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Utilisation Of Natural Coagulant For Reduction Of Turbidity From Waste water

T.Phani Madhavi[1]*, R. RajKumar[2]

[1]Department of Civil Engineering, Sathyabama University, Chennai-600119, Tamilnadu, India
[2]Department of Civil Engineering, Sathyabama University, Chennai, India

***Corres.Author : talasilamadhavi@gmail.com**
Telephone Number : +91-8939139453

Abstract: Water is undoubtedly the most vital parameter among the natural resources. Turbidity imparts a enormous problem in waste water treatment. In this present study, 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 wastewater. 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 wastewater. It was found that natural coagulant worked better with turbid water. Highest turbidity reduction efficiency of about 78% was noticed. Influence of the pH on the system found to be significant on turbidity removal. The study clearly indicates that at optimum pH system conditions, there is significant reduction in coagulant dose required and in some cases a further increase in turbidity removal. Therefore in practical situations a judicious selection of system pH would result in either reduced coagulant dose requirements or an increased turbidity removal or even both. Utilisation of locally available natural coagulant was found to be suitable, easier, cost effective and environment friendly for water treatment .
Keywords: Coagulation, Turbidity, Natural Coagulant, Tamarind seed, Wastewater.

Introduction[1-2]

In modern societies proper management of wastewater is a necessity, not an option. Historically, the practice of collecting and treating wastewater prior to disposal is a relatively recent undertaking. The treatment of wastewater lagged considerably behind its collection. Treatment was considered necessary only after the self – purification capacity of the receiving waters was exceeded and nuisance condition become intolerable. The purpose of wastewater treatment is to remove the contaminants from water so that the treated water can meet the acceptable quality standards. The quality standards usually depend upon whether water will be reused or discharged into a receiving stream. Wastewaters contain particles with a wide variety of shapes, sizes, densities, etc, which influence their behavior in water and, therefore, their capacity to be removed. The extent and type of treatment required , however, depends upon the character and quality of both sewage and source of disposal. A

small community at the seaside might discharge its unaltered sewage directly into the ocean without any ill effects, but if this city were located inland on a small stream, a high degree of treatment might be needed.

Turbidity in wastewater is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms. A turbid water has muddy or cloudy appearance and it is aesthetically unattractive. The turbidity increases as sewage becomes stronger.

The history of the use of natural coagulant for the removal of turbidity is long. Natural organic polymers have been used for more than 2000 years in India, Africa, and China as effective coagulants and coagulant aids at high water turbidities. They may be manufactured from plant seeds, leaves, and roots [2]. Natural coagulants have bright future and are concerned by many researchers because of their abundant source, low price, environment friendly, multifunction, and biodegradable nature in water purification.

The aims of the present study were
(i)to reduce the level of turbidity from water using locally available natural coagulant
(ii)to make the treatment process easier and environmental friendly for household applications.
The object of coagulation is to alter these particles in such a way as to allow them to adhere to each other. Most colloids of interest in water treatment remain suspended in solution because they have a net negative surface charge that causes the particles to repel each other. The intended action of the coagulant is to neutralize that charge, allowing the particles to come together to form larger particles that can be more easily removed from the raw water.

Materials And Methods[1,2]

To investigate the effectiveness of turbidity removal from waste water by using tamarind seed powder as natural coagulant, the following materials and methods were used in the present study.

Materials

Glassware

All glassware used in the present study was Pyrex quality manufactured by Borosil works limited, Bombay and marketed under the brand name 'corning'. The glass ware cleaned with nitric acid and rinsed with water before use. They were further acid washed and rinsed with water after use and stored for subsequent use in further experiments.

Water

Water used in all experiments was laboratory distilled water, redistilled using a glass distillation still. Average specific conductivity of this water is $2.9x10^{-6}$mhos/cm. Tap water is also used in experimental work to clean the apparatus. An Average analysis of tap water is shown in the Table 1.

Table 1: Analysis of tap water

Sl. No	Parameter	Average value
1	pH	7.5
2	Total dissolved solids	700
3	Total hardness (as $CaCO_3$)	330
4	Total alkalinity (as $CaCO_3$)	180
5	Specific conductivity (mhos/cm)	$610x10^{-6}$
6	Chlorides (as Cl^-)	80
7	Sulfates (as SO_4^{-2})	60
8	Calcium (as $CaCO_3$)	50

NOTE: All values except pH and specific conductivity are in mg/l.

Instruments

Instruments used for present work are, turbidity was measured using turbidity meter . pH was measured using pH meter (Systronic, model 324), μpH system 361 from systronics industries, electronic Balance (Mettler, AJ 1000, Accuracy 0.1 mg), hot air oven (Tempo-T1-130FAD), Desiccators (Borosil ,model 3078) .

Chemicals

Sulphuric acid (0.1N) and Sodium hydroxide (0.1 N) were used for adjusting the pH values of effluent to assess the effect of pH on turbidity removal.

Experimental Methodology

Jar Test Apparatus

All coagulation experiments were carried out by using a conventional jar test apparatus.

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.

Procedure Of Coagulation Process

Take 1 liter of sample in each of the 6 beakers. Add varying doses of natural coagulant i.e. from 10 mg/l to 500 mg/l to different beakers simultaneously.

Switch on the motor and adjust the speed of paddles to about 100rpm, and thus rapid mixing is done for 1-2 minutes.

Reduce the speed of paddles to about 30 to 40 rpm and continue slow mixing for 20 minutes. This corresponds to process of flocculation.

Switch off the motors and allow it to settle for 20-60minutes . This corresponds to sedimentation or settling of impurities. Collect the supernant from each beaker with the help of pipette, without disturbing the sediment and measure the percentage of turbidity removal using Turbidity meter.

