

Use of natural Coagulants for Pre-treatment of Dairy Waste Water

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Abstract-Dairy Industry is one of the huge food processing industries in the world. The amount of wastewater produced is very high and is treated with many natural coagulants instead of chemical coagulants. Well known natural coagulant *Moringaoleifera* and Fenugreek 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 decreases. The reduction of various parameters like BOD, COD, Turbidity, etc. takes place. *Moringaoleifera* is more efficient than other coagulants as it contains protein.

Key Words: *Moringaoleifera*, Fenugreek, Alum, Turbidity, BOD, COD, Total Solids etc.

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. The dairy industry involves processing raw milk into products such as consumer milk, condensed milk, butter, cheese, yogurt, milk powder, etc. using processes such as chilling, pasteurization, and homogenization. Typical by-products include buttermilk, whey, and their derivatives. Wastewater generated from operations like washing, disinfection of equipment, loss of packages containing milk, loss during internal transportation etc. Waste water contains high concentration of organic material such as protein, carbohydrates, fats, grease, etc. having high values of BOD, COD, turbidity, TS etc. as shown in table 1. Also contains high detergents and sanitizing agents which affect aquatic life.

Various conventional methods like trickling filter, activated sludge process, and aerated lagoon etc. used to treat dairy wastewater. 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. Instead of using chemical coagulants natural coagulants are preferred and efficiency is determined in this study. The principal aim of this paper is to verify the efficiency of natural coagulants and chemical coagulants for treatment of dairy wastewater. *T. foenum-graecum* (Fenugreek) and *Moringa oleifera* Lam (Moringaceae) are two well-known and locally available natural coagulants.

Table I. Parameters of raw wastewater of dairy industry.

Item	Unit	Value (effluent)
pH	-	7.2-7.5
TSS	Mg/l	72000-80000
TS	Mg/l	8000-10000
BOD	Mg/l	1300-1600
COD	Mg/l	2500-3000

II. MATERIALS AND METHODS

The natural coagulants like *T. foenum-graecum* (Fenugreek) and *Moringaoleifera* Lam (Moringaceae) are used for treatment of raw dairy waste. These materials are collected from farms and locally available market in Kolhapur. The waste samples are collected from dairy of Shree Warana Sahakari Dudd Utpadak Pravriva Sangh Ltd. Warananagar.



Fig. 1 Dry seeds of *Moringa oleifera*



Fig. 2 Powder of Moringa oleifera Seed



Fig. 3 Dry seeds of Fenugreek



Fig. 4 Powder of Fenugreek Seed

A. Preparation of natural coagulants

The seeds of *T. foenum-graecum*(Fenugreek) and *Moringa oleifera* are collected from farms. These seeds are kept in natural sunlight or in oven for 24 hours to remove all the water content in it. Further they are grind into domestic mixture and is sieved through 600 µm sieve.

III. SELECTION OF OPTIMUM DOSE OF COAGULANT

For appropriate dose jar test is used. Arrangement consists of 6 beakers with paddles for mixing coagulant. The coagulant is added in each beaker with varying dose in which 1000 ml sample is taken. Paddles are made to rotate by motors keeping speed of 300rpm for 3 minutes. Further speed is reduced to about 20 to 40rpm and continued for 20 minutes. Then the sample is led to sedimentation for

180 minutes and the percentage reduction of turbidity is measured by turbidity meter.

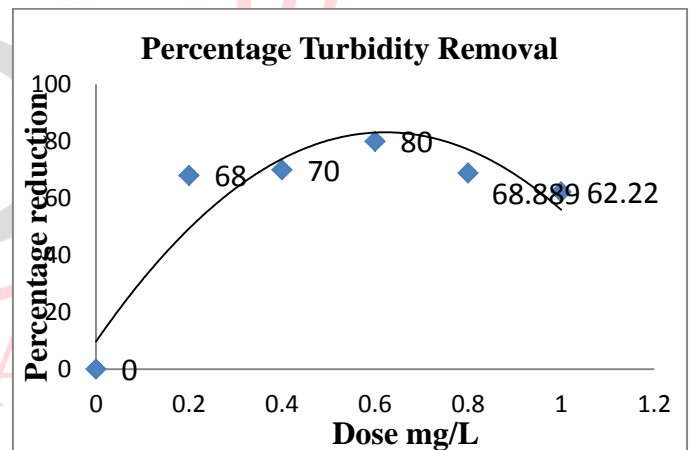
A. Moringa oleifera

The doses given by *Moringa oleifera* are 0.2gm/l, 0.4gm/l, 0.6gm/l, 0.8gm/l and 1gm/l. From this optimum dose selected is 0.6gm/l as shown in table 3.1

