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THE USE OF MORINGA OLIFERA SEEDS AND ALUM AS A NATURAL COAGULANT FOR DOMESTIC WASTE WATER TREATMENT IN SUMMER, WINTER & RAINY SEASONS

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Abstract

Moringa olifera is a pan tropical, multipurpose tree whose seeds contain a high quality edible oils (up to 40% by weight) and water soluble proteins that act as effective coagulants for water and waste water treatment. The use of this natural coagulant material has not yet realised its potential. A water extract of Moringa olifera seeds was applied to a waste water treatment sequence comprising coagulation-floculation-sedimentation-Filtration. The objective of this study is to evaluate the removal efficiency of turbidity, suspended solids, B O D, C O D& Total solids in three different seasons by using moringa olifera as a natural coagulant. Indiscriminate disposal of waste water with suspended solids have led to higher amount of pollution to the natural water bodies. Turbidity imparts a great problem in waste water treatment. It attempts the investigation of the coagulation performance of some parameters in contaminated domestic wastewater. The test results will be carried out using the conventional jar test apparatus. This study aims to add the fine powder of pre mentioned seeds as a natural coagulant in treating the domestic waste water which is turbid and the same water will be studied with synthetic coagulants such as alum. Both of these coagulant materials the removal efficiency is obtained very high in moringa olifera seeds. When used moringa olifera seed powder as coagulant, it caused favourable changes in the pH of the treated water and the best colour, turbidity & BOD removal at acceptable pH was obtained.

Keywords: Moringaolifera Seed Powder, Alum, Domestic Effluent, Coagulation, Jar test Apparatus.

1. INTRODUCTION

Water is a basic necessity of life for both animal and plants. Water covers over70.9% of the Earth's surface, of which 97% of the total water is covered by oceans, 2.4% by polar ice caps and 0.60% by other land surface water bodies like river, lakes. Water has become the most commercial product of the century; this may sound bizarre but true. In fact what oil was to the 20th century, water is for the 21st century? Human beings are putting an increasing pressure on the planet's water resources. In the earlier days when earth's population was less, it was imagined that oceans were too big to pollute. But in the recent century with increasing population the oceans also seems to be too smaller for getting polluted. (Harushet al.2011).

Generation of wastes is part of human activity from the ancient times. Disposal of waste on

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land, surface waters is a general practice, but the capacity to treat the waste water by natural process is limited. The two different ways in which water pollution can occur. If pollution comes from a single location then it is known as point source of pollution. A great deal of water pollution happens not from one single source but from many different scattered sources, which is called Non-point Source pollution. (Harushet al.2011).

Reuse of treated wastewater should not be limited to domestic discharges. In some cases, industrial wastewater discharges are of significant quantities and, when treated, should be considered part of the wastewater reuse. One of the most industrial sectors that produce large quantities of wastewater is the slaughterhouse sector which often contains high concentration of biodegradable organic matter. (Al–Mutairi et al., 2004)

From the environmental engineering point of view, this indicates that their treatment might be more demanding than domestic wastewaters. However, these wastewaters may be quiet useful when it comes to wastewater reuse for agriculture. As has been reported. (Al–Mutairi et al., 2004)

Domestic wastewater is very harmful to the environment. Effluent discharges from domestic wastewater can result in the depletion of oxygen from water bodies, and the contamination of groundwater. These effluents contain high levels of organic matter, which generally arise from paunch, faecal, fat and undigested food, blood, suspended material, urine, loose meat, soluble proteins, excrement, and particles. The pollution potential of meat-processing and slaughterhouse plants has been estimated at over 1 million population equivalent in the Netherlands (Sayed 1987), and 3 million in France (Festino and Aubart 1986).

2. OBJECTIVES OF THE STUDY

- Determine the efficiency of moringaolifera & Alum as a coagulant in different seasons. (Summer, winter & rainy Seasons).
- To treat the domestic waste water using moringaolifera & Alum as a coagulant to get the quality of water for agriculture.
- To determine optimum dosage of coagulant in different seasons. (Summer, winter & rainy Seasons.)

3. MATERIALS AND METHODS

Sample Collection; Samples were collected from the sedimentation tank it is situated outside of chickballapur town before any treatment was given. Initial colour of sewage is grey. Preserving the sample: Till the analysis was conducted, the samples were preserved at 4 degree centigrade and kept in refrigerator to prevent contamination.

Analysis of Sample: Parameters like BOD, Turbidity, COD, pH, Chlorides, Alkalinity, Total Solids of domestic waste water has been analysed as per standard methods by referring a code APHA book. The coagulation process conducted by jar test apparatus with moringaolifera seed powder& alum.

