

Turbidity Removal from Surface Water Using *Tamarindus Indica* as Natural Coagulant

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Abstract: Water is undoubtedly the most vital parameter among the natural resources. Turbidity imparts a enormous problem in waste water treatment. In this project, an attempt has been made to evaluate the effectiveness of locally available tamarind seed powder as natural coagulant for reduction of turbidity in the quality improvement of surface water. The tests were carried out using the conventional jar test apparatus. The dosing of water-soluble extract of tamarind seed at various concentrations obtained the reduction of turbidity in Surface water. It was found that natural coagulant worked better with turbid water. Utilisation of locally available natural coagulant was found to be suitable, easier, cost effective and environment friendly for water treatment.

Keywords: Tamarind seed, coagulant, turbidity

1. 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. 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. To overcome those disadvantages researchers search for new coagulants derived from natural products. Coagulation with natural coagulants is in practice since 2000 BC.

Synthetic coagulants like aluminium salts are most commonly used in water purification all over the world. Due to the environmental concerns many authors put their doubt towards the application of aluminium salts. The alternatives like ferric salts along with synthetic polymers are now getting popularity. But their cost and unclear environmental consequences are the main obstacles to their usage. In recent years finding natural sources of coagulant are getting priority. Both mineral and vegetable origin of the natural coagulant have been simultaneously observed. Since recently there has been more interest in the subject of natural coagulant especially for the treatment of water and wastewater in developing countries.

Water is one of the fundamental requirements of life and any undesired addition of chemical substances leads to its contamination and makes it unfit for human utility. The removal of colloidal and suspended particles present in water would be extremely beneficial as it would assuage the majority of problems associated with turbidity. Most particulate matter cannot settle by gravity and their sizes are so small that they pass through the pores of most common filtration media. Conventionally, the enmeshment and removal of the colloids in water could be achieved by coagulation. For many developing countries, this treatment process is not feasible because of the high costs involved and the difficulty in assessing chemical coagulants including alum. Moreover, recent studies have pointed out the health threats arising from the consumption of residual aluminium present in water, such as Alzheimer's disease and neuro degenerative illness. Subsequently, large non-biodegradable sludge volumes are produced comprising of residual aluminum sulphate requires treatment facilities to prevent further contamination into the environment. It is evident that the use of extracts from plant species possessing both coagulating and antimicrobial properties which are safe for human health. To overcome chemical coagulant problems it can be a suitable solution to increase the use of natural coagulants for water treatment.

1.2 Coagulants

In contrast to chemical coagulants, plant-based natural coagulants are safe, eco-friendly and generally toxic free. Natural coagulants have been found to generate not only a much smaller sludge volume of up to five times lower but also with a higher nutritional sludge value. As such, sludge treatment and handling costs are lowered making it a more sustainable option. The raw plant extracts are often available locally and hence, a low cost alternative to chemical coagulants. Since natural coagulants do not consume alkalinity unlike alum, pH

adjustments can be omitted and this provides extra cost savings. Natural coagulants are also non-corrosive which eliminate the concerns of pipe erosions.

1.3 Tamarindus Indica Seed

Tamarindus indicais a leguminous tree in the family of fabaceae indigenous to tropical Africa. The genus Tamarindus is a monotypic taxon, having only a single species. It is used as traditional medicine in India, Africa, Pakistan, Bangladesh, Nigeria, and most of the tropical countries. Natural plant extracts has been used as water purifying agent for many years. Most of these extracts are derived from the seeds, leaves, pieces of bark or sap, roots and fruit extracts of trees and plants.. But it was necessary to compare the efficiency of natural seeds to commercial chemical coagulant.

2. Methodology

2.1 Materials

The materials used in this study were purchased from nearby village (Kunnamkulam). The tamarindus indica seeds were used for preparation of coagulant extract.

2.1.1 Tamarindus Indica Seed

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Figure 1: Tamarindus indica seeds

2.1.2 Water sample

The sample water used throughout the study was collected from the kecheri River, located near the Thrissur city. The raw water was stored in the plastic bottle in the laboratory.