Table II. Turbidity reduction by different doses of moringa oleifera.

Dose gm/L	Turbidity	Percentage reduction of Turbidity
0	450	0
0.2	144	68
0.4	135	70
0.6	90	80
0.8	140	68.88
1	170	62.22

Graph 3.1 Turbidity reduction by different doses of moringa oleifera



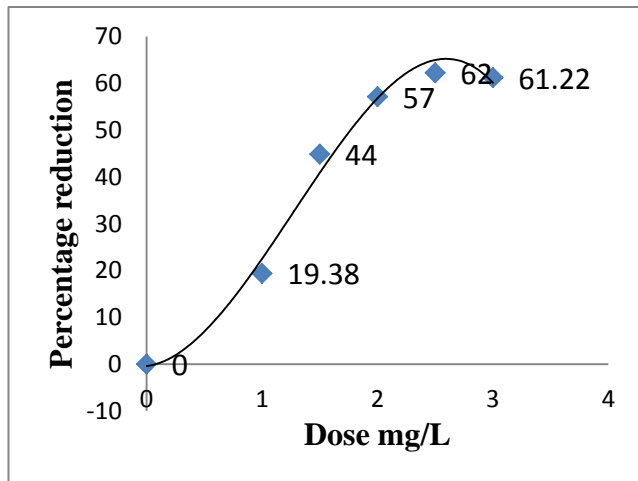
B. Fenugreek

The doses given by Fenugreek are 1 gm/l, 1.5 gm/l, 2 gm/l, 2.5 gm/l and 3 gm/l. From this optimum dose selected is 2.5 gm/l as shown in table 3.2

Table III. Turbidity Reduction by different doses of Fenugreek.

Dose gm/L	Turbidity	Percentage reduction of Turbidity
0	490	0
1	395	19.38
1.5	270	44.89
2	210	57.14
2.5	185	62.24
3	190	61.22

Graph 3.2 Turbidity Reduction by different doses of Fenugreek.



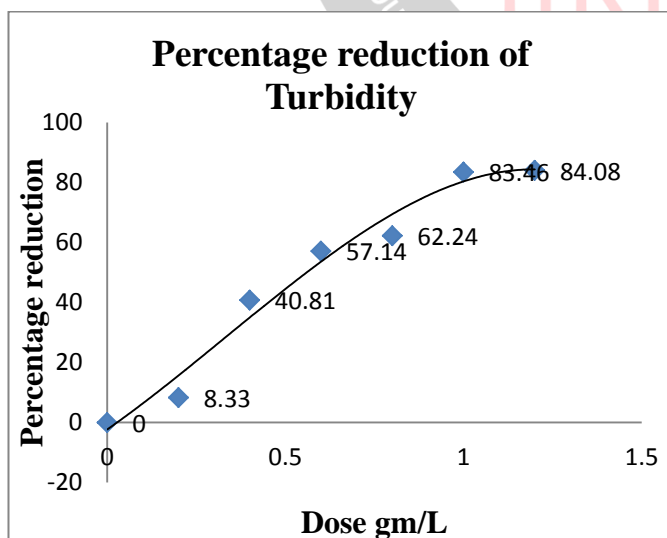
C. Alum

The doses given by Alum are 0.2 gm/l, 0.4 gm/l, 0.6 gm/l, 0.8 gm/l, 1 gm/l and 1.2 gm/l. From this optimum dose selected is 1 gm/l as shown in table 3.3

Table IV. Turbidity Reduction by different doses of Alum.

