Use of Herbal coagulants for treatment of dairy waste water

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***Abstract*: The dairy industry is generally considered to be the largest source of food processing. These industry wastewater is characterized by high COD, BOD, TDS, TSS, etc. Such wastewater is to be treated by using natural coagulants and then tests are to be carried to check the water characteristics like BOD, COD, TDS, pH and turbidity, etc. The initial pH, Turbidity, COD and BOD_5 are 7.42. 43 NTU, 1826 mg/l, 400 mg/l respectively. Natural coagulants to be used are Tamarind seed and Cicer arietinum. The efficiency of reduction of turbidity Tamarind seed and Cicer arietinum are 39.53 % and 30.23 % respectively. The efficiency of reduction of COD from Tamarind seed and Cicer arietinum are 81.81% and 63.63% respectively. For variation of doses of these natural coagulants the reduction of solids takes place. There is not much change in pH and conductivity due to natural coagulants. The efficiency of Tamarind seed powder is more compared to Cicer arietinum ; this depends on the protein content which is present in the natural coagulant.**

Keywords: Dairy waste water, Natural Coagulants, Tamarind seed, Cicer arietinum, turbidity, COD, BOD, TSS, TDS, TS

I. INTRODUCTION

Coagulation-flocculation followed by sedimentation by using a chemical coagulant is a very common treatment method used mainly in the waste water treatment practices. The popular chemical coagulant is alum. Use of high level of alum in water treatment is hazardous to human health. It may cause disease like Alzheimer. So, in this study an attempt has been made, about the use of natural coagulants in the water treatment instead of chemical coagulants. Use of natural coagulants in water treatment may help in reducing the health effect and cost of chemical coagulant. Natural coagulants used in this study are Cicer arietinum and Tamarind seed powder.

In conventional treatment a chemical coagulant like alum, Aluminum salts and ferric chloride are generally used. In rural area, the use of natural coagulant is quite popular. Natural coagulants have been used more than 1000 years in India, Africa and China. These coagulants are derived from seeds, leaves and roots of plants and trees. So natural coagulant has potential in water treatment because of their low cost, easily available, multifunctional, biodegradable and ecofriendly characteristics.

The dairy industry is one of the biggest food processing waste water industries in India. These dairies collect milk from the produces and then either simply bottles it for marketing, or produce different milk foods according to their capacities. Large quantity of wastewater originates due to their different operations. A dairy needs large volumes of water for various purposes and the wastewater discharge from a diary is also equally large in volume with highly variable pollution characteristics. Wastewaters from dairy plants consist of washings from cans, dairy equipments, floors, etc. and therefore contain high organic solid concentrations particularly milk suspensions.

As such, the dairy wastes, through biodegradable, are very strong in nature. The pH of the dairy wastewaters can vary significantly depends on the cleaning strategy employed. Dairy wastewaters are characterized by high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) concentrations.

In this investigative study were undertaken to explore the feasibility of physio-chemical processes, particularly coagulation with herbal coagulant- Cicer arietinum and Tamarind seed powder for dairy waste water treatment. Dairy wastewater from one of co-operative dairy plant, situated in Kopargaon was collected and used during experimental work and investigative studies to explore the possibility of application of coagulation-sedimentation with Cicer arietinum and Tamarind seed power as a coagulant for treatment of dairy wastewater to improve its characteristics and make it suitable for further treatment and disposal in the environment. This paper is the report on investigative studies and its findings.

A. Problem Statement:

1. The impact of dairy wastewater discharge on economically important natural resources and ecosystem.
2. The risk to health posed by inadequate handling and disposal of sewage of dairy waste water.
3. Dairy waste generated is causing serious pollution of surface and ground waters
4. Dairy waste water contains high concentration of Turbidity, COD, BOD, TS, TSS, TDS, EC etc.

B. **Objectives of the study:**

The aim of this study is the use of natural coagulant and their benefits in comprises to chemical coagulant. The objectives of this study are as follows.

