technologies available, but coagulation is considered to be better as compared to other methods because of its ease of operation and simplicity in design (Gdoura et al.,2012). In conventional practice coagulants used in water treatment are lime and alum. But there are some health hazards arisen like Alzheimer's disease and neurological disorders etc. (B.coco-Rivero et al.,2013). To overcome those disadvantages researchers search for new coagulants derived from natural products. Coagulation with natural coagulants is in practice since 2000 BC. In the recent years, natural products used for water treatment are obtained from plant origin namely *Moringa oleifera* seed husks (pollard et al., 1995,B natia et al.,) lead removal from Banana peel (suhartini et al., 2013&Gusto et al., 2011) Okra seeds for removal of turbidity (Muhammad et al., 2013) use of Hibiscus & C.tridens weeds for water treatment (Jodi et al., 2012). The aim of this present study is to assess the effectiveness of various agricultural wastes (or) by products for water treatment.

II. MATERIALS AND METHODS

Water sample is collected as shown in Fig:1 from a pond near Chengalpet district in Tamil Nadu. Characterisation is done as per the standard procedure and the results are shown in table 1. The optimum dosage test is done by using Jar test apparatus as shown in Fig:2.

Figure - 1 Water Sample before treatment

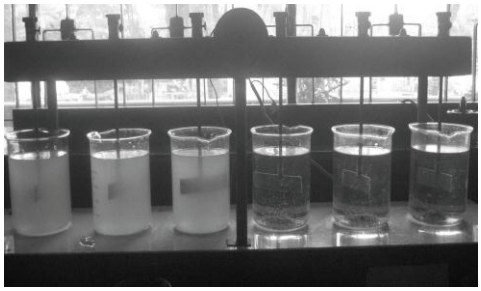

Figure - 2 Conventional jar test apparatus

Table 1.Characteristics of water Sample

No	Parameter	Value
1.	pH	5.49
2.	Total solids	4300 mg/l
3.	Turbidity	62.4 NTU
4.	Suspended solids	600 mg/l

In order to investigate the coagulating efficiency of plant materials on the characteristics of water sample, powdered Banana peel, Tamarind seed, Neem seed, *Moringa olifera* seeds and Sweet potato were prepared and the water samples were treated and left to settle for different time periods. After each experimental period the samples were analysed again and compared with the standards.

III. RESULTS AND DISCUSSIONS

A. *Turbidity*

The jar test experiments were conducted on water sample with different amount of coagulant dosages and results are tabulated in Table 2.It was clear from the results that the amount of coagulant dose increased, the turbidity reduction also increases. Fig 3 shows the results of different dosages of powdered coagulants along with the Alum-Lime during jar tests. Before treatment the raw sample turbidity was found to be 64 NTU (Medium turbidity) it is found that from Fig 3,the turbidity reduced from 64 NTU to 1NTU corresponding to different dosages of powdered coagulants. From the results it was clear that Neem seeds (*Azadirachata indica*) shows maximum removal efficiency. The above experimental study also revealed that increase in dosage did not significantly increase the removal efficiency.

Table 2. coagulant dosage Vs turbidity removal efficiency

COAGULANTS	DOSAGE mg/l	%REMOVAL EFFICIENCY
Banana peel	15	97
	20	95
	25	94
	30	94
Moringa olifera	15	95
	20	97
	25	97
	30	96
Ipomoea batatas (sweet potato)	15	98
	20	98
	25	98
	30	97
Azadirachta indica (neem seed)	15	99
	20	99
	25	98
	30	98
Tamarindus indica (tamarind seed)	15	95
	20	95
	25	94
	30	94
Alum / lime	15	94
	20	94
	25	95
	30	95

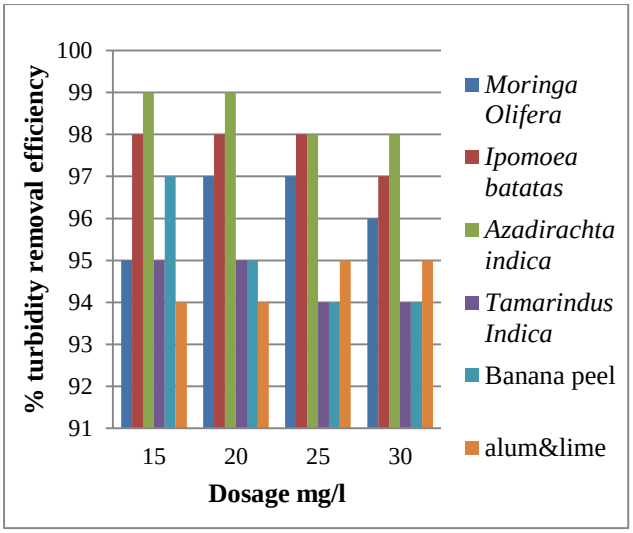

Figure 3 – plot of turbidity removal efficiency Vs coagulant dosage

B. *pH*

The pH ranges from 6.4 to 7.4 as shown in table 3 which shows neutral condition of the polluted water. From the results, it can be seen that there is not much significant alteration in pH values with various types of coagulants. Therefore, it is obvious that these natural coagulants helps in maintaining the desirable parameters (Patale et al., 2010).