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Major parameters selected for the study were Turbidity, BOD & Total Solids. The procedure for the preparation of MO seed powder is given below:

- High quality pods, those which were new and not infected with disease and insects were selected.
- Seeds were opened and from pods and then dried sun light 48 hr to remove any moisture content if present.
- Hulls and wings from the kernels were removed manually to increase the effect of powder as coagulant and to reduce to waste sludge formation.
- The seed kernels were ground to a medium fine powder in grinder and sieved to get particles of the size 600 µm .The fine powder was used as coagulant for analysis.

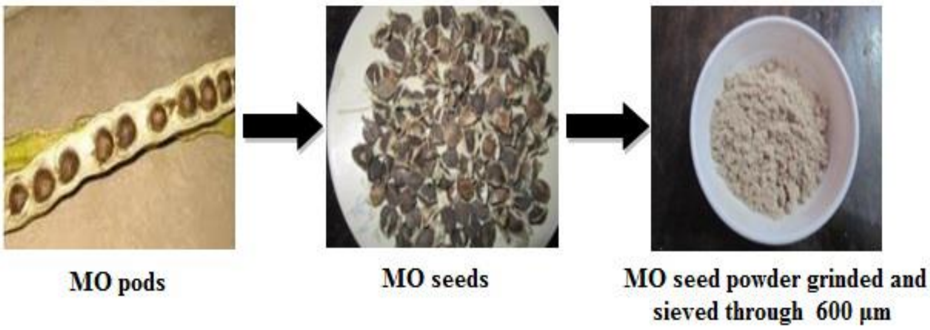

Fig 1: Preparation steps of Moringaoleifera seed powder

3.1 Coagulation Test

Jar test is most widely used experimental methods for coagulation-flocculation. A conventional jar test apparatus was used in the experiments to coagulate sample of domestic wastewater using moringaoleifera and beans seed powder. It was carried out as a batch test, accommodating a series of six beakers together of 1 liter capacity with six spindle steel paddles. Before operating the jar test, the sample is mixed homogenously. Then analyzing the parameters Turbidity, pH, total dissolved solids, suspended solids, total solids, colour, BOD and COD for both the moringaoleifera and alum by referring APHA book. Then results are plotted on graphs than they are compared. (Nabi*et al.*2007)

The batch experiment involving rapid mixing, slow mixing and sedimentation. The apparatus consists of six beakers to be agitated simultaneously. 500 ml of the domestic wastewater samples is put in to each 6 one-liter beakers and placed under jar test apparatus. The required dose of Moringaoleifera seed powder and Alum is added simultaneously. The paddles are inserted in the jars, the apparatus is switched on and the whole procedures in the jar test are conducted in different rotating speed, which consist of rapid mixing (100 rotations per minute, rpm) for 1 minute and slow mixing (30rpm) for 10 minutes. After the agitation being stopped,

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the suspensions are allowed to settle for 20 minutes. Finally, a sample was withdrawn using a pipette from the middle of supernatant for physicochemical measurements, so that the effect of coagulant dose on coagulation could be studied. Then, the samples are measured for different parameters.

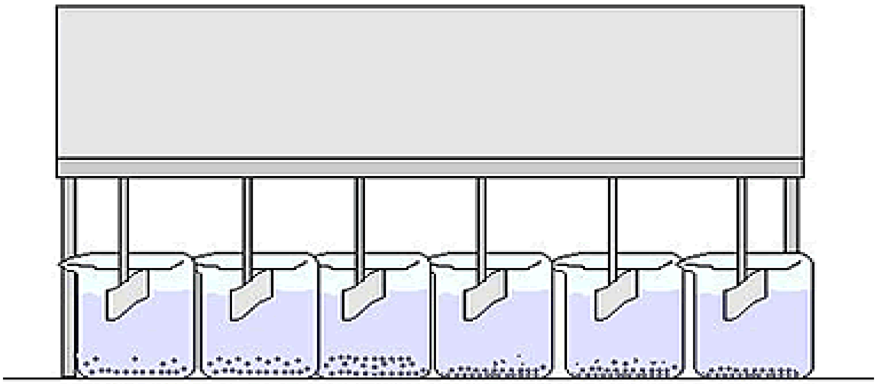

Fig 2: Jar Test Apparatus

4. RESULTS AND DISCUSSIONS

The Coagulant powder has been prepared and Optimum dosage of Moringa Olifera seed powder has been determined, graphs & Comparative study have been done. The domestic waste water was analyzed to understand the basic characteristics of wastewater in terms of parameters like pH, colour, turbidity, Total Solids, Total Suspended Solids, BOD, COD, Chlorides, Alkalinity, Oil and grease, Total Nitrogen, Electrical Conductivity and Iron. The tests are conducted by using moringaolifera seed powder tabulated below

