



Use of Natural Coagulants for Primary Treatment of Dairy Wastewater Treatment- A Review

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ABSTRACT

Dairy Industry is one of the huge food processing industry in the world. The amount of wastewater produce is very high and is treated with many natural coagulants instead of chemical coagulants. Well known natural coagulant *Moringaoleifera* is used for dairy wastewater treatment which is having coagulant property of about 80% to 85%. Various doses are given for raw sample and tests like BOD, COD, Turbidity, Total Solids etc. are carried out and optimum dose is calculated. As dose increases turbidity increases. The reduction of various parameters takes place. *Moringaoleifera* is more efficient than other coagulants as it contains protein.

Keywords: Dairy wastewater, *Moringaoleifera*, COD, BOD, Turbidity, Total solids

I. INTRODUCTION

The steady rise in the demand of milk and milk products led to growth in production of milk from cattle in rural areas. This had been led to huge growth in the dairy industries in most countries. The waste produced is about 2 to 3 liters of waste water per liter of milk processed. Waste water contains high concentration of organic material such as protein, carbohydrates, fats, grease, etc. having high values of BOD and COD. Also contains high detergents and sanitizing agents which affect aquatic life.

We used various conventional methods like trickling filter, activated sludge process, and aerated lagoon etc. to treat dairy wastewater but this method is very costly. Also chemicals like Polyaluminum Chloride, Aluminum Chloride, Aluminum Sulfate (Alum)

$Al_2(SO_4)_3$, Ferric Chloride, alum etc. for wastewater treatment are not economical. The principal aim of this review is to verify the efficiency of natural coagulants and chemical coagulants for treatment of dairy wastewater.

II. LITERATURE SURVEY

Kokila Parmar et al., (2012) [1] stated that *Moringaoleifera* (MO) are from regions of north-west India and from many parts of Asia, Africa, and South America. The pods are non-toxic natural organic polymer and effective sorbent for the removal of organics and for coagulation of water treatment as seeds contains natural polyelectrolyte. The best and efficient removal was observed at pH 7.0-9.0 for all turbidities with dose of 100 mg/l of *Moringaoleifera* seed. Following table shows percentage reduction of various parameters.

PARAMETERS	PERCENTAGE REDUCTION BY MORINGA OLEIFERA
Turbidity	75 % to 85 %
TDS	15 % to 20 %
COD	35 % to 45 %
BOD	55 % to 65 %
Microbial load	90 % to 95 %

It is concluded that the MO seeds have the potential to be used in the dairy industry waste water treatment in an efficient way and with low cost.

Chitteti Ramamurthy et al., (2012) [2] describes that the ability of seed extracts of *Trigonella foenum-graecum* (T. foenum-graecum) and *Cuminum cyminum* (C. cyminum) to act as natural coagulants. These extracts tested using natural turbid water and prepared using distilled water and NaCl (0.5 M and 1.0 M) solution. Only 1.0 M NaCl extract of T. foenum-graecum had coagulation capability and did not depend on pH values. Following table shows coagulation properties of various natural coagulants and chemical coagulant aluminum sulphate for the pre-sent study.

COAGULANT	COAGULATION PROPERTIES IN PERCENTAGE
T. foenum-graecum	75-85
Strychnos potatorum	85-95
Moringa oleifera	60-70
Aluminum Sulphate	90-97

When compared with pond water, T. foenum-graecum extract treated water shows decrease in alkalinity, turbidity, KMnO_4 demand and total coli-form. This study concludes that seed extract of T. foenum-graecum can be used as natural water coagulant.

Pallavi N. and Dr. Mahesh S. (2013) [3] presented that use of natural coagulant named *Moringa oleifera*, to treat raw dairy wastewater. The Optimum MO dosage for various particle sizes.

COAGULANTS	REDUCTION OF TURBIDITY (%)	REDUCTION OF COD (%)
Moringa oleifera	60-65	60-65
Trigonella foenum-graecum	55-60	60-65
Dolichos lablab	70-75	72-78
Cicerarietinum	75-80	80-85

The efficiency of *Cicerarietinum* is more compared to other three as it depends on the protein content which is present in the natural coagulant. The increase of dosage causes the increase of turbidity.

PARTICLE SIZE OF MO (μm)	OPTIMUM DOSE (mg/L)
425	300
212	500
150	500

Particle size 212 μm *Moringa oleifera* used in this paper and following table shows percentage reduction in various parameters:

PARAMETERS	PERCENTAGE REDUCTION
COD	64.28
Total solids	53.95
Oil & grease	85.17

Prof. Chidanand Patil and Ms. Manika Hugar (2015) [4] states that the dairy industry wastewater is characterized by high COD, BOD, nutrients and is to be treated natural coagulants and then tests are to be carried to check the water characteristics like BOD, COD, pH and turbidity, etc. The initial pH, Turbidity, COD are 7.41, 289.5 NTU, 10000 mg/l respectively. Natural coagulants to be used are *Moringa oleifera* seeds, *Trigonella foenum-graecum*, *Dolichos lablab* and *Cicerarietinum* and efficiency of reduction of turbidity and COD is given in below table:

Mangesh K. Urade et al., (2017) [5] presented that the characteristics of wastewater is treated by natural coagulant like *Moringa oleifera* seeds, *Trigonella foenum-graecum*, *Dolichos* and *Cicerarietinum*. The efficiency of reduction turbidity as 60-80% and to dosages increases to increases the turbidity. The

MoringaOleifera is one of the most efficient herbal coagulants to remove the turbidity. The initial BOD and COD dose of dairy wastewater is 58-60% respectively and residual BOD remained below 500 mg/l. The maximum discharged of treated effluent limit is allowed to land through irrigation.

