

Removal of Turbidity from Dairy Waste Water Using Natural Coagulants

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Abstract - The water is treated using natural coagulants i.e. Chickpea (*cicerariethinum*), Hyacinth bean (*dolichos lablab*), Drumstick seed (*moringa oliefera*), Tamarind seeds (*Tamarind Indica*) and Fenugreek (*trigonella foenum graecum*), so that chemical usage in the treatment is reduced and hence there is a reduction in the treatment cost. The most of the natural coagulants used in the process are chosen such that they either waste or can be obtained at a cheaper rate. This will also help reduce the waste generation. There might be any harmful effects on the plants and animals when the water is treated through the chemical and discharged into water body and if used for gardening, if not the effect might be of long term. Even this harmful could be avoided using the natural coagulants.

- ❖ To remove the suspended impurities from the dairy waste water.
- ❖ To find out the optimum time, speed intensity and coagulant dosage.
- ❖ To study the coagulation efficiency of natural coagulants in turbid water.
- ❖ To investigate physical characteristics of dairy waste water discharged by the milk processing unit.

Keywords: Coagulants, Chickpea, Hyacinth bean, Fenugreek, Drumstick seed, Tamarind seed.

1. INTRODUCTION

Water is the most ubiquitous material in nature and most vital for domestic purposes such as drinking, cooking, washing, bathing etc. Nearly 70 percent of the world is covered by water in which only 2.5 percent of it is fresh, the rest is saline and ocean-based. Even then, just 1 percent of our freshwater is easily accessible. The problem of water crisis is due to water pollution. Sewage produced by industries should be treated in an effective manner to reduce the pollution content in the waste. This method needs huge investment, therefore to reduce the cost of treatment, we should try to find coagulants which are efficient, and at the same time it is cheap too. Hence we have chosen natural coagulants, due to which the treatment cost would be reduced.

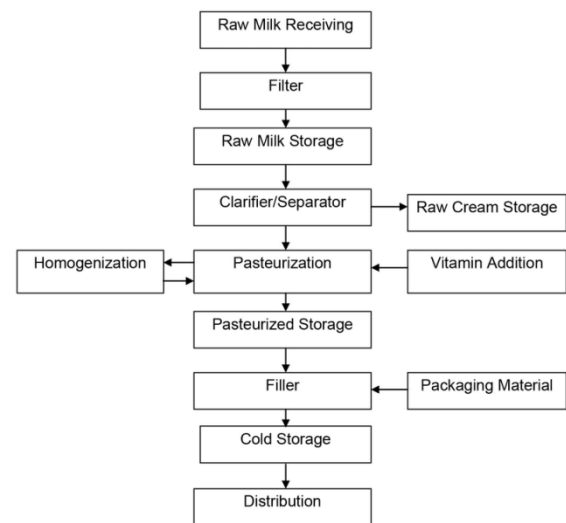
The water which is supplied by any supply board treats the water using the chemical coagulants. There may have an adverse effect on health of animals and plants if used in excess or might show long term effect in future. There are many advanced methods to treat the water but those are expensive too.

2. OBJECTIVE

- ❖ To use various eco friendly natural coagulants materials for the dairy waste water treatment.

3. BACKGROUND

3.1 DAIRY PRODUCTS MANUFACTURING PROCESS



Source: M.N.Rao, A.K Datta, "Industrial wastewater treatment", third edition, oxford & IBH publishing Co Pvt.Ltd.

3.2 CHARACTERISTICS OF TYPICAL DAIRY WASTE WATER PARAMETERS

Dairy effluents contain dissolved sugars proteins and fats and possibly residues of additives. The key parameters are biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids, and total dissolved solids. Cream, butter, cheese, and whey production are major sources of BOD in wastewater. The dairy wastewater may contain pathogens from contaminated

materials or production processes. A dairy often generates odors and, in some cases, dust, which need to be controlled. Most of the solid wastes can be processed into other products and by-products.