Table 4.1: Characteristics of Domestic Waste Water in Summer Season

Sl. No	Parameter	Units	K.S.P.C.B	Raw water
1	pH	-	5.5-9.0	9.37
2	Turbidity	N.T.U	2.0 Max	85.1
3	T.D.S	Mg/l	600	1100
4	B.O.D	Mg/l	0	166
5	Chlorides	Mg/l	250	85.1
6	Total hardness	Mg/l	300	650
7	Total alkalinity	Mg/l	200	600
8	Total solids	Mg/l	600	2180
9	Electrical conductivity	µmhos/cm	2250 Max	8050
10	Dissolved oxygen	Mg/l	4-8	8.5
11	Chemical oxygen demand	Mg/l	250	289
12	colour	-	Agreeable	-

From the table it is clear that parameters like colour, turbidity, Conductivity, BOD, COD, Total Suspended Solids, Oil and Grease content and Total Nitrogen of the domestic wastewater are more than KSPCB Standards. Whereas pH, Iron as Fe and Copper as Cu are well within the permissible limits prescribed by KSPCB.

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Table 4.2: Characteristics of Domestic Waste Water in Winter Season

Parameters	Unit	K.S.P.C.B	Values
pH	-	5.5-9.0	7.34
TDS	mg/L	600	550
Turbidity	NTU	2.0	237
Conductivity	µs/cm	2250	570
TS	mg/L	600	522
SS	mg/L	600	555
Chlorides	mg/L	250	455
Alkalinity	mg/L	200	612
Total Hardness	mg/L	300	1050
BOD	mg/L	5	625
COD	mg/L	250	970

The domestic waste water was analyzed to understand the basic characteristics of waste water in respect of parameters like turbidity, BOD, COD, pH, TS, TSS, Chlorides, Hardness, Electrical Conductivity. The results of the analysis are tabulated below.

From the above desk it is clear that parameters like turbidity, BOD, COD, pH, TS, TSS, Chlorides, Hardness, Electrical Conductivity in that total dissolved solids, conductivity, suspended solids are under the permissible limits quoted by KSPCB.

Table 4.3: Characteristics of Domestic Wastewater in Rainy Season

Parameters	Unit	K.S.P.C.B	Values
pH	-	5.5-9.0	8.15
TDS	mg/L	600	412
Turbidity	NTU	2.0	148.5
Conductivity	µs/cm	2250	455
TS	mg/L	600	402
SS	mg/L	600	450
Chlorides	mg/L	250	340
Alkalinity	mg/L	200	500
Total Hardness	mg/L	300	955
BOD	mg/L	5	550
COD	mg/L	250	980

From the above table it is clear that parameters like turbidity, BOD, COD, pH, TS, TSS, Chlorides, Hardness, Electrical Conductivity in that total dissolved solids, conductivity, suspended solids are within the permissible limits prescribed by KSPCB.

4.1 Tests carried out with MOSP in Summer Season. (Moringa Oleifera Seed Powder)

Jar tests were performed to obtain the optimum dosage of MOSP. Tests had shown that the best dosage of MOSP is in the range of 0.75g/l to 1.5g/l of domestic wastewater. The initial turbidity of waste water had been reduced in the after using MOSP as a coagulant.

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Figure 3&4 shows the variation in the reduction of turbidity with respect to various MOSP & ALUM dosages. The various parameters of Domestic Waste water were found to vary with the treatment of MOSP. The following test results gives an insight to change in parameters occurred after the treatment of domestic waste water with MOSP.

