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EFFICIENCY OF TAMARIND AND PAPAYA SEED POWDER AS NATURAL COAGULANTS

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Abstract - *The ever increasing urbanization and rapid industrialization leads to considerable increase in the rate of water pollution. Coagulation flocculation using chemical coagulants such as aluminium sulphate, ferric chloride, polyaluminium chlorides are adopted for treatment process. But due to the high cost of chemical coagulants, this can be replaced by natural coagulants as a safe and economically viable alternative for treatment of waste water. In the present study an attempt has been made to evaluate the comparative effectiveness of natural coagulants such as tamarindus indica seed powder and carica papaya seed powder for the treatment of kitchen waste water. Various conditions such as adsorbent dose, stirring time and settling time is varied and its optimum values are obtained. Physicochemical parameters such as pH, turbidity, conductivity, TSS, BOD, COD were analyzed before and after treatment. Results show reduction in turbidity, conductivity, TSS, BOD and COD by using natural coagulants.*

Key Words: **Kitchen waste water, Natural coagulants, Tamarindus indica, Carica papaya, TSS, BOD, COD.**

1. INTRODUCTION

Water is used for a variety of purpose like drinking, washing, bathing, recreation as well as numerous other varied industrial applications. Water covers 71% of earth surface, on earth,96.5% of planet's water is found in ocean,1.7% in ground water, 1.7% in glaciers and icecap in Antarctica and Greenland, a small fraction in various other water bodies, 2.5% of earth water is fresh water and 98.8% of that water is in ice and ground water, less than 0.3% of all fresh water is in river, lakes and the atmosphere, and an even small amount of earth's fresh water contained within biological bodies and manufactured products [1].

Much of the pollution is due to anthropogenic activities like discharge of sewage, effluents and wastes from industrial and domestic sectors, pesticides and fertilizer effluents from agricultural areas, particulate matters and wastes from mining and metallurgical sectors. The final effect of this activities leads to water degradation both in quality and quality [2].

Coagulation flocculation process is one of the efficient methods involved in the treatment of waste water. Coagulation using chemical coagulants is costly process and may also leads to various health problems. Hence coagulation flocculation using natural coagulants such as tamarind and papaya seed powder can be used for treatment of waste water.

1.1 OBJECTIVE

- To study the performance of tamarind seeds as natural coagulant
- To study the performance of papaya seeds as natural coagulant

2. METHODOLOGY

2.1 Sample Collection

In this project kitchen waste water is used to analyze the efficiency of natural coagulants. Kitchen waste water was collected from canteen outlet of KMCT College of Engineering for Women.

2.2 Coagulant Preparation

2.2.1 Preparation of Carica Papaya Seed Powder

Carica papaya seeds were collected from the market and nearby locations. The fruits were sliced open using a clean knife, seeds were taken and washed severally with water. Then the seeds were dried under sunlight for a period of 7 days before crushing. The seed were made into fine powder using home grinder and sieved through a sieve of 600 micron and powder was collected in sterile bottle with air tight cap then used as coagulant.

Fig -1: Carica papaya seed powder

2.2.1 Preparation of Tamarindus Indica Seed Powder

The Tamarindus Indica seeds were collected washed with water to remove dust and pulp and the clean seeds were dried in the sunlight for a period of 7 days before crushing. The seed were made into fine powder and sieved through a sieve of 600 micron and powder was collected in sterile bottle with air tight cap then used as coagulant.

Fig -2: Tamarind seed powder

2.3 Treatment Technique

2.3.1 Coagulation flocculation by jar test

In this work, two separate experiments are performed: first, Tamarind seed powder as coagulant, second, Papaya seed powder as coagulant. The jar test apparatus was used to carry out coagulation and flocculation and study the effect of coagulant dosage on coagulation and the effect of stirring time and settling time on coagulation. Various parameters such as turbidity, conductivity, TSS, pH, BOD and COD were measured before and after the coagulation.

