

ASSESSMENT AND OPTIMIZATION OF THE USE OF A PLANT BASED BIO-FLOCCULANTS FOR DAIRY EFFLUENT

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Abstract- Generally, a huge amount of wastewater is generated from dairy industry. By treating dairy effluent at the end, sludge is produced which can be used as manure for agriculture purpose. Formation of sludge in effluent of dairy industry is mainly formed due to coagulation-flocculation process, they generally use chemical-coagulants in this process, which produces more sludge and are toxic in nature. When these toxic sludges are used in agriculture it may deplete the quality of crops. Hence to overcome these problems a plant-based bio-flocculants can be derived and used as an alternate for artificial-coagulants. Which are economical, non-toxic and biodegradable in nature. We have been selected tamarind seed and aloe vera as natural plant-based coagulants for treating of dairy effluent. Physio-chemical parameters of dairy effluent were carried out and later treated with these bio-flocculants. Mainly, optimum dosages of tamarind seed powder and aloe vera leaf powder were obtained by jar test. Optimum dosage of tamarind seed powder is 120 mg/l and aloe vera leaf powder are 100 mg/l. Tamarind seed powder showed more efficiency in treating BOD about 88.64% when compared to aloe vera leaf powder which is of 87.44%. Aloe vera leaf powder has showed great efficiency in treating COD and turbidity attained 88.44% and 87% respectively, compared to tamarind seed powder COD and turbidity is 86.89% and 63% of reduction respectively. For more effectiveness dosages aloe vera leaf powder can be increased in treating of dairy wastewater.

Key Words: Coagulation/flocculation process, Jar test, plant-based bio-flocculants, Tamarind seed, Aloe vera.

1. INTRODUCTION

India is a largest milk producing country in the world, which is about 22% of total world's production. Dairy industry is looking forward to increase its activities up to 9-11 percent in year 2021-2022. As per 2022, India's production is 203.5 MMT. Per capita consumption of milk is 406 g/day as per 2019-2020. Around 80 million people of India depends upon dairy farming for their income.

Pollution caused by industry is a significant concern throughout the world. Among all the industrial activities the food sector plays a major role in the highest consumption of water and it is one of the substantial producers of effluent per unit of mass production (Ashish Tikariha and

Omprakash Sahu 2014). Dairy industry is the main example of this sector. Dairy industry is one of the considerable food production industries in India, out of all countries India ranks first maximum milk producing country. The characteristics of dairy industry wastewater involves Temperature, P^H, Color, BOD, COD, DO, Dissolved solids, Suspended solids, Sulphate, Chlorides, Oil and Grease. It depends mainly on the quantity of milk clarified and type of the mass of product produced (Bharati S. Shete and N. P. Shinkar 2013).

The coagulation/flocculation procedure are part of the water and wastewater treatment process (L Muruganandam et al.,2017). Main purpose of this process is to clear the water or dividing the suspended particles by wastewater. Coagulation is explained as destabilization method of colloidal matter using amalgamate for treatment of water and wastewater. Flocculation is a technique of ease for collection, and is accomplished by larger molecular weight amalgamation (Setyo Budi Kurnaiwan et al.,2021).

Bio-flocculants/bio-coagulants are considered more environment friendly and useful as a substitute to reduce the risk that takes place in environment. Using chemical-based flocculant/coagulant are not good for environment and not good for human health for consumption purpose (Nandagopan S et al.,2021). To maintain safety for human health and environment using bio-flocculant/bio-coagulant is important, and at the same time cost effective and are easily available (Nandagopan S et al.,2021).

1.1 Scope of present study

Bio-coagulants/flocculants are developed from seeds and vegetables this are used for the wastewater treatment purpose. Examples for plant-based bio-flocculants are as follows aloe vera (leaf), fruit peels, fenugreek (mucilage), guar gum, hibiscus, tamarind (seed), dates, oil nut gum, okra, jackfruit seed and drum stick etc., In this study tamarind seed and aloe vera has been used as a plant-based bio-flocculants.

1.2 Objectives

1. To collect and characterize the dairy industry waste water.

2. To use tamarind seed and aloe vera as a plant-based bio-flocculants, as an alternative to chemical coagulants.
3. Extraction and preparation of plant-based bio-flocculants.
4. To treat the collected sample by tamarind seed and aloe vera.
5. To find out the optimum dosage of plant-based bio-flocculants.
6. To examine the coagulation/flocculation efficiency of tamarind seed and aloe vera in treating of dairy effluent.
7. To discuss on the cost-effective and suitability of plant-based bio-flocculants in the treatment of dairy wastewater.

2. MATERIALS AND METHODOLOGY

2.1 Preparation of plant-based bio-flocculants

2.1.1 Tamarind seed

Tamarind seed is used as a bio-flocculant in this study. Around 1 kg of tamarind seed was purchased in local market of davanagere city. Tamarind seeds were washed properly in tap water to remove dirt and sun dried for 2-3 days to remove moisture content present in it. And then sun-dried seeds were finely grinded to make powder and sieved against 4.75mm sieve and then tamarind powder is stored in air tight container. Dilution of tamarind seed powder was made by using 0.1g of tamarind seed powder in 100ml of distilled water. Likewise, further different dilutions were made from tamarind seed powder to use as a bio-flocculant in the present work (Shivam B. Magar and M.V Jadhav 2018).



Fig 1: Tamarind seed powder preparation

2.1.2 Aloe vera

Aloe vera leaves are used as a plant-based bio-flocculants in this study. Aloe vera leaves was collected from some area in

Davanagere city. The aloe vera leaves were washed properly in tap water to remove dirt. And whole leaves were cut in to small pieces without removing any part of it. And then kept in hot air oven in 105°C for 24hrs. And then finely grinded to make aloe vera powder and sieved against 4.75mm sieve, then aloe vera powder was stored in air tight container. Dilution was done with 0.1g of aloe vera powder in 100ml of distilled water (Akhila Jinna et al.,2019). Further the different dilutions were made from aloe vera powder as per requirement of project work.