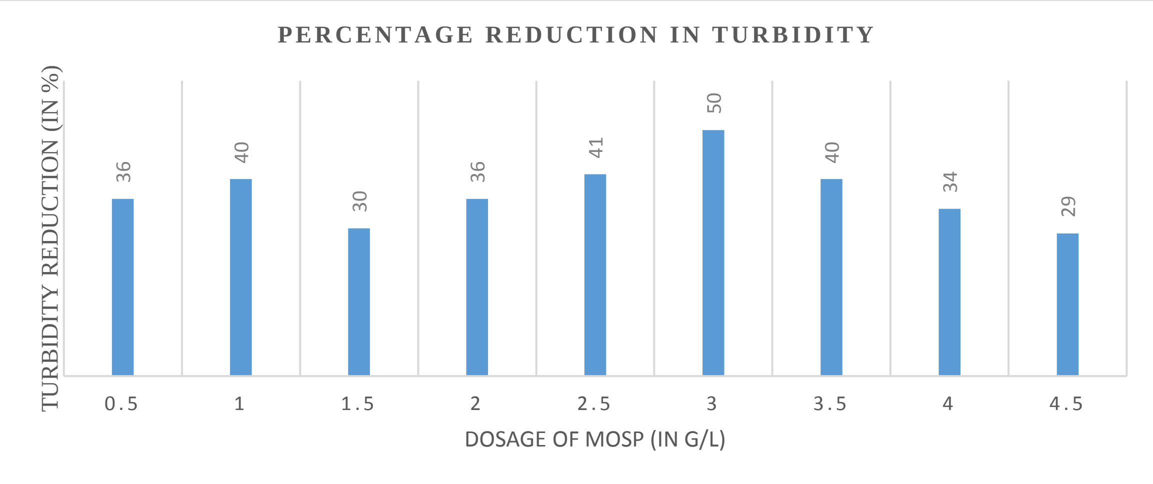

Fig 3: Percentage reduction in turbidity with varying MOSP dosages

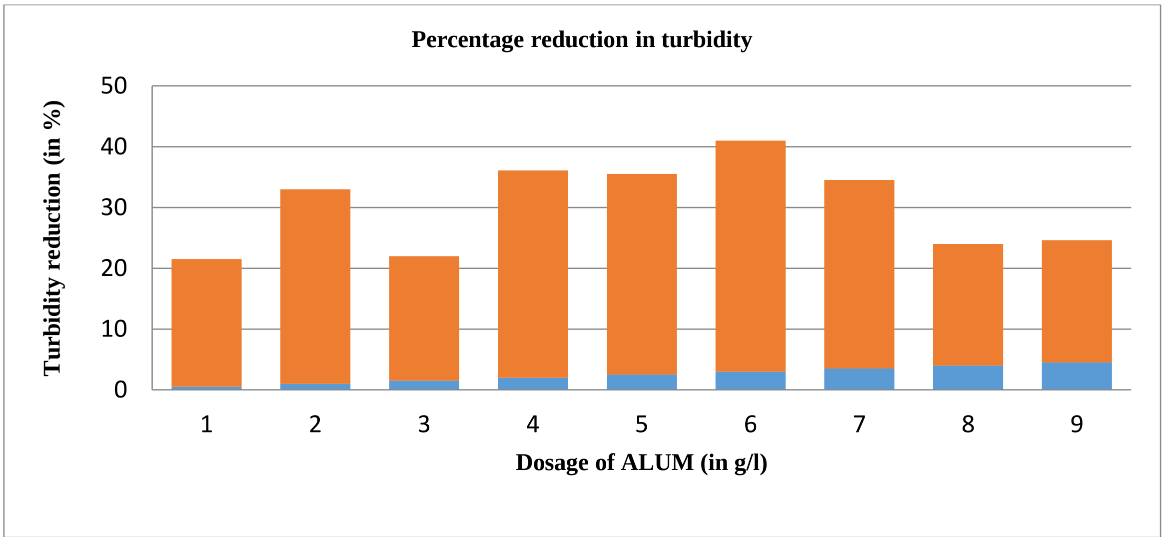

Fig 4: Percentage reduction in turbidity with varying MOSP dosages

Some parameters like turbidity, total hardness, total solids and Electrical Conductivity had greatly reduced after treatment with MOSP. Total hardness content was reduced to 650mg/l from 500 mg/l (76.92%). Turbidity was reduced from 85.1 to 28.5 NTU (32.9%). EC reduction was from 8.050µmhos/cm to 3.100µmhos/cm (71.76%) and Total Dissolved solids content reduced from 1100 mg/l to 800 mg/l (72%).