2.2 Methods

2.2.1 Preparation of Tamarindus Indica Seed Coagulant

The coagulant which is used is tamarindus indica seed for treatment of surface water such as river water. Locally available dry Tamarindus indicaseeds were obtained from the village ayyamparambu situated in kunnamkulam. The seeds were dried in sunlight and kept in room temperature. Then the seeds were oven dried and grounded to fine powder using a mortar and then kitchen blender to make it of approximate size of 0.005mm to make soluble in water of active ingredients of the seeds.



Figure 2: Tamarindus indica seeds and powder

2.2.2 Experimental Work

Jar test is the most widely used experimental methods for coagulation-flocculation. A conventional jar test apparatus was used in the experiments to coagulate sample of turbid water using natural coagulant. It was carried out as a batch test, accommodating a series of six beakers together with six-spindle steel paddles. Before operating the jar test, the sample was mixed homogenously. Then, the samples ought to be measured for turbidity, for representing an initial concentration. Coagulants of varying concentrations were added in the beakers. The whole procedures in the jar test were conducted in different rotating speed. Turbidity measurements were conducted using digital Nephelo turbidity meter. The pH was measured using a digital pH meter.



Figure 3: Jar test Apparatus

3. Results and Discussions

3.1 Raw Water Characteristics

It may be observed from Table 1 that, at a residual turbidity of 0.84 NTU the optimum dose of coagulant was 150mg/l by using tamarind seed powder. The respective coagulant dosage levels with corresponding residual turbidity values was clearly shown in the form of graph in Figure 1. It was noticed that turbidity values are gradually decreasing from coagulant dosage level of 50mg/l to 150mg/l and gradually increasing from dosage level of 200mg/l to 250mg/l.

Table 1: Turbidity Of Sample Using Tamarind Seed Powder

Sl. No	Coagulant dosage in mg/l	Residual Turbidity (NTU)
1	50	1.98
2	100	1.55
3	150	0.84
4	200	1
5	250	1.4

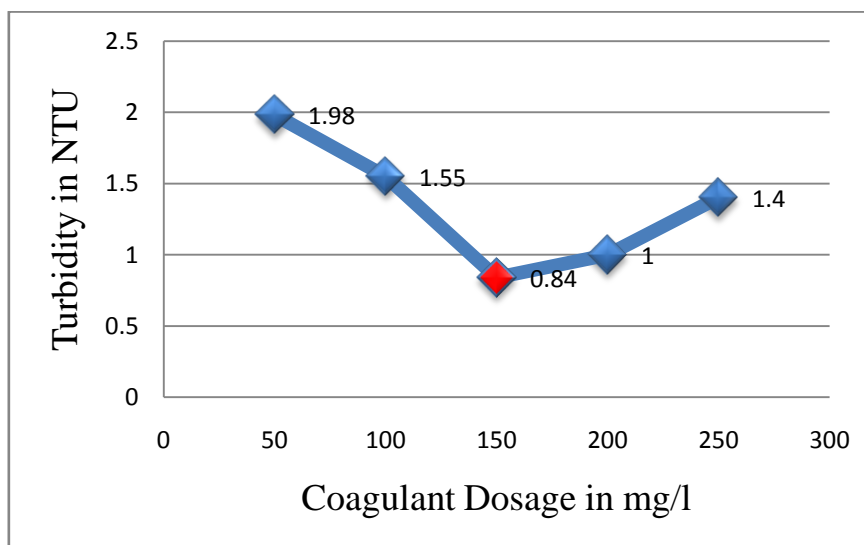


Figure 4: Graph Of Coagulant Dose Vs Residual Turbidity

3.2 Optimum pH and Turbidity Removal

The optimum pH was determined at a pH of 8.0 and the turbidity removal was 95.44% as shown in Table 2. It was found that the percentage of turbidity removal was gradually increased from pH 2 to 8 and the % of turbidity removal was gradually declined from pH 10 as shown in Figure 5.

