

## Effects of Plant Based Coagulants in the Treatment of Dairy Wastewater

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**Abstract:** The aim of present work is to study the efficiency of plant-based coagulants in the treatment of dairy wastewater. The dairy industry is generally considered to be largest source of food processing. As the demand of dairy products is increasing day by day which results in a development of the dairy industry and increase in dairy wastewater due to its processing, cleaning and sanitary. Such wastewater if discharged without proper treatment, severely pollute receiving water bodies and disrupts complete ecosystem. Thus, the dairy wastewater must be treated. The dairy wastewater is characterized by high COD, Suspended solids and nutrients *etc.* The initial TDS and chlorides of dairy wastewater are 833 mg/l and 287.7 mg/l. In the present work, the dairy wastewater was treated by using plant-based coagulants to check the wastewater characteristics like COD, pH and total suspended solids, Chlorides *etc.* The natural coagulants used in this project work are Moringa Oleifera seeds (Drumstick) and Trigonella Foenum-Graecum (Fenugreek). Earlier studies were carried out by using natural coagulants individually. But in this experimental work, attempts will be made to use these natural coagulants in various proportions. The removal efficiency of TDS and Chlorides by T. Foenum are at 69.5%, 62.66% and by M. oleifera TDS and Chloride Removal are 60.2%, 58.89%. By performing various trial of mix coagulants on the dairy wastewater the most effective combinations of varying doses of coagulants will be decided. The main objective of this paper, is to determine the most efficient mix ratio of (M. oleifera and T. Foenum). This method is eco-friendly, it does not produce any harm to environment and acts as the best potential substitute over all the chemical coagulants.

**Keywords:** Dairy Wastewater, Plant Based Coagulant, Total Suspended Solids, COD, Moringa oleifera, Trigonella Foenum-Graecum, Eco-Friendly.

### 1. Introduction

The dairy industry provides large range of milk-based chilled food products in its own right, as well as fresh and dried ingredients, which can be introduced into chilled foods. This product come mainly from cows, but the milk of other animals is also used for specialty products like buffalo and sheep. The dairy industry is generally considered to be the largest source of food processing wastewater in many countries. With increase in demand for milk and milk products, many dairies of different sizes have come up in different places. These dairy industries produce wide range of perishable (milk) and semi-perishable like (cheese, butter and milk powder) foods. To maintain the product quality, functionality and safety the microbiological guidelines is strictly followed. These dairies collect the milk from the produces, and then either simply bottle it for marketing, or produce different milk foods according to their capacities. Large quantity of wastewater originates due to their different operations. The organic substances in the wastes comes either in the form in which they were present in milk, or in a degraded form due to their processing. As such, the dairy wastes, through biodegradable, are very strong in nature.

## **1.2. Characteristics of Dairy Wastewater**

The dairy industry is one of the world's staple (milk) industries, hence the treatment possibilities of dairy effluents have been attracting more and more attention. The nature and composition of wastes depends on type of effluents and the capacity of processing of the plants. The cleaning waters used in dairy wastewater treatment may also contain a variety of sterilizing agents and various acid and alkaline detergents. Thus, it results into increase in pH of the wastewaters and this pH can vary significantly depending on the cleaning strategy employed. Dairy wastewaters are characterized by high biochemical oxygen demand (BOD) due to organic nutrients loading and chemical oxygen demand (COD) concentrations. Chemical oxygen demand (COD), which is normally about 1.5 times the BOD level, it also contains total solids, total dissolved solids, nitrogen and phosphorous. Significant indicators for knowing the quantity of organic load of dairy plant effluents are biological oxygen demand (BOD) and chemical oxygen demand (COD).

## **1.3. Plant Based Coagulants**

### **1.3.1. Moringa Oleifera**

Moringa Oleifera is a fast growing, drought resistance tree of family Moringaceae, common names include moringa, drumstick tree, horseradish tree and ben oil tree. It is widely cultivated for its young seed pods and leaves used as vegetables. Many researchers have reported Moringa oleifera as a coagulant specifically for the last 25years. They have found that the Moringa oleifera seed is non-toxic and good coagulant in water treatment. It is recommended to be used as a coagulant in developing countries. Muyibi and Evison have reported Moringa oleifera powder have the capability of reducing low and high turbidity values in surface water. Mature seeds showing no signs of discoloration, softening or extreme desiccation were used.

### **1.3.2. Trigonella Foenum Graecum**

The Trigonella Foenum-Graecum is an annual plant in the family Fabaceae. It is commonly known as Fenugreek. The Fenugreek is used as herb (dried or fresh leaves), and vegetable (fresh leaves, sprouts). Many researchers have proved that seeds of Trigonella Foenum graecum is useful for wastewater treatment.



Fig.1: Moringa Oleifera (Drumstick)



Fig.2: Trigonella Foenum Graecum (Fenugreek)

## **2. Material and Methodology**

### **2.1. Collection of Sample Water**

The sample of dairy wastewater was collected from the Government Milk Processing Unit Stationed at Amravati, Maharashtra, India. The collected wastewater was kept as stock solution in the refrigerator and the sample used for studies was prepared by diluting the stock solution for avoiding the fault results.