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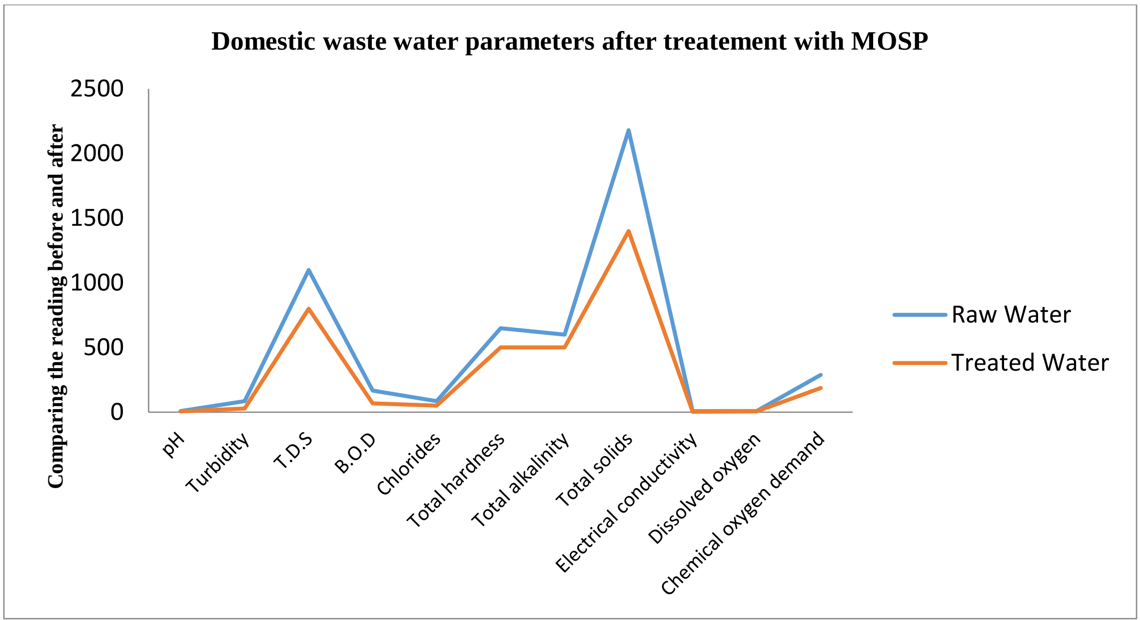

Fig 5: Test results after treatment with MOSP

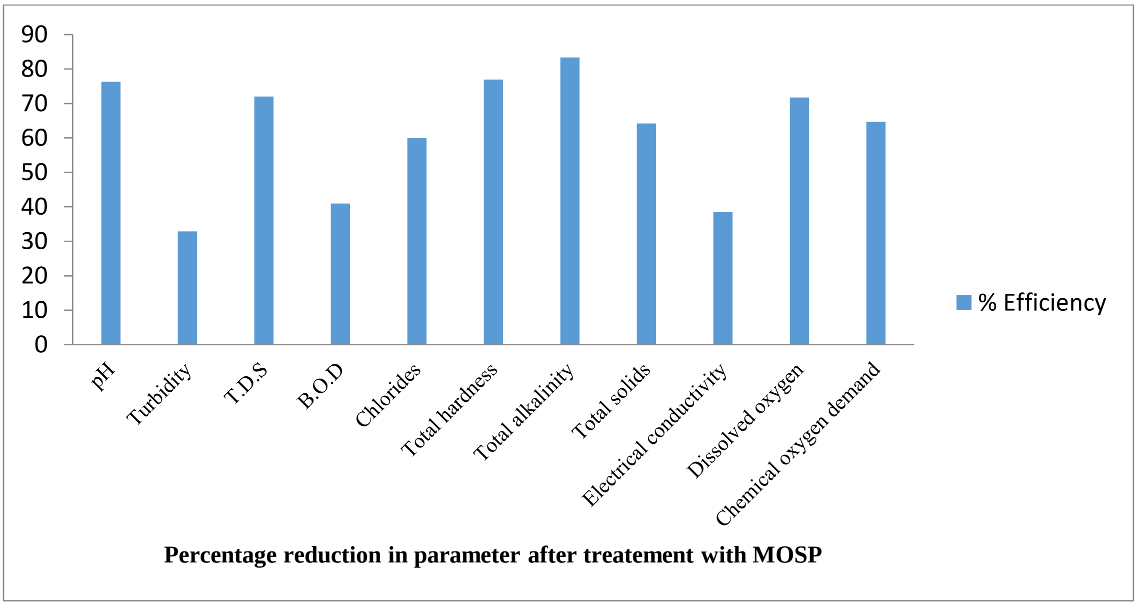

Fig 6: Percentage reduction in turbidity with varying MOSP dosages

Figure 5&6 shows the percentage reduction in parameter after treatment with MOSP& ALUM. The various parameters of domestic waste water were found to vary with the treatment of MOSP. The following test results give an insight into the change in parameters efficiency occurred after the treatment of domestic waste water with MOLP.