Dose gm/L	Turbidity	Percentage reduction of Turbidity
0	360	0
0.2	330	8.33
0.4	290	40.81
0.6	210	57.14
0.8	185	62.24
1	81	83.46
1.2	78	84.08

Graph 3.3 Turbidity Reduction by different doses of Alum.



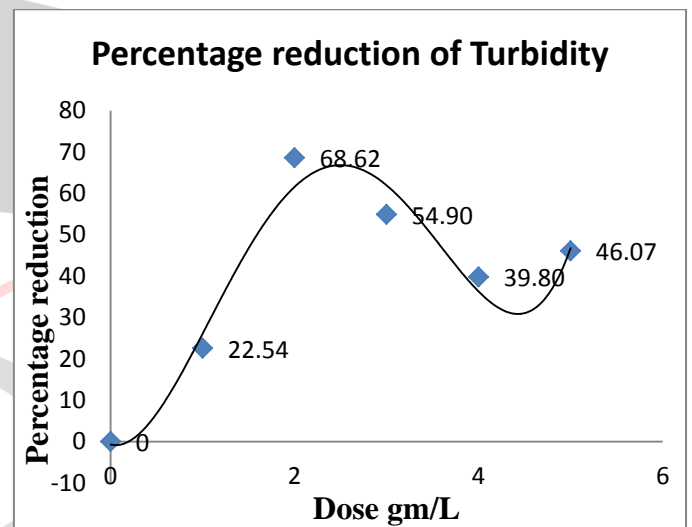
D. Combination of Alum, Moringa oleifera and Fenugreek

The doses given by Alum are 1 gm/l, 2 gm/l, 3 gm/l, 4 gm/l, and 5 gm/l. From this optimum dose selected is 2 gm/l as shown in table 3.4

Table V. Turbidity Reduction by different doses of combined coagulant.

Dose gm/L	Turbidity (NTU)	Percentage reduction of Turbidity
0	510	0
1	395	22.54
2	160	68.62
3	230	54.90
4	307	39.80
5	275	46.07

Graph 3.4 Turbidity Reduction by different doses of combined coagulant.



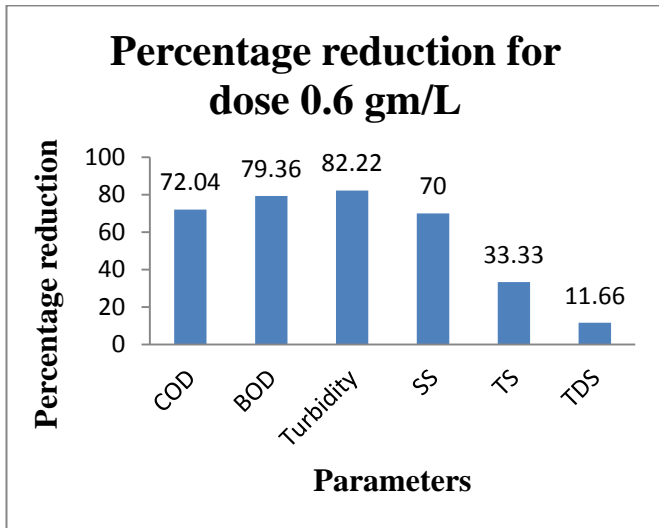
IV. RESULTS AND DISCUSSION

A. Moringa Oleifera

Table VI. Change in parameters by Moringa Oleifera dose of 0.6 gm/L

Parameters	Without treatment	With dose 0.6 gm/L	Percentage removal
pH	4.12	6.8	-
COD	5187	1450	72.04
BOD	2350	485	79.36
Turbidity	450	80	82.22
SS	750	225	70
TS	1650	1100	33.33
TDS	900	795	11.66