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1. To study the effect of natural coagulants on removal of COD, BOD, TDS, TSS, TS, pH, and Turbidity.

2. To find the optimum coagulant dosage of coagulant.
3. To study the coagulation efficiency of natural coagulants in dairy waste water effluents.

II. MATERIALS AND METHODS:

A. Collection of dairy effluent:

The dairy waste water sample was collected from a Sanjivani dairy, Kopargaon. This dairy is located near the SRES campus. The water of this dairy is very much polluted. The main reason for its pollution is that, it is utilized as a disposal point of all waste water generated by the dairy processing. Due to these reasons, the dairy is selected for this study. The satellite image of the dairy is shown in figure: 1

The sample was collected on a daily basis. Daily 20 liter sample was collected for the testing dairy waste water for the testing and used 20 liter drum for collection. The dairy waste water sample is shown in figure: 2

Fig. 1 Satellite view of source of sample.

Fig. 2 Raw water sample

*B. **Materials:***

a) Natural coagulant preparation:

The natural coagulants selected for this study were prepared before the experimental work. Manual extraction of seeds from the pods, cleaning, sun drying, and sieved were carried out in this study.

1. Cicer arietinum:

Cicer arietinum seeds were removed from the hulls and then seeds were grounded to fine powder and sieved to particle size of 600µ (m). 10g of Cicer arietinum powder is then dissolved in 1L of distilled water. This suspension of Cicer arietinum was stirred on magnetic stirrer for 10 minutes. The suspension was filtered through whats man filter paper. The filtrate is stored in are refrigerator at 5^0C.

Cicer arietinum stock solution: For making 2% suspension solution of Cicer arietinum, 2gm of C.arietinumwas added into 100ml of distilled water. After this the solution was shaken for 30 min with the help of magnetic stirrer. The Cicer arietinum stock solution has a problem of ageing effect with time, so every time before experiment, preparation of 'fresh solution' and 'shakes well' before experimental use is necessary. Figure 3 shows pods and powdered form of seeds used in the experimental work.

Fig. 3 Pods and Powder form of C.arietinum

2. Tamarind seed:

Tamarind seed is first dried for 15 days. Then grinded and sieved to obtain a very fine powder, then then grinded tamarind seed was passed through 600µm sieve, because this size is suitable for solubaliztion of the ingredient of seeds.

Tamarind seed stock solution: For making 2% suspension solution of *Tamarind seed*, 2gm of *Tamarind seed* was added to 100 ml of distilled water. After this the solution was shaken for 30 min with the help of stirrer. The Tamarind seed stock solution has a problem of ageing effect with time, so every time before experiment, preparation of 'fresh solution' and 'shakes well' before experimental use is necessary. Figure 4 shows pods and powdered form of seeds used in the experimental work

Fig. 4 Pods and Powder form of Tamarind seed

C. ***Methods:***

a) Experimental set up:

In this study different methodology were adopted. Natural coagulant was prepared and used for jar test experiment, and then parameters of dairy waste were analyzed in the laboratory.

1. Jar Test:

Jar test is carried out for finding the optimum dose of coagulants. It helps for determine the required dose of coagulant for maximum removal of turbidity. In this test first all the jars were washed with tap water, then all jars were placed in the jar apparatus. Six Beaker of 1 liter capacity was used for the jar test. Predetermined doses of chemical and natural coagulants were used for the test. Switch on the motor initial 2 minutes with 100-120 rpm and after 2 minutes the rpm reduces to 20-30 rpm for 20 minutes, for first 2 minutes it was coagulation process that is fast mixing process that neutralizes the charge on impurity and next 20 minutes was for flocculation, this time period was for formation of floc.

After this process allow for final settlement of impurity for 20- 60 minutes. This same procedure was followed for the all other natural coagulant. The figure of the jar test is shown in figure: 5

Fig. 5 Jar Test Apparatus

D. ***Characteristics of Sanjivani dairy waste water:***

It is observed that wastewater generated from 9 to 11 am has high values of characteristics parameters because of washing of floors, cans and equipments. Twenty liters sample was collected just before the screens, and analyzed for various parameters following the procedure given in Standard Method (AWWA, APHA, 1987).
Characteristics of Dairy waste water are shown in the table: 1.