Five different weights of the coagulant were placed in each beaker, the first having 0.2g, and the remaining five varying from 0.2-1g at 0.2g interval in order to determine the optimum dosage. The waste water sample was then added to make up the 1000ml mark and the jars were then placed in the jar test apparatus and the stirrers lowered into each. The stirring speed was set at 100rpm for rapid mixing for 1 minute and 40rpm for slow mixing for 10 minutes. After this was completed the samples were allowed to settle for 30 minutes and then the supernatant was taken for analysis. From the results obtained the dosage with the best results in turbidity removal was taken as the optimum.

The procedure above was used again; however optimum dose was maintained in all five beakers, the optimum stirring time was determined. The stirring time was varied at 5mins, 10mins, 15mins, 20mins and 25mins for each beaker. After the coagulation process was completed, the samples were then analyzed for the various tests. Repeat the same for determination of optimum settling time. The optimum dosage and stirring time was maintained in all five beakers. The settling time was varied at 10min, 20min, 30min, 40min and 50 min for each beaker. The supernatant were taken for analysis of various parameters. The above procedure is done by using both tamarind seed powder and papaya seed powder. Comparative study of efficiency of both seeds to treat waste water is also studied.

3. RESULTS AND DISCUSSIONS

This section deals with the various test results and its discussion of coagulation- flocculation in waste water treatment using natural coagulants.

Table -1: Characteristics of waste water before treatment

Parameters	Before treatment	
	Tamarind	Papaya
pH	6.91	6.94
Turbidity (NTU)	208	206
Conductivity (µs/cm)	1295	1232
TSS (mg/l)	40	40
BOD (mg/l)	1140	1260
COD (mg/l)	3420	4320

3.1 Effect of Coagulant Dosage

Table -2: Effect of dosage for waste water treatment

Parameter	Coagulant	After treatment				
		0.2g	0.4g	0.6g	0.8g	1g
pH	Tamarind Seed	6.41	6.43	6.39	6.48	6.40
Turbidity (NTU)		85	50	39	74	79
Conductivity (µs/cm)		589	526	386	541	550
TSS (mg/l)		14	12	11	13	13
BOD (mg/l)		502	480	400	450	465
COD (mg/l)		1580	1378	1150	1164	1214
pH	Papaya Seed	6.62	6.57	6.63	6.60	6.69
Turbidity (NTU)		87	59	80	88	88
Conductivity (µs/cm)		739	561	662	748	754
TSS (mg/l)		21	16	18	18	20
BOD (mg/l)		682	560	720	734	770
COD (mg/l)		2282	2160	2188	2380	2398