Graph 4.1 Change in parameters by Moringa Oleifera dose of 0.6 gm/L



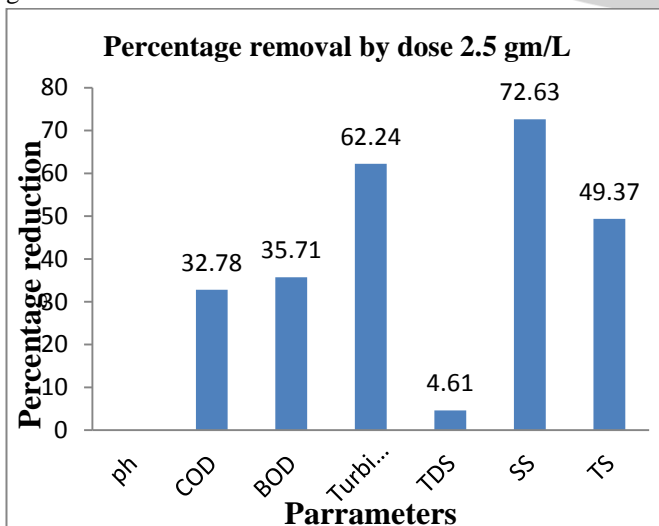
From graph we can observe that reduction of COD, BOD, Turbidity, SS, TS, TDS is 72.04%, 79.36%, 82.22%, 70%, 33.33% and 11.66% respectively. In this turbidity removal is more than other parameters i.e 82.22%.

B. Fenugreek

Table VII. Change in parameters by Fenugreek dose of 2.5 gm/L

Parameters	Without treatment	With dose 2.5 gm/L	Percentage removal
PH	5.2	6.5	-
COD	6100	4100	32.78
BOD	2800	1800	35.71
Turbidity	490	185	62.24
TDS	650	620	4.61
SS	950	260	72.63
TS	1600	810	49.37

Graph 4.2 Change in parameters by Fenugreek dose of 2.5 gm/L



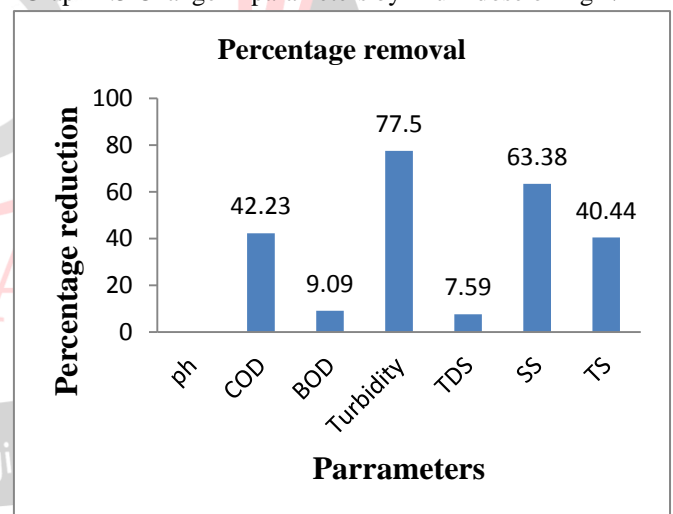
From graph we can observe that reduction of COD, BOD, Turbidity, TDS, SS, TS is 33.78%, 35.71%, 62.24%, 4.61%, 72.63% and 49.37% respectively. In this Suspended solids (SS) removal is more than other parameters i.e 72.63%.

C. Alum

Table VIII. Change in parameters by Alum dose of 1 gm/L

Parameters	Without treatment	With dose 1 gm/L	Percentage removal
Ph	5.2	5.2	-
COD	5540	3200	42.23
BOD	4510	4100	9.09
Turbidity	360	81	77.5
TDS	395	365	7.59
SS	710	260	63.38
TS	1360	810	40.44

Graph 4.3 Change in parameters by Alum dose of 1 gm/L



From graph we can observe that reduction of COD, BOD, Turbidity, TDS, SS, TS is 42.33%, 9.09%, 77.5%, 7.59%, 63.38% and 40.44% respectively. In this Turbidity removal is more than other parameters i.e77.5%.