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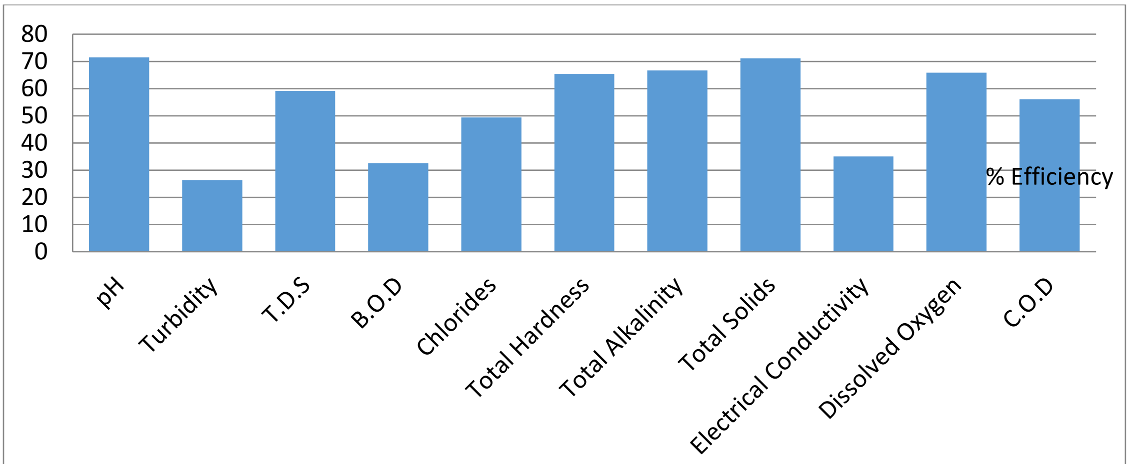

Fig 7: Percentage reduction in turbidity with varying ALUM dosages

Tests carried out with MOSP & Alum in Winter Season

Jar test were performed to obtain the optimum dosage of MOSP & Alum. Tests had shown that the best dosages of MOSP & alum are in the range of 0.4 mg/l of domestic waste water. The initial turbidity of water had been reduced in the after using MOSP as a coagulant. The obtained removal efficiency of turbidity, BOD was 83.54 & 76.80 in winter season.

Table 4.4: Change in pH for MO and Alum in Winter Season

Dosage (g)	Influent(mg/L)	MO	ALUM
		Effluent mg/L	Effluent mg/L
0.1	7.34	7.12	5.7
0.2	7.34	7.18	5.8
0.3	7.34	7.13	5.9
0.4	7.34	7.29	6.4
0.5	7.34	7.02	5.1

Table 4.5: Change in Turbidity for MO and Alum in Winter Season

Dosage (g)	Influent(mg/L)	MO	ALUM	% Removal with MO	% Removal with Alum
		Effluent mg/L	Effluent mg/L		
0.1	237	119	56	49.78	76.37
0.2	237	101	61	57.38	74.26
0.3	237	87	66	63.29	72.15
0.4	237	39	72	83.54	69.62
0.5	237	52	65	78.05	72.57

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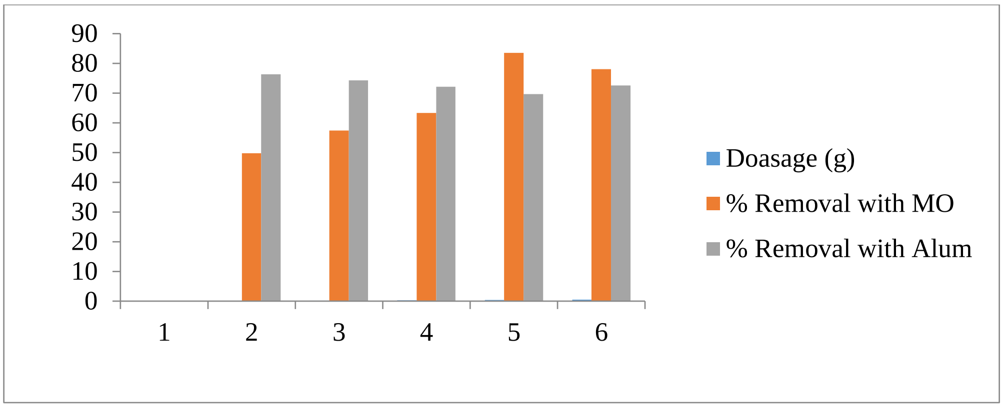

Fig 8: variation in the reduction of turbidity

The above third figure showcase the variation in the reduction of turbidity with respect to varying dosages of MOSP & ALUM in winter season. The removal efficiency of turbidity was 83.54 & 69.62 for 0.4 gm/L dosage. At an optimum dosage of 0.4mg/l of MO, the turbidity of waste water sample was reduced from 237 NTU to 39 NTU. From this we are observing the greater reduction of turbidity by using natural coagulant Moringa olifera Seeds. It is therefore concluded that the method of allowing water to settle without coagulation is not efficient in addressing the challenges facing potable water supply especially where the scarcity of water. Removal of organic matter is high in winter season due to the availability of DO