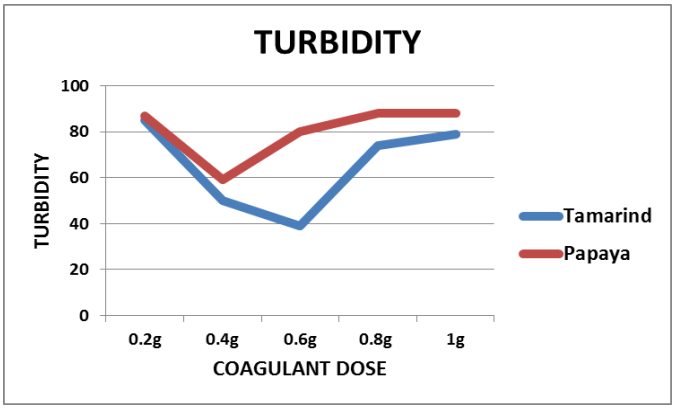

Chart -1: Variation of turbidity with varying dose

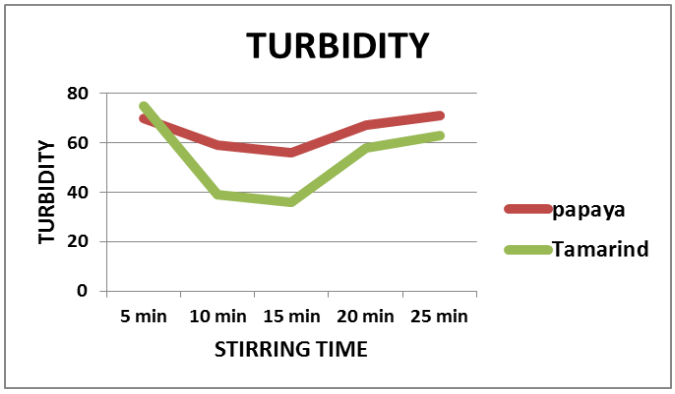

Chart -2: Variation of turbidity with varying stirring time

Effect of coagulant dosage on coagulation was studied by varying dosage from 0.2g to 1 g at 0.2g interval and by keeping stirring time and settling time constant. As per the results it can be seen that by using tamarind seed powder as coagulant, various parameters shows maximum removal efficiency at an optimum dosage of 0.6g and by using papaya seed powder as coagulant, various parameters shows maximum removal efficiency at an optimum dosage of 0.4g.

3.2 Effect of stirring time

Table -3: Effect of stirring time on coagulation

Parameter	Coagulant	After treatment				
		5min	10 min	15 min	20 min	25 min
pH	Tamarind Seed	6.56	6.40	6.36	6.48	6.48
Turbidity (NTU)		75	39	36	58	63
Conductivity (µs/cm)		429	386	356	374	481
TSS (mg/l)		10	10	8	12	13
BOD (mg/l)		586	410	390	528	550
COD (mg/l)		1280	1156	1100	1180	1220
pH	Papaya Seed	6.69	6.58	6.51	6.60	6.68
Turbidity (NTU)		70	59	56	67	71
Conductivity (µs/cm)		752	562	491	666	676
TSS (mg/l)		18	15	14	15	16
BOD (mg/l)		590	564	550	588	610
COD (mg/l)		2230	2158	2100	2136	2218

Effect of stirring time on coagulation was studied by varying stirring time from 5 min to 25 min at 5 min interval and by keeping optimum dosage and constant settling time in all five beakers. For tamarind seed optimum dose is 0.6g and for papaya seed it is 0.4g. Results reveal that maximum removal efficiency of all parameters is obtained at optimum stirring time of 15 min for both of the seeds.

3.3 Effect of settling time

Table -4: Effect of settling time on coagulation

Parameter	Coagulant	After treatment				
		10 min	20 min	30 min	40 min	50 min
pH	Tamarind Seed	6.50	6.44	6.38	6.42	6.47
Turbidity (NTU)		88	73	34	41	64
Conductivity (µs/cm)		681	438	359	555	556
TSS (mg/l)		12	11	8	10	11
BOD (mg/l)		530	442	300	410	480
COD (mg/l)		1322	1202	1110	1168	1230
pH	Papaya Seed	6.58	6.55	6.52	6.49	6.60
Turbidity (NTU)		68	59	58	48	59
Conductivity (µs/cm)		660	560	492	418	584
TSS (mg/l)		14	15	15	13	16
BOD (mg/l)		578	570	552	480	560
COD (mg/l)		2238	2094	2110	2080	2100

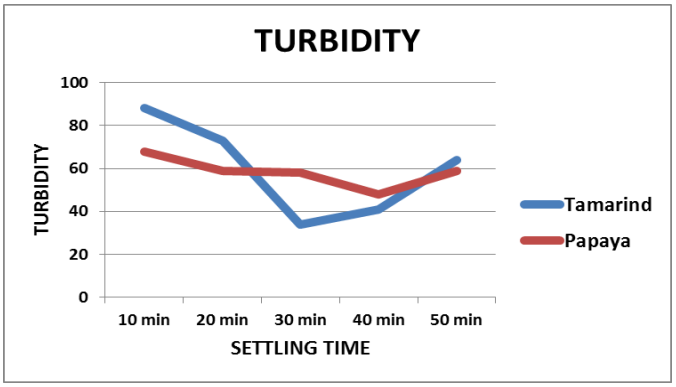

Chart -3: Variation of turbidity with varying settling time

Effect of settling time on coagulation was studied by varying settling time from 10 min to 50 min at 10 min interval and by keeping optimum dosage of and optimum stirring time in all five beakers. Optimum dose of tamarind seed is 0.6g and. for papaya seed it is 0.4g. Optimum stirring time is 15 min for both seeds. From results it can be seen that in case of tamarind seed various parameters shows maximum removal efficiency at optimum settling time of 30 min and in case of papaya seed various parameters shows maximum removal efficiency at optimum settling time of 40 min.