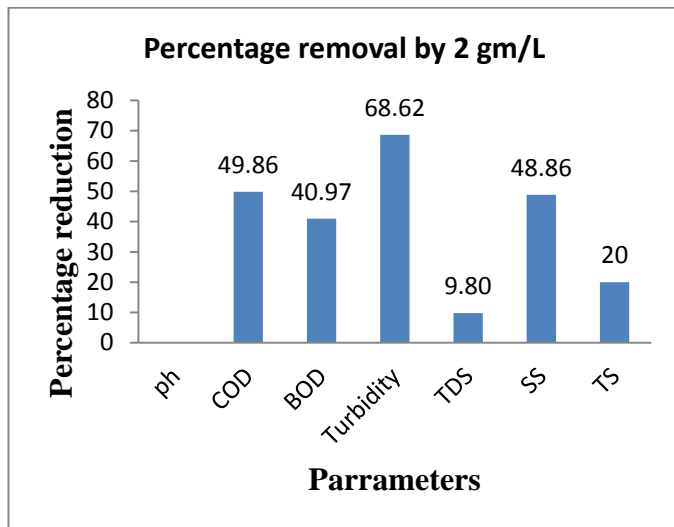
D. Combination

Table IX. Change in parameters by combine dose of 2 gm/L

Parameters	Without treatment	With dose 2 gm/L	Percentage removal
pH	5.2	5.2	-

COD	7500	3760	49.86
BOD	3500	2066	40.97
Turbidity	510	160	68.62
TDS	520	469	9.80
SS	880	450	48.86
TS	1400	1120	20

Graph 4.4 Change in parameters by combine dose of 2 gm/L



From graph we can observe that reduction of COD, BOD, Turbidity, TDS, SS, TS is 49.86%, 40.97%, 68.62%, 9.80%, 48.86% and 20% respectively. In this Turbidity removal is more than other parameters i.e.68.62%.

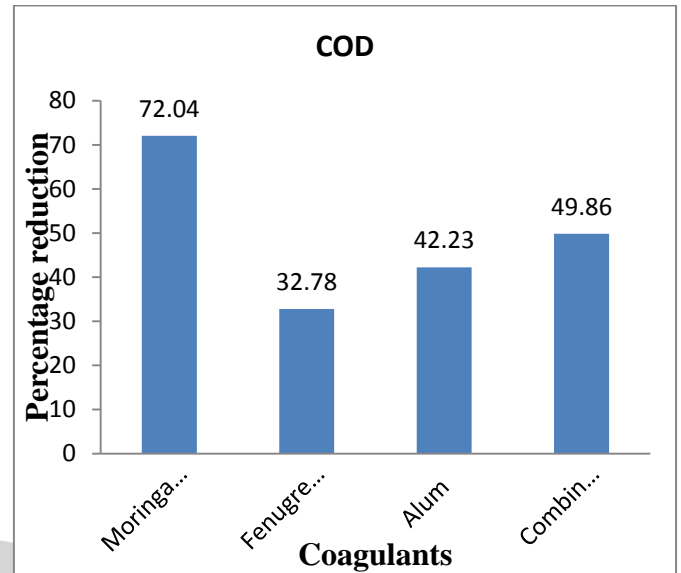
E. Comparison of all coagulants with different parameters

COD

Table X. Percentage reduction of COD by different coagulants

Coagulant	Percentage reduction of COD
Moringa Olefera	72.04
Fenugreek	32.78
Alum	42.23
Combination	49.86

Graph 4.5 Percentage reduction of COD by different coagulants



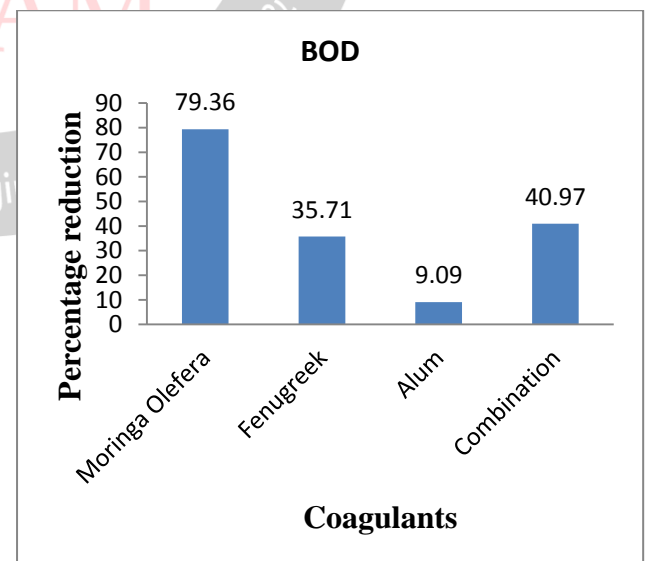
From graph we can observe that maximum reduction of COD is 72.04% by Moringa Oleifera