Table 2: Percentage Turbidity Removal With Optimum Dosage 150mg/L

Sl.No	pH	Turbidity Removal in (%)
1	2	89.11
2	4	91.27
3	6	92.44
4	8	95.44
5	10	94.77

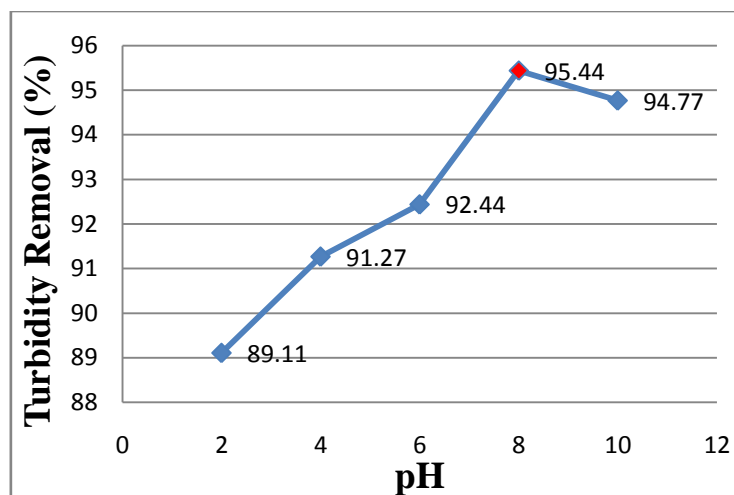


Figure 5: Graph Of pH Vs Percentage of Residual Turbidity

3.3 Turbidity Removal By Varying Mixing Time With Constant Dosage

The turbidity removal of the coagulant was also observed by varying mixing time, and the results obtained were as shown in Figure 6. In this case, the pH and the coagulant dosage were kept constant at 8 and 150 mg/L, respectively. From the figure, the turbidity removal was observed to increase as the mixing time was increasing up.

Table 3: Turbidity Removal By Varying Mixing Time With Constant Dosage

Sl.No	Time (min)	Turbidity Removal in (%)
1	10	90.2
2	15	91.16
3	20	92.33
4	25	94.83
5	30	95.55

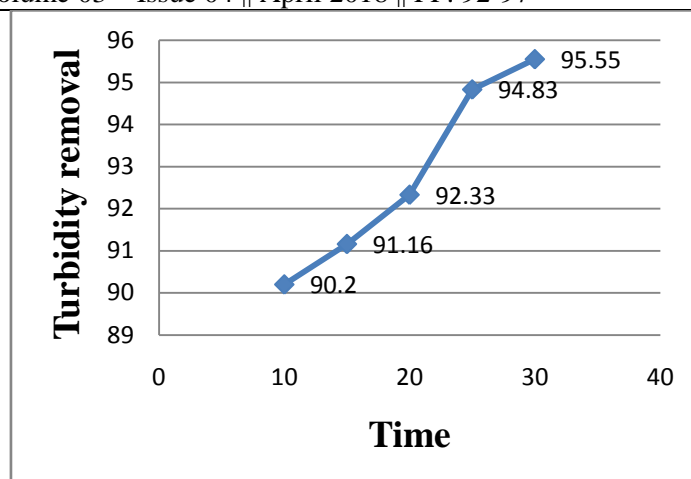


Figure 6: Graph Of Turbidity Removal By Varying Mixing Time With Constant Dosage

Jar test is conducted with optimum dosage of 150mg/l at pH of 8, characteristics of waste water as shown in table 4.

Table 4: Characteristics of Waste Water After Treatment

Sl. No	Parameter	Initial Characteristics	Characteristics After Treatment
1	Turbidity (NTU)	18	0.84
2	pH	9.5	8
3	Hardness (as CaCO ₃ in mg/l)	9	7.5
4	Chlorides (as Cl in mg/l)	75	53
5	Sulphate(mg/l)	24	16
6	Alkalinity(mg/l)	183	141
7	Biological oxygen demand (mg/l)	25	20
8	Dissolved oxygen (mg/l)	8	12
9	Dissolved solids(mg/l)	155	145

From the table it is observed that all the parameters reduced from the initial value after treated with tamarindus indica seed as natural coagulant.

4. Conclusions

It was concluded that, turbidity removal efficiency was found to be 95.33% at 150mg/l of optimum coagulant dosage. At optimum pH of 8, the turbidity removal efficiency was obtained as 95.44%. so it was suggested that, we can use locally available natural coagulant (tamarind seed powder) to treat river water which is cost effective and environment friendly.

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