## 2.2. Coagulants Preparation

### 2.2.1. Preparation of M. Oleifera Powder

M. Oleifera seeds pods are allowed to mature and dry naturally to a brown color on the tree. The seeds were removed from the pods, kept for sun dry and external shells were removed. Using grinder, fine powder achieved from seed kernel. (Fig 1)

### 2.2.2. Preparation of T. Foenum Powder

The T. Foenum seeds were washed with water to remove dust and then clean seeds were in the shade for 24hrs. After that the seeds are powdered with grinder and takes up to 250gm of the powdered natural coagulant. (Fig 2)



Fig.3: Powdered sample of M. Oleifera



Fig.4: Powdered sample of T. Foenum

## 2.3. Coagulation Study

For the study of coagulation, jar apparatus has been used. The doses considered for T. Foenum are 0.1gm, 0.125gm, 0.25gm, 0.5gm, 1gm, 1.5gm, 2gm, 2.5gm, 3gm per 500 ml of sample. And for M. oleifera are 0.04gm, 0.06gm, 0.08gm, 0.1gm, 0.12gm, 0.14gm, 0.16gm, 0.18gm per 500ml of sample. The jar apparatus has the six beakers and six steel paddles which helps in the agitation process. The initial speed of agitation is 100rpm for 2 min, followed by 40rpm for 30min. The settling time applied for this coagulation process is 60 min.

## 3. Result and Discussion

### 3.1. Characteristics of Untreated Dairy Wastewater

Table 1: Characteristics of untreated dairy wastewater

Sr. No.	Parameters	Values
1	pH	8.41
2	TDS	833 mg/l
3	COD	1679 mg/l
4	Chlorides	287.7 mg/l

### 3.2. Optimum Doses for T. Foenum and M. Oleifera

The optimum dosage for T. Foenum and M. Oleifera is determined by varying the dosage of coagulants. The doses for T. Foenum are 0.1gm, 0.125gm, 0.25gm, 0.5gm, 1gm, 1.5gm, 2gm, 2.5gm, 3gm /500ml at original pH of dairy wastewater (pH=8.41). Whereas, the doses for M. Oleifera are 0.04gm, 0.06gm, 0.08gm, 0.1gm, 0.12gm, 0.14gm, 0.16gm, 0.18gm/500ml of sample. The Optimum Dose is determined on the basis of percentage T.D.S. Removal Efficiency.

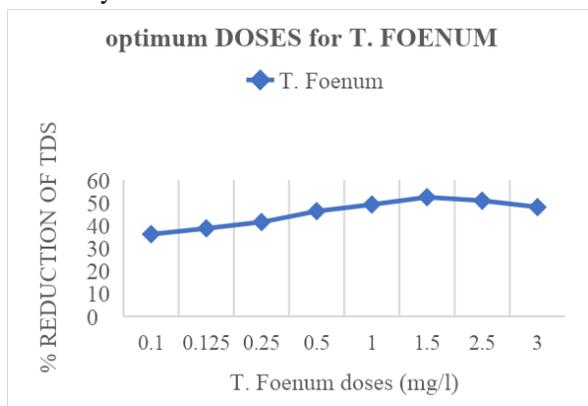


Fig.5: Optimum dose for T. Foenum

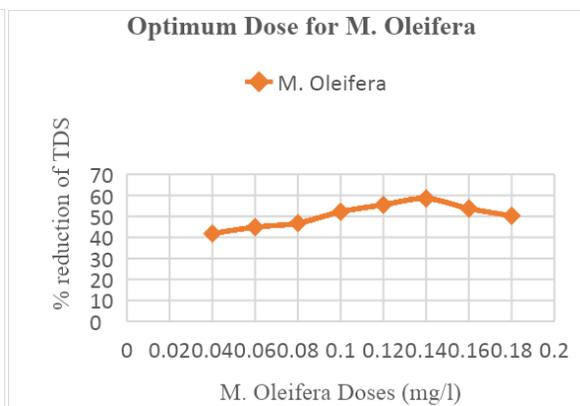


Fig.6: Optimum Dose for M. Oleifera

The optimum dose for T. Foenum is 1.5gm/500ml of dairy wastewater, (fig 1). Also, the optimum dose for M. Oleifera is 0.14gm/500ml, (fig 2).

### 3.3. Optimum pH for T. Foenum and M. Oleifera

Optimum pH is the pH at which the maximum reduction of total suspended solids take place. Optimum pH can be determined by varying the pH value as 6.0, 6.78, 7.32, 7.9, 8.01, 7.8, 7.43, 6.23. from Fig 3, the Optimum pH for T. Foenum and M. Oleifera is 8.01.