Table 3. coagulant dosage Vs pH

COAGULANTS	DOSAGE mg/l	pH
Banana peel	15	6.52
	20	6.51
	25	6.52
	30	6.43
Moringa olifera	15	7.11
	20	7.15
	25	7.13
	30	7.13
Ipomoea batatas (sweet potato)	15	7.32
	20	7.20
	25	7.31
	30	6.80
Azadirachta indica (neem seed)	15	7.1
	20	7.1
	25	6.83
	30	6.79
Tamarindus indica (tamarind seed)	15	6.7
	20	6.8
	25	6.72
	30	6.81
Alum and lime	15	7.8
	20	7.6
	25	7.8
	30	7.8

C. *Total solids*

Table 4 shows the TSS concentration during various dosages of different adsorbents. It is found that the TSS concentration gradually reduced with dosages of 15, 20, 25 and 30 mg/l respectively. Figure 4 compares the removal of TSS using various natural coagulants with the conventional alum and lime. From the results, it is clear that natural coagulants are also efficient in reducing TSS from the raw water (Murali Mohan et al., 2014).

Table 4. coagulant dosage Vs total solids

COAGULANTS	DOSAGE mg/l	TOTAL SOLIDS
Banana peel	15	3700
	20	3680
	25	3650
	30	3700
Moringa olifera	15	3550
	20	3650
	25	3600
	30	3650
Ipomoea batatas (sweet potato)	15	3600
	20	3640
	25	3590
	30	3680
Azadirachta indica (neem seed)	15	3550
	20	3540
	25	3570
	30	3600
Tamarindus indica (tamarind seed)	15	3690
	20	3680
	25	3650
	30	3700
Alum and lime	15	3600
	20	3650
	25	3520
	30	3600

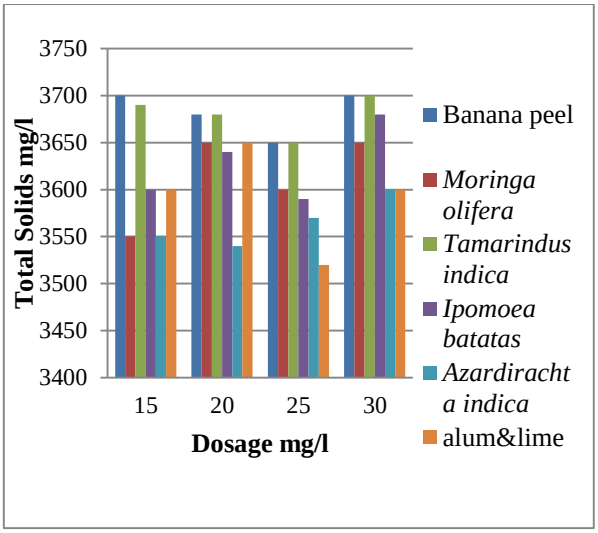

Figure 4 – plot of coagulant dosage Vs total solids

IV. CONCLUSION

The aim of this present study is to assess the effectiveness of various agricultural wastes as natural coagulants for surface water treatment. In the present study, sample of pond water is examined for the various characteristics like turbidity, pH and TSS with natural coagulants like banana peel , *Azadirachta indica* (neem seed), *Ipomoea batatas* (sweet potato), *Moringa olifera*, *Tamarindus indica* (tamarind seed) and compared with alum and lime.

Ranking is usually done to determine the best coagulant based on the Removal efficiency, Settling rate, Clarity, Availability and cost of the materials. Neem seeds displayed better results and the other coagulants were ranked as follows.

Neem seed > banana peel > *Moringa olifera* > sweet potato > tamarind seed

This method is very economical compare to chemical treatment since they are naturally available, very cheap and biodegradable. Low maintenance and no skilled labour are required. They are non toxic and non corrosive. The studies presented showed that Neem seeds could be employed as natural coagulants for surface water treatment.

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