Table:1 Characteristics of Dairy Wastewater water

Sr. No.	PARAMETERS	VALUE	UNITS
1	Color	White	Hazen
2	Turbidity	43	NTU
3	pH	7.42	NIL
4	BOD_5	400	ppm
5	COD	1826	ppm
6	TDS	1220	ppm
7	TSS	2780	ppm
8	TS	3476	Ppm
9	EC	2.227	mS

III. RESULTS AND DISCUSSION:

In this study, we explained the effect of natural coagulant in coagulation process and their efficiency then it was compared with different water quality parameters and found that every natural coagulant has some specific efficiency and better results in terms of waste water parameter removal. After that the optimum dose of natural coagulants was determined and the variation in water quality parameters were determined through the analysis in an environmental laboratory at Sanjivani College of Engineering, Kopargaon, Maharashtra. The results were discussed and elaborated with the help of graphs. Initially the characteristics of Dairy waste water were determined for further comparison of treated water sample.

A. ***Results:***

When the coagulants such as Tamarind and Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in Turbidity of the coagulants obtained is as below:

Table: 2 Percentage change in Turbidity of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	13.95	32.55
3	4 ml	13.95	30.23
4	6 ml	23.95	37.20
5	8 ml	30.23	39.53
6	10 ml	27.90	37.20

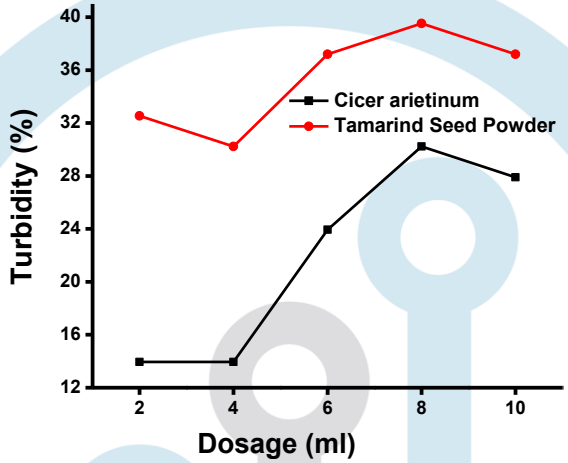

Fig. 6 Variation of the Turbidity for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in pH of the coagulants obtained is as below:

Table:3 Percentage change in pH of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	13.20	29.11
3	4 ml	15.22	29.64
4	6 ml	20.61	31.26
5	8 ml	19.40	32.61
6	10 ml	16.44	30.32

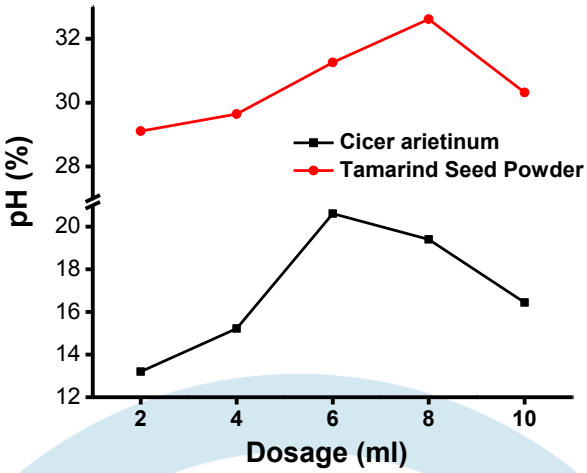

Fig. 7 Variation of the pH for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in COD of the coagulants obtained is as below:

Table: 4 Percentage change in COD of Dairy waste water when agitated with different coagulant

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	36.36	68.18
3	4 ml	45.46	65.63
4	6 ml	36.36	81.81
5	8 ml	63.63	67.27
6	10 ml	50.90	73.09