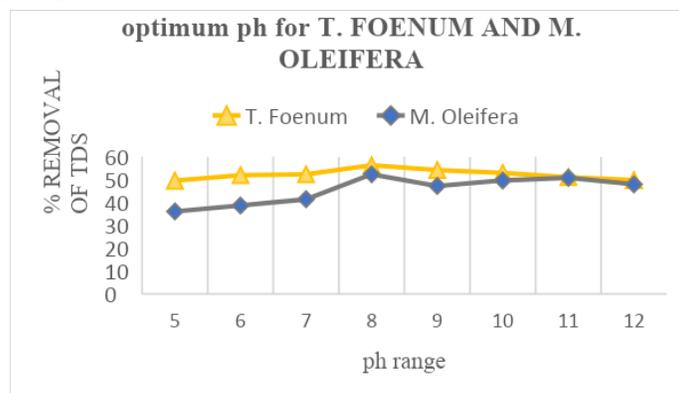


Fig.7: Optimum pH for T. Foenum and M. Oleifera

### 3.4. Removal Efficiency of T. Foenum

The results were plotted in graph with T. Foenum dosage on X- Axis and percentage TDS removal on y- axis. This plotted graph was shown in fig 4. The T. Foenum shows max. reduction in TDS at 69.5% and Chloride Removal at 62.66%.

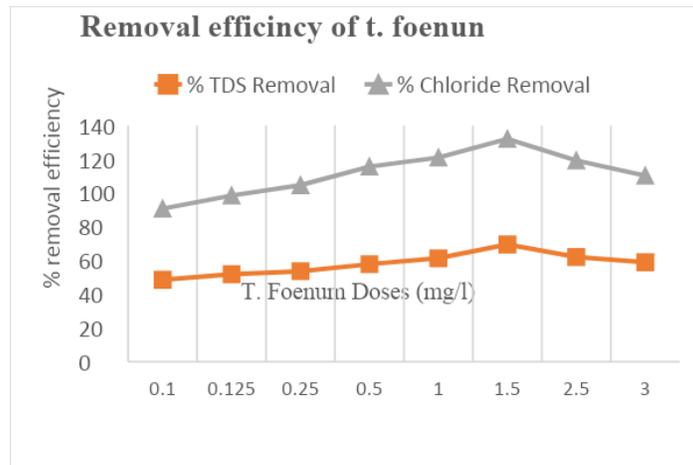


Fig.8 Removal Efficiency of TDS and Chloride for T. Foenum

### 3.5. Removal Efficiency of M. Oleifera

The results were plotted in graph with M. Oleifera dosage on X- Axis and percentage TDS removal on y- axis. This plotted graph was shown in fig 3. The M. Oleifera shows max. reduction in TDS at 60.2% and Chloride Removal at 58.89%.

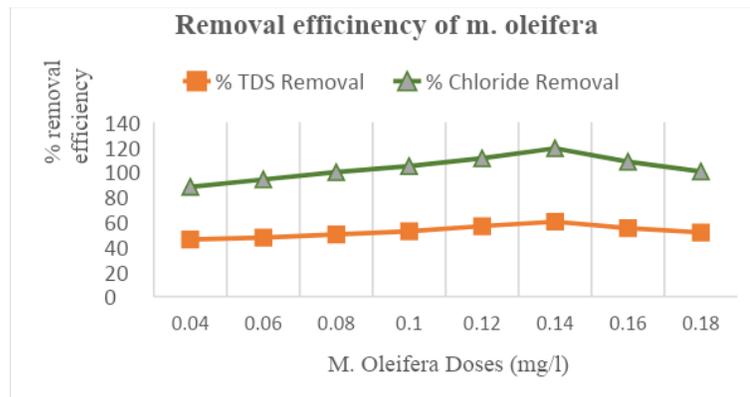


Fig.9 Removal Efficiency of TDS and Chloride for M. Oleifera

## 4. Conclusion

The use of plant-based coagulant for the treatment of wastewater and the properties of both coagulants such as Trigonella Foenum and Moringa Oleifera. Preparation and Methodology of natural coagulant such as T. Foenum and M. Oleifera. The physio-chemical parameters of wastewater before and after the treatment of dairy wastewater and to evaluate the removal efficiency on the major pollutants of concerned dairy wastewater treatment, such as pH, Chlorides, Total Suspended Solids are examined.

The optimum pH and optimum dosage of T. Foenum and M. Oleifera are examined and test results are given. The optimum pH for both coagulants is 8.01 whereas, the optimum doses for T. Foenum is 1.5gm/500ml sample and for M. Oleifera is 0.14gm/ 500ml sample. In my project, T. Foenum removing content 69.5% TDS, 62.66% Chloride and M. Oleifera removing content 60.2% TDS, 58.89% Chloride. From the experimental study, it may be concluded that the maximum removal efficiency is in T. Foenum than M. Oleifera on the major pollutants of concerned dairy

wastewater treatment, such as pH, Chloride and Total Suspended Solid. Further work will be including the combinations of mix coagulants *i.e.* (T. Foenum: M. oleifera) also its removal efficiency over individual T. Foenum efficiency.

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