Fig 2: Aloe vera leaf powder preparation

2.2 Sample collection and analysis

In this the sample taken is dairy wastewater is collected. Grab sampling is involved for the collection of the sample. The sample is collected from equalizer tank where all process of dairy wastewater is stored in that tank. 20 litres of sample were taken, sample is taken at a particular space and time. Sampling tool depends upon the type of the sample. Here 20 litres are used for collection of samples. Safety measures depends upon the type of the sample. For hazardous waste safety measures must be taken for collection of wastewaters as per the guidelines. Here gloves and face mask were used to collect the sample (Amir Adul Azeez et al.,2020)

The initial parameters of the raw water sample have been carried out to determine the initial characteristics of wastewater and mentioned it as before treatment. The initial parameters like PH, turbidity, chlorides, calcium, TS, TDS, BOD and COD are studied.

Table 1: Initial parameters of raw sample

Parameters	Initial value
PH	5.67
Turbidity	831 NTU
Chlorides	254 mg/l
Calcium	182.4 mg/l
TS	4000 mg/l

TDS	3880 mg/l
BOD	2890.02 mg/l
COD	1,32,000 mg/l

Table 2: Characteristics of Dairy effluent after treatment

Sl.No.	Characteristics	Tamarind seed	Aloe vera
1	pH	6.07	6.10
2	Turbidity	308 NTU	109 NTU
3	Chlorides	242 mg/l	202 mg/l
4	Calcium	60.8 mg/l	102.4 mg/l
5	TS	2800 mg/l	2400 mg/l
6	TDS	2400 mg/l	2088 mg/l
7	BOD	328.07 mg/l	362.97 mg/l
8	COD	17300 mg/l	15250 mg/l

3. Results and Discussion

Coagulation/flocculation process is carried out in laboratory by jar test for both tamarind seed and aloe vera as natural coagulants in treating of dairy effluent. Turbidity test is done for every dosage. The optimum dosage of tamarind seed is 120 mg/l and aloe vera is 100 mg/l in treatment of dairy wastewater in this particular study. Optimum dosage is considered corresponding to the lowest residual turbidity. Further experiments were conducted using optimum dosage as coagulant dosage.

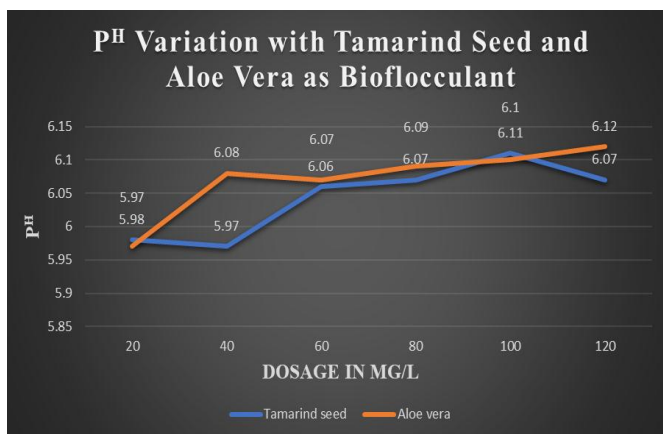


Chart-1: pH Variation

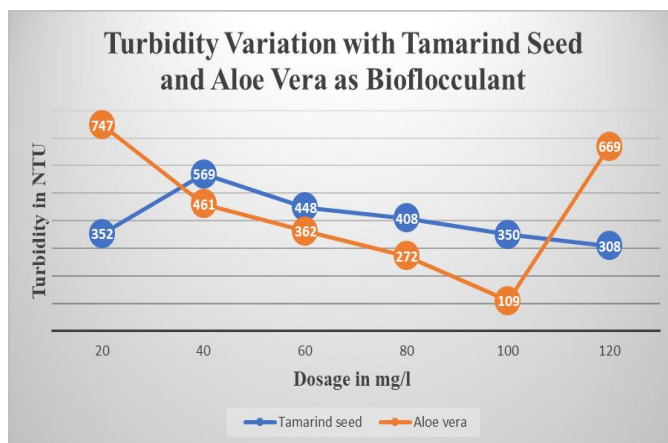


Chart-2: Turbidity Variation

In this present work, tamarind seed and aloe vera have been used as plant-derived bio-flocculants and their efficiency has been analyzed for treatment of dairy effluent. From above results we can conclude that optimum dosage of using tamarind seed powder was found to be 120 mg/l and aloe vera leaf powder is about 100 mg/l. From the examined results, the maximum percentage reduction efficiency, when compared between tamarind seed and aloe vera it was found that tamarind seed was more effective in treating dairy wastewater parameters like alkalinity, calcium and BOD and in aloe vera the most effective parameters were acidity, chlorides and COD.

4. CONCLUSION

In this study turbidity removal efficiency using tamarind seed powder is shown as 63% and while using aloe vera leaf powder is shown 87%. Hence, aloe vera is more efficient in removing turbidity compared to tamarind seed. In BOD removal efficiency the tamarind seed powder achieved 88.64% while aloe vera leaf powder achieved 87.44%. Hence tamarind seed is highly effective in removing BOD compared to aloe vera. In cod removal efficiency the tamarind seed powder obtained 86.89% and while aloe vera has obtained 88.44%. Hence aloe vera has great efficiency in removing BOD. Aloe vera can be used as an effective coagulant in dairy wastewater treatment mainly for COD and for turbidity removal.

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