Turbidity removal corresponding to various doses of natural coagulant ranging from 10 to 500 mg/l were measured and the least dose producing maximum removal was designated as optimum coagulant dose.

Optimum system pH was found by adding 75% of the optimum coagulant dose and the pH of the sample was varied from 2.0 to 12.0 and the pH value producing maximum turbidity removal (optimum pH) was determined.

Reduction in coagulant dose requirement at optimum system pH condition was determined by adding varying doses to the sample maintained at optimum system pH level and corresponding removal were determined and the least dose producing maximum removal was obtained.

To evaluate the turbidity removal, sample concentrations were measured before and after the experiment by using Turbidity meter and the procedure is repeated as above.

Table 2 : Analyzed results of sample from Perungudi

Sl. No	PARAMETER	VALUE
1	pH	9
2	TSS	1500 (mg/l)
3	TDS	1000 (mg/l)
4	HARDNESS	600 (mg/l)
5	ACIDITY	30 (mg/l)
6	ALKALINITY	364 (mg/l)
7	COD	350
8	BOD	100
9	CHLORIDES	500 (mg/l)
10	SULPHIDES	250 (mg/l)
11	TURBIDITY	148 (NTU)

Results And Discussion

Analyzed Results Of Samples

Analysis is done for the taken sample at Perungudi and the results are shown in Table 2. The analysis of the waste water sample was done by APHA (1995) standards methods for the examination of water and waste water, 19th edition[1].

The objective of the present study is to remove the turbidity from the waste water originating from perungudi area in Chennai . In this context, to treat the waste water natural coagulant was used. Tamarind seed powder is selected as natural coagulant .

It may be observed from Table 3 that, at a residual turbidity of 7NTU 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 3 Turbidity of sample using tamarind seed powder

Sl. No	Volume of sample in ml	Coagulant dose in mg/l	Residual turbidity(NTU)
1	1000	50	60
2	1000	100	29
3	1000	150	7
4	1000	200	26.3
5	1000	250	29.2
6	1000	sample	148

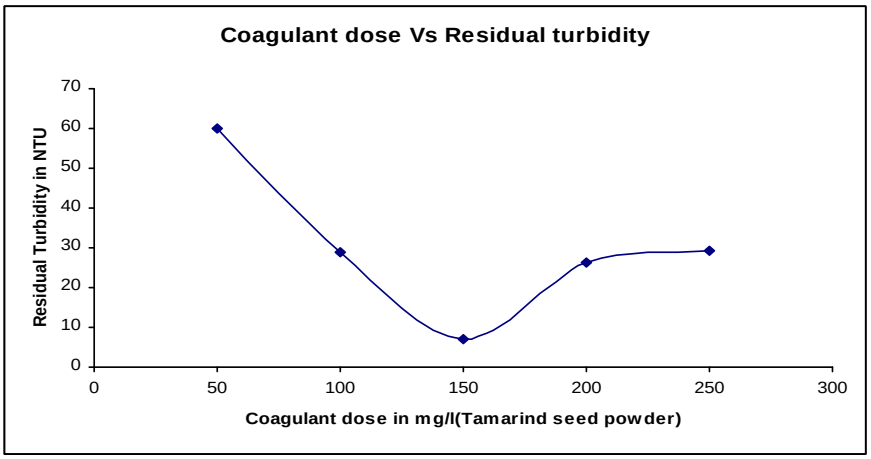

Figure 1 : Coagulant dose Vs Residual turbidity (Tamarind seed powder)

The optimum pH was determined at a pH of 8.0 and the turbidity removal was 78% as shown in Table 4 . 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 to 12 as shown in Figure 2.

Table 4 : Percentage turbidity removal with optimum dosage 150mg/l (Tamarind seed powder)

Sl. No	pH	Turbidity removed in %
1	2	20
2	4	45
3	6	47
4	8	78
5	10	70
6	12	65

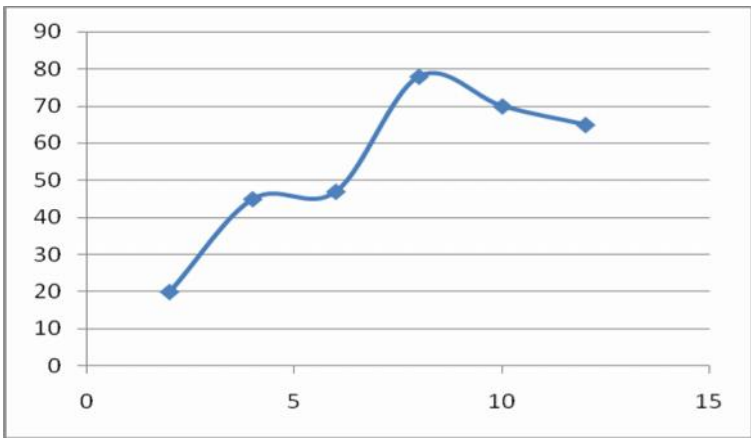

Figure 2. pH Vs % of turbidity removal(pH on X-axis Vs %of turbidity removal on y-axis)

Conclusion

The present study clears that, turbidity was removed effectively at a optimum dose of 150mg/l with a optimum pH of 8.0 as shown in table 5.

Table 5 : Final results of analyzed waste water

Location of Sample	Tamarind Seed Powder(Natural Coagulant)		
	Optimum dose of coagulant, mg/l	Optimum pH	Maximum removal of turbidity
PERUNGUDI,(Chennai)	150	8.0	78%

It was concluded that the maximum removal of turbidity for the sample was achieved as 78%. So, it was suggested that, we can use locally available natural coagulant(tamarind seed powder) to treat the low turbid wastewater which is cost effective and environment friendly.

References

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