BOD

Table XI. Percentage reduction of BOD by different coagulants

Coagulant	Percentage reduction of BOD
Moringa Oleifera	79.36
Fenugreek	35.71
Alum	9.09
Combination	40.97

Graph 4.6 Percentage reduction of BOD by different coagulants



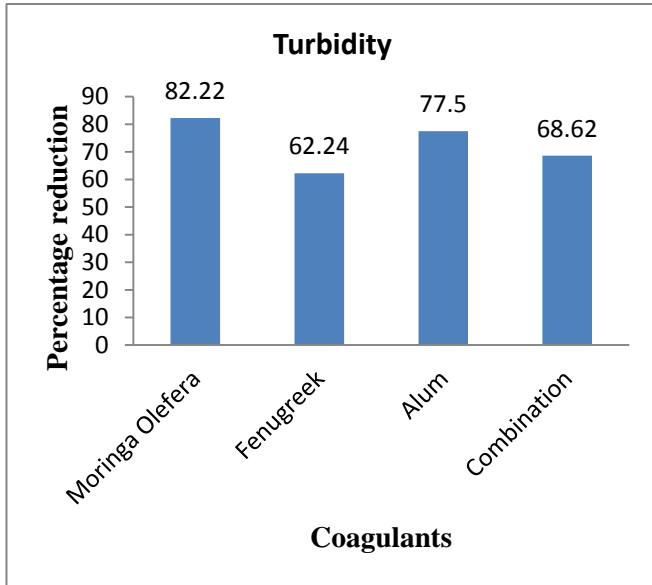
From graph we can observe that maximum reduction of BOD is 79.36% by Moringa Oleifera

Turbidity

Table XII. Percentage reduction of turbidity by different coagulants

Coagulant	Percentage reduction of Turbidity
Moringa Olefera	82.22 %
Fenugreek	62.24 %
Alum	77.5 %
Combination	68.62 %

Graph 4.7 Percentage reduction of turbidity by different coagulants



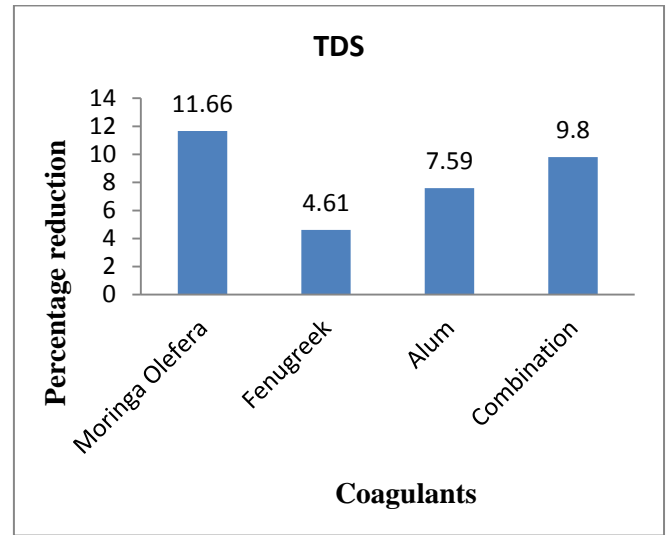
From graph we can observe that maximum reduction of Turbidity is 82.22% by Moringa Olefera

TDS

Table XIII. Percentage reduction of TDS by different coagulants

Coagulant	Percentage reduction of TDS
Moringa Olefera	11.66
Fenugreek	4.61
Alum	7.59
Combination	9.8