Table 4.6: Change in BOD for MO and Alum in Winter Season

Dosage (g)	Influent(mg/L)	MO	ALUM	% Removal with MO	% Removal with Alum
		Effluent mg/L	Effluent mg/L		
0.1	625	310	340	50.04	45.60
0.2	625	285	380	54.40	54.40
0.3	625	267	415	57.28	33.60
0.4	625	145	430	76.80	31.20
0.5	625	165	310	73.60	50.40

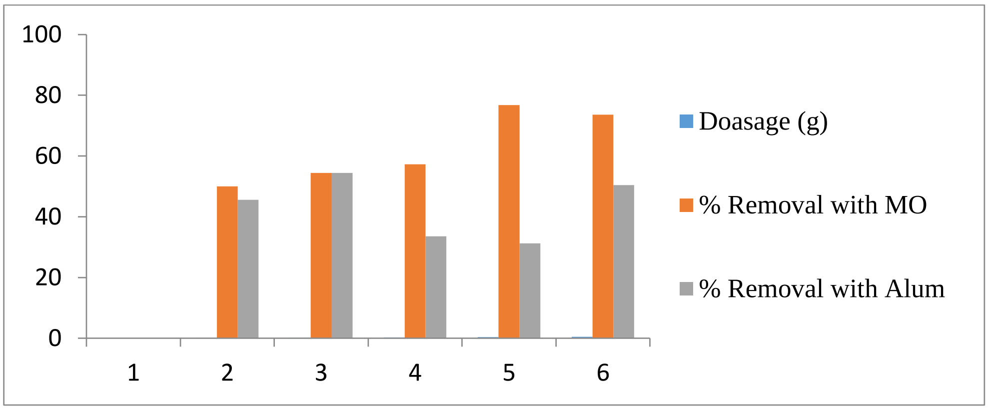

Fig 9: Variation in the reduction of BOD with respect to varying dosages

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From above fourth chart it shows the variation in the reduction of BOD with respect to varying dosages of MOSP & ALUM in winter season. The removal efficiency of BOD was 76.80 & 31.20 for 0.4 gm/l dosage. At an optimum dosage of 0.4 mg/l of MO, the BOD value of waste water was reduced from 625mg/l to 145 mg/l. From this we are observing the greater reduction of BOD by using natural coagulant Moringaolifera Seeds. Here we are observing the removal of organic compounds is very high.

4.7: Change in pH for MO and Alum in Rainy Season

Dosage (g)	Influent(mg/L)	MO	ALUM
		Effluent mg/L	Effluent mg/L
0.1	8.15	6.08	7.12
0.2	8.15	5.99	7.05
0.3	8.15	5.95	7.02
0.4	8.15	5.95	6.99
0.5	8.15	6.0	6.91

Table 4.8: Change in Turbidity for MO and Alum in Rainy Season

Dosage (g)	Influent(mg/L)	MO	ALUM	% Removal with MO	% Removal with Alum
		Effluent mg/L	Effluent mg/L		
0.1	148.5	56	71	76.37	52.18
0.2	148.5	51	64	65.65	56.90
0.3	148.5	46	61	69.02	58.92
0.4	148.5	42	55	71.71	62.96
0.5	148.5	55	62	62.96	58.24

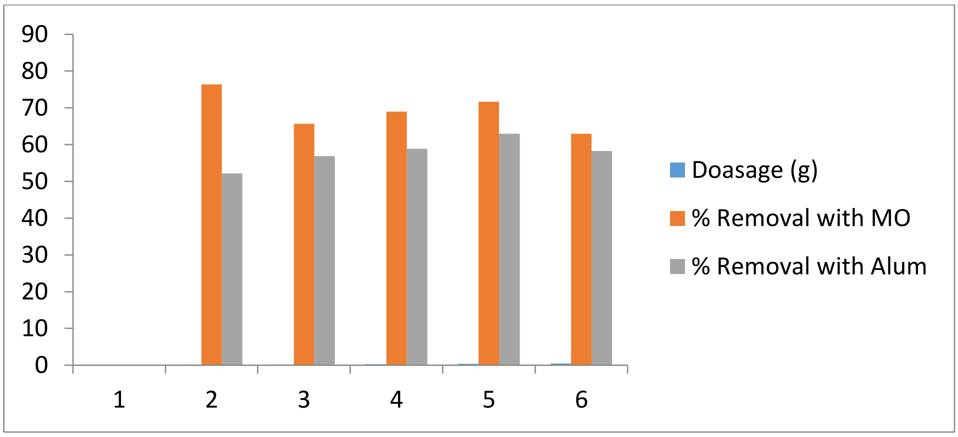

Fig 10: Variation in the reduction of turbidity with respect to varying dosages

Figure 10 shows the variation in the reduction of turbidity with respect to varying dosages of MOSP & ALUM in rainy season. The removal efficiency of turbidity was 71.71 & 62.96 for 0.4 gm/l dosage. At an optimum dosage of 0.4mg/lof MO, the turbidity value of waste water was reduced from 148.5 NTU to 42 NTU. From this we are observing the higher reduction of turbidity by using natural coagulant Moringa Olifera Seeds.