Table 1 Characteristics of typical dairy waste water parameters

Items	Value
pH	7.2
Alkalinity	600 mg/l as CaCO ₃
Total Dissolved Solids	1060 mg/l
Suspended Solids	760 mg/l
BOD	1240 mg/l
COD	84 mg/l
Total Nitrogen	84 mg/l
Phosphorus	11.7 mg/l
Oil and grease	290 mg/l
Chloride	105 mg/l

Source: M.N.Rao, A.K Datta, "Industrial wastewater treatment", third edition, oxford & IBH publishing Co Pvt.Ltd.

3.3 DAIRY WASTE WATER TREATMENT PROCEDURE

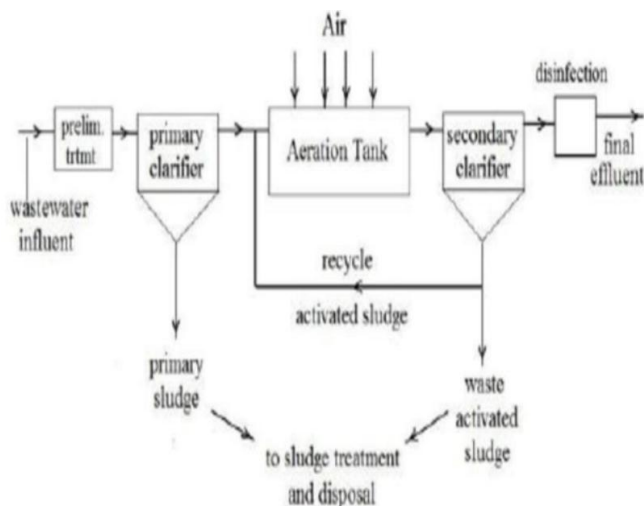


Figure 1 Dairy waste water treatment procedure

Source: M.N.Rao, A.K Datta, "Industrial wastewater treatment", third edition, oxford & IBH publishing Co Pvt.Ltd.

4. MATERILAS AND EQUIPEMENTS

4.1 MATERIALS

The natural coagulants are collected from the local market of Bangalore, Karnataka, India.

4.1.1 Drumstick seeds (scientific name: Arachis hypogaea):



Figure 2 Drumstick seeds

4.1.2 Chickpea (scientific name: Cicer arietinum):



Figure 3 Chickpea

4.1.3 Fenugreek (scientific name: Trigonella Foenum Graecum):



Figure 4 Fenugreek

4.1.4 Hyacinth bean (scientific name: Dolichos Lablab):



Figure 5 Hyacinth bean

4.1.5 Tamarind seeds (scientific name: Tamarind Indica):



Figure 6 Tamarind seeds

4.2 EQUIPEMENTS

4.2.1 pH meter



Figure 7 pH meter

4.2.2 Turbidity



Figure 8 Turbidity

4.2.3 Jar test apparatus



Figure 9 Jar test apparatus

5. METHODOLOGY

- ❖ All the natural coagulants are collected and dried in the sunlight.
- ❖ Then all the seeds are ground to fine powder of approximate size 600 µm sieve.
- ❖ The diary waste water is collected from the local market of Bangalore, Karnataka.
- ❖ The analysis of waste water sample using the various parameters such as TDS, COD, BOD etc.
- ❖ The optimization for natural coagulants dosage was performed using the jar test apparatus.
- ❖ The apparatus permitted six beakers to be agitated all together 0.5L of diary waste water were doused with 3, 3.5, 4, 4.5, 5 ml of natural coagulants was stirred for rapidly for 1min at 100 rpm followed by 10, 20 and 30 min & slow stirring for flocculation to settle at bottom.
- ❖ Floc are settled for 1hr and treated sample is taken for analysis.
- ❖ These procedures are repeated several times so that optimum pH, speed, time and dosage of coagulants can be calculated.