Graph 4.8 Percentage reduction of TDS by different coagulants



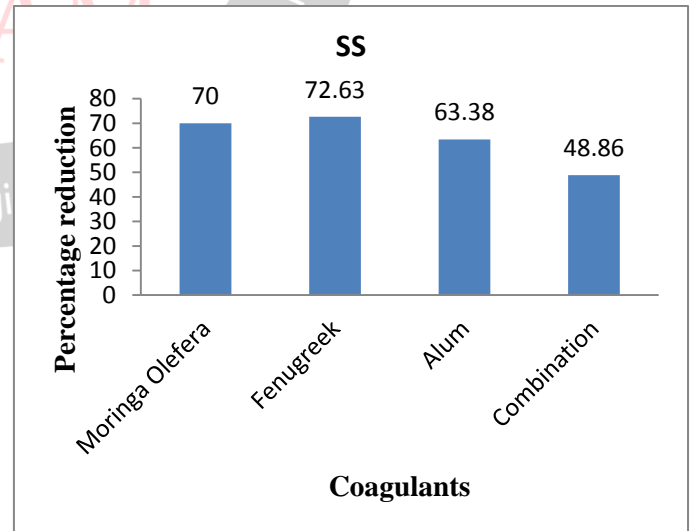
From graph we can observe that maximum reduction of TDS is 11.66% by Moringa Olefera

SS

Table XIV. Percentage reduction of SS by different coagulants

Coagulant	SS
Moringa Olefera	70
Fenugreek	72.63
Alum	63.38
Combination	48.86

Graph 4.9 Percentage reduction of SS by different coagulants



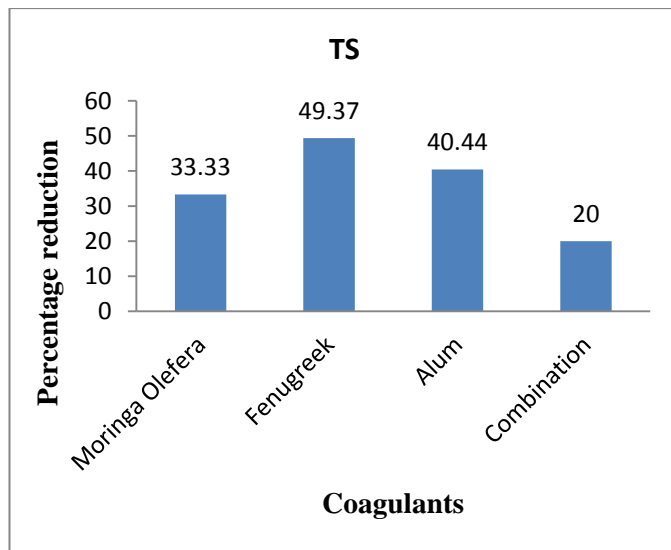
From graph we can observe that maximum reduction of SS is 72.63% by Fenugreek

TS

Table XV. Percentage reduction of TS by different coagulants

Coagulant	TS
Moringa Olefera	33.33
Fenugreek	49.37
Alum	40.44
Combination	20

Graph 4.10 Percentage reduction of TS by different coagulants



From graph we can observe that maximum reduction of TS is 49.37% by Fenugreek

V. CONCLUSION

The maximum reduction of COD is obtained by Moringa Olefera that is 72.04 % than other coagulants. Hence if removal of COD is main objective than Moringa Olefera with dose 0.6 gm/L is best.

In case of BOD maximum reduction is 79.86% which is due to Moringa Olefera which would be best if removal of BOD is main objective.

The maximum reduction of Turbidity and TDS is 82.22% and 11.66% respectively by using 0.6 gm/L dose of Moringa Olefera. Hence to remove Turbidity and TDS Moringa Olefera is best.

The results of Fenugreek dose 2.5 gm/L shows maximum reduction of SS and TS which is 72.63 and 49.37 respectively. Hence removal of SS and TS is prime objective than Fenugreek is best.

In general if we observe all graphs it is quite clear that using minimum dose of Moringa Olefera maximum reduction is achieved in COD, BOD and turbidity. Hence Moringa Olefera is very effective for pre-treatment of

dairy waste water treatment which will reduce load on Effluent Treatment Plant.

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