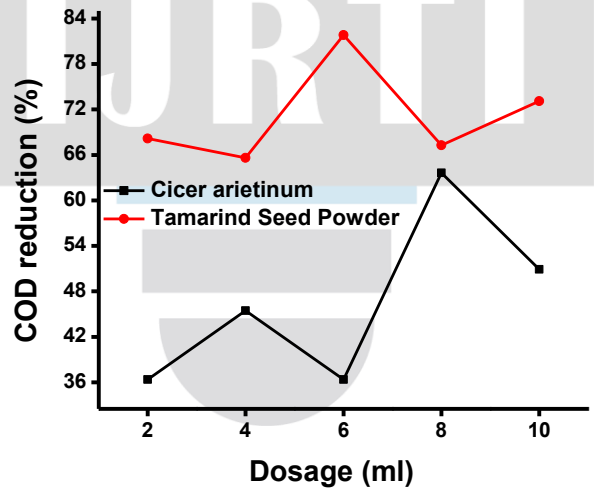

Fig. 8 Variation of the COD for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in BOD_5 of the coagulants obtained is as below:

Table: 5 Percentage change in BOD_5 of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	25	37.5
3	4 ml	37.5	37.5
4	6 ml	50	62.5
5	8 ml	50	56
6	10 ml	37.5	37.5

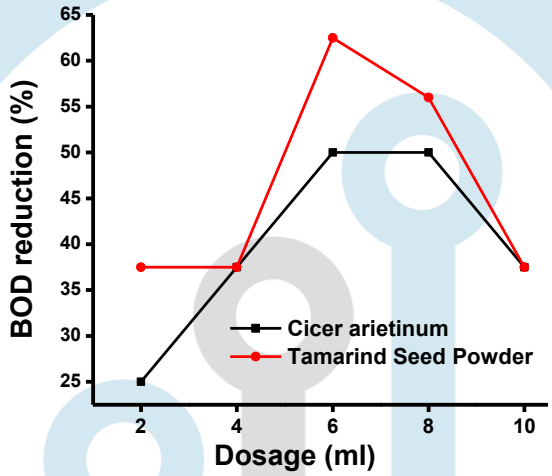

Fig. 9 Variation of the BOD_5 for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in TDS of the coagulants obtained is as below:

Table: 6 Percentage change in TDS of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	16.97	34.09
3	4 ml	24.27	50.81
4	6 ml	25.76	58.69
5	8 ml	25.68	52.45
6	10 ml	25.54	53.28

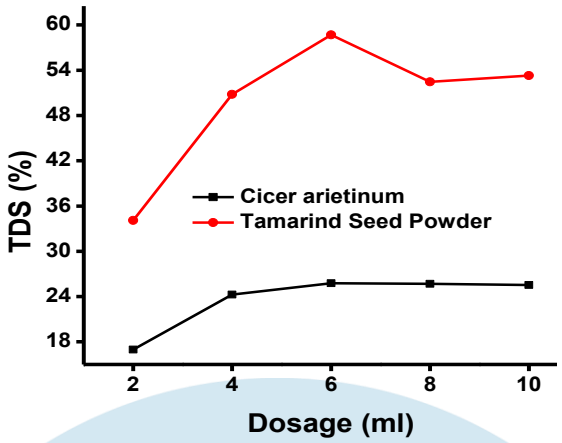

Fig. 10 Variation of the TDS for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in TSS of the coagulants obtained is as below:

Table: 7 Percentage change in TSS of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	16.97	34.09
3	4 ml	24.27	50.81
4	6 ml	25.76	58.69
5	8 ml	25.68	52.45
6	10 ml	25.54	53.28