3.4 Comparison of coagulants by removal efficiency

Table -5: Removal efficiency with varying dose

Parameter	Coagulant	Removal Efficiency (%)				
		0.2g	0.4g	0.6g	0.8g	1g
Turbidity (NTU)	Tamarind Seed	59.1	75.9	81.2	64.4	62
Conductivity (µs/cm)		54.5	67.1	70.1	58.2	57.5
TSS (mg/l)		65	70	72.5	67.5	67.5
BOD (mg/l)		55.9	57.8	64.9	60	59.2
COD (mg/l)		53.8	59.7	66.3	65.9	64.4
Turbidity (NTU)	Papaya Seed	57.7	71.3	61.1	57.2	57.2
Conductivity (µs/cm)		40.0	54.4	46.2	39.2	38.7
TSS (mg/l)		47.5	60	5	55	50
BOD (mg/l)		45.8	55.5	42.8	41.7	38.8
COD (mg/l)		47.1	50	49.3	44.9	44.4

Table -6: Removal efficiency with varying stirring time

Parameter	Coagulant	Removal Efficiency (%)				
		5min	10 min	15 min	20 min	25 min
Turbidity (NTU)	Tamarind Seed	63.9	81.2	82.6	72.1	69.1
Conductivity (µs/cm)		66.8	70.1	75.5	71.1	62.8
TSS (mg/l)		75	75	80	70	67.5
BOD (mg/l)		48.5	64.0	65.7	53.6	51.7
COD (mg/l)		62.5	66.1	67.8	65.4	64.3
Turbidity (NTU)	Papaya Seed	66.0	71.3	72.8	67.4	65.5
Conductivity (µs/cm)		38.9	54.3	60.1	45.9	45.1
TSS (mg/l)		55	62.5	65	62.5	60
BOD (mg/l)		53.1	55.2	56.3	53.3	51.5
COD (mg/l)		48.3	50.0	51.3	50.5	48.6

Table -7: Removal efficiency with varying settling time

Parameter	Coagulant	Removal Efficiency (%)				
		10 min	20 min	30 min	40 min	50 min
Turbidity (NTU)	Tamarind Seed	57.6	64.9	83.6	80.2	69.2
Conductivity (µs/cm)		47.4	66.1	72.2	57.1	57.0
TSS (mg/l)		70	72.5	80	75	72.5
BOD (mg/l)		53.5	61.2	73.6	64.0	57.8
COD (mg/l)		61.3	64.8	67.5	65.8	64.0
Turbidity (NTU)	Papaya Seed	66.9	71.3	71.8	76.6	71.3
Conductivity (µs/cm)		46.4	54.5	60.0	66.0	52.5
TSS (mg/l)		65	62.5	62.5	67.5	60
BOD (mg/l)		54.1	54.7	56.1	61.9	55.5
COD (mg/l)		48.1	51.5	51.1	51.8	51.3

For kitchen waste water, tamarind seed powder is showing best results at an optimum dose of 0.6g, optimum stirring time of 15 min and optimum settling time of 30 min. Removal efficiency of turbidity, conductivity, TSS, BOD and COD are 83.6%, 72.2%, 80%, 73.6%, 67.5% respectively.

3. CONCLUSIONS

A study of waste water treatment by coagulation process was carried out using two natural coagulants such as tamarind seed powder and papaya seed powder. According to the results obtained, coagulation using natural coagulants is a promising technique for kitchen waste water treatment. From the present study, it can be concluded that tamarindus indica seed powder found to be more effective in reduction of various parameters of kitchen waste water.

Natural coagulants can also extent its performance to treat various other waste waters such as textile waste water, tannery waste water and also for treatment of surface water. The use of locally available natural coagulants was found to be cost effective, environmental friendly and safe method for waste water treatment.

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