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Table 4.9: Change in BOD for MO and Alum in Rainy Season

Dosage (g)	Influent(mg/L)	MO	ALUM	% Removal with MO	% Removal with Alum
		Effluent mg/L	Effluent mg/L		
0.1	550	305	340	44.54	38.18
0.2	550	297	325	46.00	40.90
0.3	550	271	305	50.72	44.54
0.4	550	235	294	57.27	46.54
0.5	550	262	321	52.36	41.63

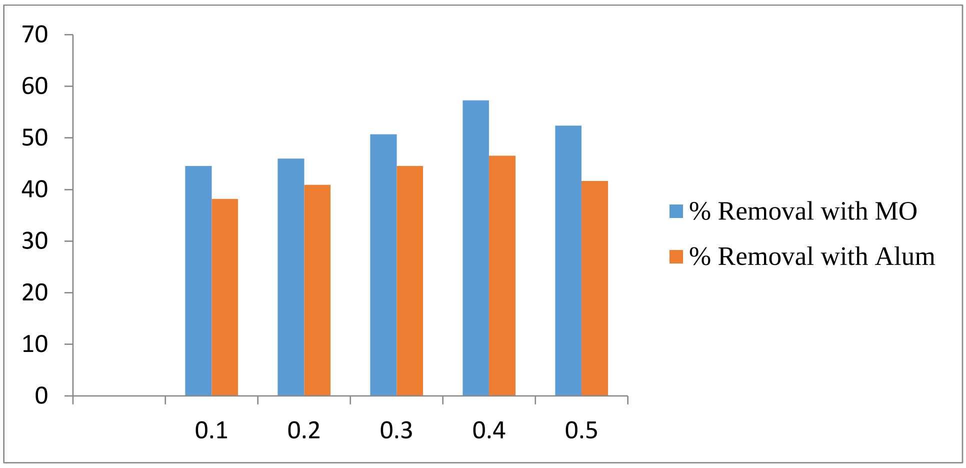

Fig 11: variation in the reduction of BOD

Figure 11 shows the variation in the reduction of BOD with respect to varying dosages of MOSP & ALUM in rainy season. The removal efficiency of BOD was 57.27 & 46.54 for 0.4 gm/l dosage. At an optimum dosage of 0.4gm/l of MO, the BOD value of waste water was reduced from 550 mg/l to 235 mg/l. From this we are observing the great reduction of BOD by using natural coagulant Moringa Olifera Seeds. So, overall in winter season the removal efficiencies is higher as compare to rainy season.

5. CONCLUSION

MoringaOlifera seeds are an environmentally friendly natural coagulant it is best suitable for the treatment of waste water containing undesirable parameters like Turbidity, BOD, Electrical conductivity, Total solids, Hardness, Chlorides etc… Observed on the test results; the following conclusion can be drawn

- The best dosage of MOSP in treatment of domestic waste water is in the range of 0.75g/l to 1.5g/l in summer season.
- The initial turbidity of waste water had been reduced in the range of 8% to 36% after using MOSP as a coagulant in summer.
- Compare to MOSP removal efficiency is less in Alum in summer season.

- On the other hand, some parameters which can be easily removed, like turbidity, oil and grease, total nitrogen and Electrical Conductivity, total solids and total hardness had greatly reduced after treatment with MOSP.
- The trials with MOSP had decreased the following parameters; Electrical conductivity decreased by around 71%. Turbidity content of waste water was decreased by 32% in summer season.
- The best dosage of MOSP in treatment of domestic waste water for reduction in turbidity by using in winter & rainy season are **83.54 &71.71.**
- The best dosage of MOSP in treatment of domestic waste water for reduction in BOD by using in winter & rainy season are **76.80 &57.27.**
- The initial turbidity of waste water had been reduced in the range of **80%** after using MOSP as a coagulant.
- On the other hand remaining parameters also greatly reduced after treatment with MOSP.
- The trials with MOSP had decreased the following parameters; Electrical Conductivity decreased by about **65.88%.** Chlorides content of waste water was decreased by about **42.50%.**
- The generation of sludge is greatly reduced by using MOSP as a coagulant.
- It was observed that the removal efficiency is higher in winter season compare to rainy season because, dilution ratio is high in winter seasons.

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