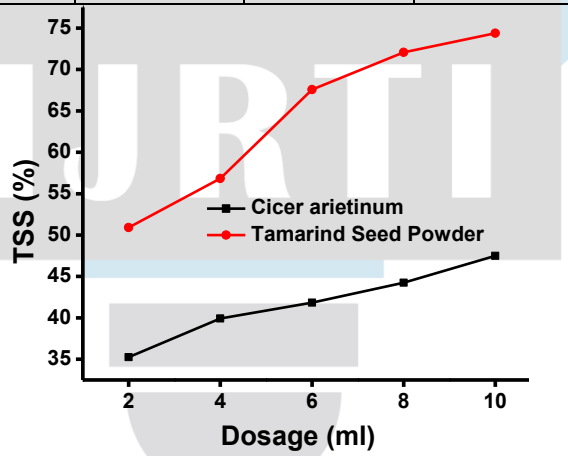

Fig. 11 Variation of the TSS for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in TS of the coagulants obtained is as below:

Table: 8 Percentage change in TS of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	28.07	42.43
3	4 ml	27.96	48.79
4	6 ml	30.70	56.81
5	8 ml	39.39	59.47
6	10 ml	41.94	64.21

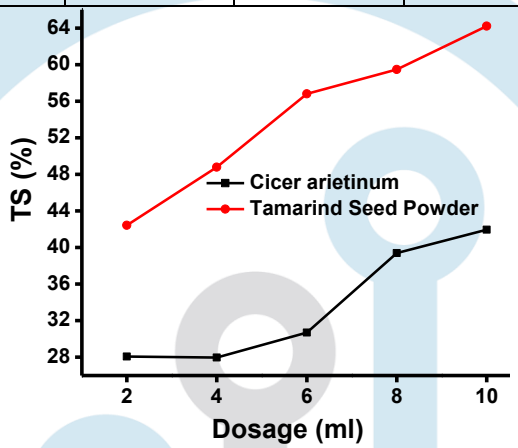

Fig. 12 Variation of the TS for different dosage of Cicer arientinum and Tamarind seed powder

When the coagulants such as Tamarind seed powder, Cicer arietinum seed powder were agitated with the effluent of Dairy industry at 100 rpm, the percentage change in EC of the coagulants obtained is as below:

Table: 9 Percentage change in EC of Dairy waste water when agitated with different coagulants

Sr. No.	Dosage	% Removal	
		Cicer arietinum	Tamarind Seed Powder
1	0ml	00	00
2	2 ml	12.39	24.11
3	4 ml	20.07	40.12
4	6 ml	22.28	37.13
5	8 ml	21.86	36.20
6	10 ml	22.13	37.13

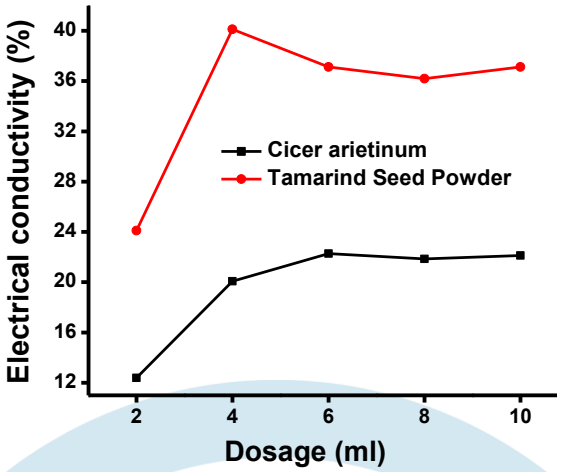

Fig. 13 Variation of the EC for different dosage of Cicer arientinum and Tamarind seed powder

IV CONCLUSION

By conduction of jar test for the natural coagulants such as Cicer arietinum and Tamarind seeds powder, it is clearly seen that tamarind seeds is a better coagulant in removing the characteristics of dairy waste water.

Based on the readings obtained during the practical and the observation tables prepared on its basis, it can be concluded that with the increase in the dosage the BOD, COD, TDS, TSS, reduction increases and the maximum reduction of BOD, COD, TDS, TSS is obtained at a dosage value of 8gm/500ml for natural coagulants and 6ml/500ml for chemical coagulants for dairy industry. With the further increase in dosage, BOD, COD, TDS, TSS reduction decreases which can be easily visualized from the graph also.

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