6. RESULTS AND DISCUSSION

6.1 TREATMENT USING NATURAL COAGULENT PREPARATION OF NATURAL COAGULENT

The seeds pod of cicerariethinum, dolichos lablab, moringa oliefera, tamridindica and trigonella foenum graecum are collected and dried naturally by sunlight. And seeds are removed from pod manually. The dried seeds were grounded to powder by domestic blenders. The powder was sieved through 600 µm sieve.

6.2 INITIAL PARAMETERS OF DAIRY WASTE WATER

The raw waste was collected from Bangalore local market is tested for its initial parameter to find the degree of pollution in the effluent. This will help us the find the amount of treatment done at the final stage by comparing it with the initial parameter.

Table 2 Initial parameters of dairy waste water

Item	Value
pH	8.88
Turbidity	188 NTU
COD	2448 mg/l
BOD	1110 mg/l
Electricity Conductivity	6.61
Total Dissolved Solids	4292 mg/l

6.3 JAR TEST

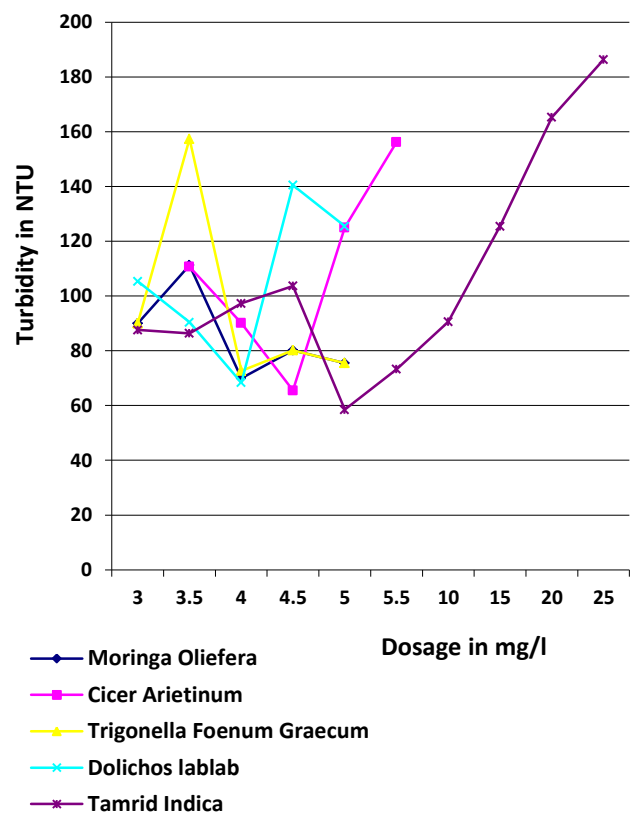
The jar test is performed to obtain the optimum dosage of coagulant, speed, time and pH. Using this optimum values the water will be treated to get the best treatment of water possible.

6.3.1 OPTIMUM DOSAGE OF COAGULANTS

Table 3 Result of optimum dosage of coagulants

Coagulant	Optimum dosage in mg/l
Moringa Oliefera	4
Cicer arietinum	4.5
Trigonella Foenum Graecum	4
Dolichos Lablab	4
Tamrid Indica	5

Optimum Dosage of Coagulants



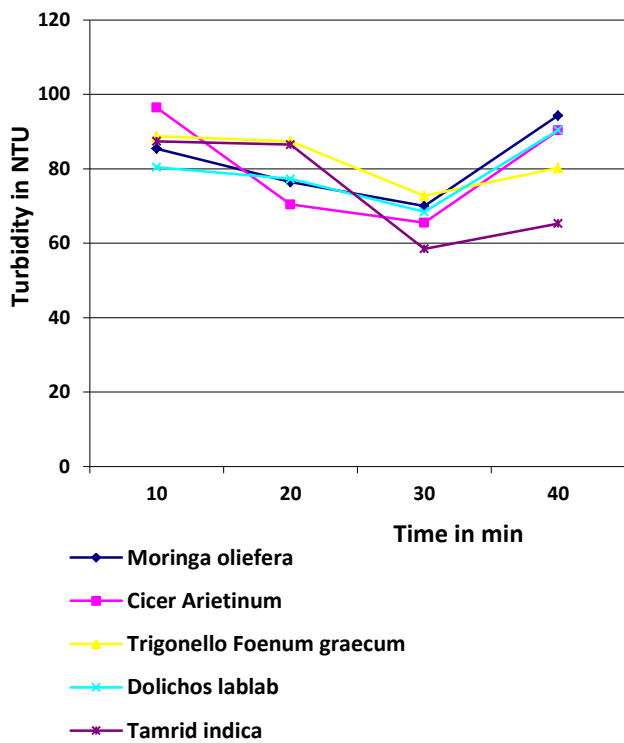
From the above graph optimum dosage can be obtained. The graph also shows that tamrid indica removes maximum turbidity from the waste that is 58.5 NTU for optimum dosage of 5mg/l.