ChaitaliBangar et al., (2017) [6] describes that dairy industry wastewater discharges which characterized by High COD, BOD, TSS, TDS, Turbidity, pH etc. Water resources get polluted if untreated waste water discharged into natural resources. The efficiency of Different Chemical Coagulant (alum) and Natural coagulant moringaoleifera (MO) was compared under same analytical conditions. The comparison of various parameters by natural coagulant and chemical coagulant shown in following table:

PARAMETERS	REDUCTION BY MO	REDUCTION BY ALUM
pH	7.4 to 7.1	-
Turbidity	65 % to 70 %	75 % to 80 %
TDS	65 % to 70 %	70 % to 75 %
COD	50 % to 55 %	55 % to 60 %
BOD	85 % to 90 %	90 % to 95 %

Hence by analyzing above results alum is more effective than moringaoleifera.

Neena Sunny et al., (2015) [7] stated that natural coagulant Moringaoleifera (MO) used for treatment of waste water at optimum air rate and optimum time period. The reduction in turbidity was between 70 to 80% at the optimum dose of 6mg/L.

Neethu.P et al., (2017)[8] presented that the huge amount of waste water produced from dairy industry is treated using natural coagulant MoringaOleifera which are easily available. The various tests like BOD, COD, turbidity, etc. are carried out before and after coagulation process. The optimum dose is 0.3 g/l. The reduction of various parameters shown in table below:

PARAMETERS	PERCENTAGE REDUCTION
Turbidity	75-80
BOD	75-80
COD	85-90
Total solids	8-10
Total Suspended Solids	95-100

D.S. Bhutada et al., (2008) [9] described that herbal coagulant MoringaOleifera is very useful in removal

of turbidity and other parameters in water and waste water. Use of this coagulant in primary treatment of industrial wastewater is explored. Coagulation, flocculation and sedimentation were conducted on laboratory using Moringaoleifera. The results were good enough and quite encouraging at the optimum dose of 60 mg/L. The percentage reduction of BOD was about 50-55% and that of COD was about 60-65%. By using fuller earth as coagulant (15 mg/L) these reductions were further increased by 5% and 6% respectively. BOD was reduced to 55-60% and COD was reduced up to 65-70% by preliminary and primary treatment together. And the residual BOD₅ was observed below 500 mg/L which is maximum limit for treated effluent to be discharge of on land.

III. SUMMERY OF LITERATURE

At pH 7-9 Moringaoleifera is very efficient in removal of turbidity and other parameters at dose of 100 mg/l. Percentage reduction of microbial load (90-95%) is more than that of percentage removal of turbidity, TDS, COD and BOD [1].

M NaCl extract of *T. foenum-graecum* had coagulant capacity than that of 0.5 M NaCl which did not depend on pH values. Maximum coagulation property is of Aluminum Sulphate i.e 90-97% as compare to natural coagulants *T. foenum-graecum*, *Strychnos potatorum*, *Moringaoleifera* and Aluminum Sulphate. After Aluminum Sulphate, *T. foenum-graecum* has good coagulation property which used for treatment of water and showed decrease in alkalinity, turbidity, KMnO₄ demand and total coliform [2].

The optimum dose of MoringaOleifera is given for various particle sizes and size of 212µm with dose 500 mg/L used. Reduction of oil & grease is 85% which is maximum than that of reduction of COD and Total solids [3].

By using *Cicer arietinum* removal of COD and turbidity is maximum i.e 75-85% followed by *Dolichos lablab*, *Trigonella foenum-graecum* and MoringaOleifera [4].

The efficiency of reduction of turbidity by MoringaOleifera seeds, *Trigonella*, *Foenum-graecum*, *Dolichos* and *Cicer arietinum* is about 60% and results of reduction of BOD and COD is below 500 mg/l [5]. The comparison of MoringaOleifera and chemical coagulant alum is done and good results are of alum than natural coagulant [6].

The turbidity removal by *Moringa Oleifera* is about 70-80% and no other parameters are considered [7].

At dose of 0.3 g/l of *Moringa Oleifera* there is maximum reduction of pH, COD, BOD, Total Solids and Total Suspended solids [8].

At dose of 60 mg/l of *Moringa Oleifera* and using fuller earth 15 mg/l reduction of BOD is 55 to 60% and reduction of COD is 65 to 70%.

From above results natural coagulant *Moringa Oleifera* can be used for coagulation process. The best among all is, dose of 0.3 g/l is optimum for maximum removal COD, BOD, turbidity, TDS and TSS [8]. Also if along with alum natural coagulants are used the results would be encouraging. For dairy industry coagulation and flocculation unit would be beneficial as a primary treatment with this natural coagulant as the load on Effluent Treatment Plant can be reduced reduce more parameters as discussed above.

IV. CONCLUSION

As the waste water from dairy industry causes environmental and health problems proper treatment is necessary. Various conventional methods like trickling filter, activated sludge process, and aerated lagoon etc. used to treat dairy wastewater but this method is very costly. Also chemicals like Polyaluminum Chloride, Aluminum Chloride, Aluminum Sulfate (Alum) $Al_2(SO_4)_3$, Ferric Chloride, alum etc. for wastewater treatment are not economical.

In technical terms, these natural coagulants are highly efficient for reduction of physical chemical parameters of the wastewater such as colour, turbidity, COD, BOD, TS and others. Planted-based coagulants also have several reasons to become effective coagulant; high cationic charge density, long polymer chains, bridging of aggregates and precipitation, safe, non-toxic, increasing floc size, eco-friendly, high biodegradability, reducing sludge volume, reduction in cost as it is raw material from renewable resources. The results carried out by researches for natural coagulant *Moringa Oleifera* are very encouraging by dose 0.3g/l can be best for reduction of various parameters which can be used for dairy waste water treatment.

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