6.3.2 OPTIMUM TIME

Table 4 Results of optimum time

Coagulant	Optimum Time in min
Moringa Oliefera	30
Cicer arietinum	30
Trigonella Foenum Graecum	30
Dolichos Lablab	30
Tamrid Indica	30

From the optimum time graph, It shows that Tamrid Indica is more efficient than any other coagulant. It removed around 58.5 NTU of turbidity for the optimum time of 30mins.



6.3.3 OPTIMUM SPEED

Optimum speed at which coagulants could effectively treat the water could be found from the graph. Maximum turbidity is removed by Tamrid Indica that is around 58.5 NTU at an optimum speed of 40 rpm.

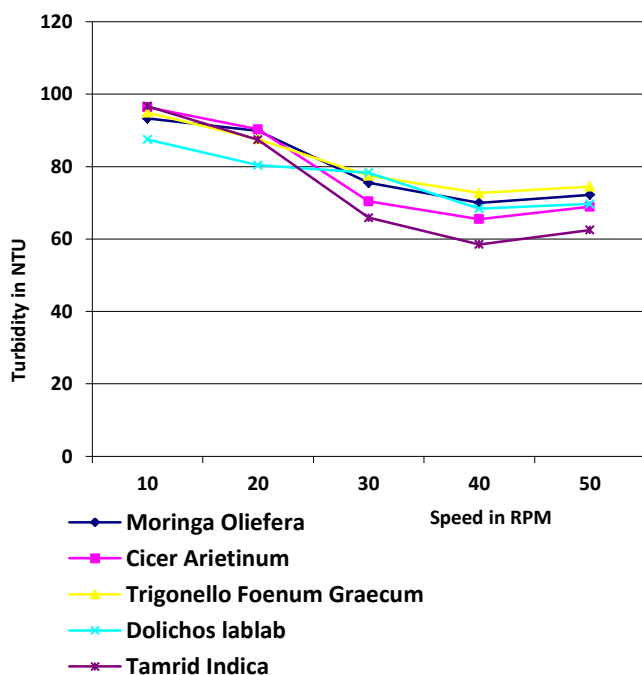


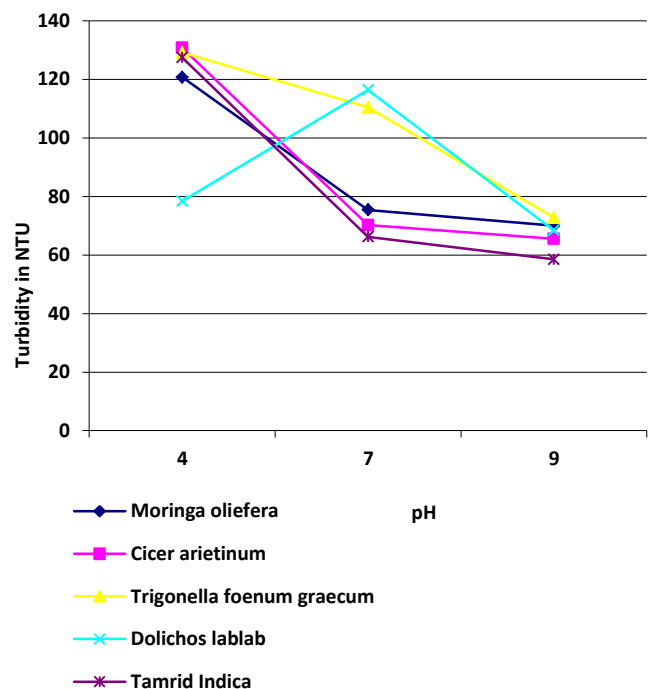
Table 5 Results of optimum speed

Coagulant	Optimum Speed in RPM
Moringa Oliefera	40
Cicer Arietinum	40
Trigonella Foenum Graecum	40
Dolichos Lablab	40
Tamrid Indica	40

6.3.4 OPTIMUM pH

Table 6 Results of optimum pH

Coagulant	Optimum pH
Moringa Oliefera	9
Cicerariethinum	9
Trigonella Foenum Graecum	9
Dolichos Lablab	9
Tamrid Indica	9



From the above graph optimum pH can be obtained. This graph also shows that natural coagulants are more effective in alkaline medium. Even in this case Tamrid Indica has cleared maximum of turbidity that is about 58.5 NTU.

6.4 FINAL PARAMETER AFTER TREATMENT

Tests were conducted to find the reduction in the parameters of the effluent. The final parameters of the treated waste water at optimum dosage, time, speed, pH are as follows,

6.4.1 WHEN TREATED WITH MORINGA OLIEFERA

Item	Value
pH	6.32
Turbidity	70 NTU
COD	1112.7 mg/l
BOD	462.5 mg/l
Electricity Conductivity	4722 u/mm
Total Dissolved Solids	3068 mg/l

6.4.2 WHEN TREATED WITH CICER ARIETHINUM

Item	Value
pH	6.32
Turbidity	65.5 NTU
COD	765 mg/l
BOD	346.8 mg/l
Electricity Conductivity	2874 u/mm
Total Dissolved Solids	1860 mg/l

6.4.3 WHEN TREATED WITH TRIGONELLA FOENUM GRAECUM

Item	Value
pH	6.32
Turbidity	72.7 NTU
COD	1170 mg/l
BOD	504.5 mg/l
Electricity Conductivity	5085 u/mm
Total Dissolved Solids	3301 mg/l

6.4.4 WHEN TREATED WITH DOLICHOS LABLAB

Item	Value
pH	6.32

Turbidity	68.2 NTU
COD	941.5 mg/l
BOD	426.9 mg/l
Electricity Conductivity	3888 u/mm
Total Dissolved Solids	2520 mg/l

6.4.5 WHEN TREATED WITH TAMRINA INDICA

Item	Value
pH	6.32
Turbidity	58.5 NTU
COD	664 mg/l
BOD	272.5 mg/l
Electricity Conductivity	2727 u/mm
Total Dissolved Solids	1474 mg/l

7. CONCLUSION

- The characteristics of untreated dairy waste water are pH 8.88, electric conductivity 6.61, COD 2448 mg/l, BOD 1110mg/l, turbidity 188 NTU and total dissolved solids 4292 mg/l.
- It could be concluded that **Tamrina indica** is the most effective coagulant since it removes the maximum turbidity than any other coagulant. It is also seen that the effluent parameter is maximum removed by **Tamrina indica** only .
- The second position in removing turbidity is secured by **Cicer Ariethinum** it has removed around 65.5 NTU of turbidity.
- And the third most effective turbidity remover is **Dolichos lablab** it removes around 68.2 NTU of Turbidity and the other parameter is also was removed effectively.
- Among the above mentioned natural coagulants, the maximum reduction of turbidity is 58.5 NTU, the maximum reduction of chemical oxygen demand is 664 mg/l, the maximum reduction bio chemical demand is 272.5, the maximum reduction of total dissolved solids is 1474 mg/l, the maximum of electrical conductivity is 2727 um/mm by Tamrina idindica and is more effective for the treatment of dairy waste water.

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