Purification of waste water using moringa Oleifera

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Abstract : The increasing demand for clean water and the limitations of conventional treatment methods have driven the search for sustainable and cost-effective alternatives. *Moringa oleifera*, a widely available plant in tropical and subtropical regions, has emerged as a promising natural coagulant for wastewater treatment. The seeds of *Moringa oleifera* contain water-soluble proteins that possess coagulating properties capable of removing suspended particles, turbidity, and certain microorganisms from contaminated water.

This study explores the efficiency of *Moringa oleifera* seed powder in the purification of wastewater. The treatment process involves seed extraction, drying, grinding into powder, and application to untreated water. Upon addition, the positively charged proteins neutralize negatively charged particles, facilitating flocculation and sedimentation. Experimental results demonstrate significant reductions in turbidity, total dissolved solids (TDS), and microbial load.

Compared to chemical coagulants such as alum, *Moringa oleifera* offers advantages including biodegradability, low toxicity, affordability, and accessibility in rural areas. However, challenges such as limited shelf life and potential organic residue require further investigation.

In conclusion, *Moringa oleifera* presents an eco-friendly and sustainable approach to wastewater treatment, particularly suitable for developing regions lacking advanced purification infrastructure.

IndexTerms **- Component,formatting,style,styling,insert.**

I. INTRODUCTION

CONVENTIONAL WATER TREATMENT HAS MANY PROBLEMS AND FEW ARE AS DESCRIBED BELOW:

As we know, we get water from rains for almost all the sources. The lakes and ponds are nothing but the rain water catchments and hence the only source is rain water. The underground water sources are from aquifers and cavities formed deep inside the earth ages ago and the water inside them is filled up due to the process of infiltration of water from the surface and hence again the main source of water is rain. Thus, for all water bodies' rain is a major source.

Rain water's characteristics vary accordingly depending upon the location of the evaporation, condensation and precipitation. The pollutants present in the atmosphere are also responsible for tampering. Other factors that are responsible for affecting the rain water are the variations in the weather depending upon the seasons, the catchment areas, the presence of chemicals and fertilizers in the area and also the soil constituents and their compositions. Hence, these conditions lead to the variation of the characteristics of the raw water quality. All these factors in turn affect the water treatment process as it leads to the change in the methodology and the amount of dosage of chemicals used for the treatment of the raw water which is a matter of rising concern.

A number of effective coagulants form plant origin have been identified; Nirmala, Okra, red bean, sugar and red maize,

M. Oleifera, natural coagulant from animal origin, Chitosan. Natural mineral coagulants have also been including fluvial clay and earth from termite hills. Of all plant material investigated, seeds of M. Oleifera are one of the most effective sources of coagulant for water treatment. In laboratory and field tests, seeds of M. Oleifera have shown excellent coagulant properties in the clarification of turbid water in many research organizations.

The seeds contain water soluble positively charged proteins that act as an effective coagulant. However, the crude Moringa extract increased the organic load in the treated water. The current research deals with the purification of waste water using the natural coagulant, i.e. purified M. Oleifera seed coagulant.

Fig.1: Moringa oleifera seed powder

2. NEED OF THE STUDY.

The need for this study arises from the growing global challenge of water pollution and the lack of access to safe and clean drinking water, especially in developing and rural regions. Rapid industrialization, urbanization, and population growth have significantly increased the contamination of water resources, making conventional treatment methods expensive and less accessible to many communities.

Chemical coagulants such as alum are widely used in wastewater treatment; however, they are associated with high costs, potential health risks, and environmental concerns due to sludge generation and non-biodegradability. This creates a demand for alternative, eco-friendly, and cost-effective purification methods.

Moringa oleifera is a natural, locally available plant with proven coagulating properties. Its seeds contain biodegradable proteins that can effectively remove impurities, reduce turbidity, and decrease microbial content in water. Despite its potential, it remains underutilized in large-scale water treatment systems.

Therefore, this study is needed to evaluate the effectiveness, feasibility, and sustainability of using *Moringa oleifera* in wastewater purification. It aims to promote a low-cost, safe, and environmentally friendly solution that can be easily adopted in resource-limited settings, contributing to improved public health and water management practices.

3. Data and Sources of Data

DESCRIPTION OF LAKE WATER SOURCE AND ITS BACKGROUND

For the project, two lake water samples were collected and put to test. The two sources of samples are:

3.1. Bellandur lake:

3.1.1. Introduction:

Bellandur Lake is a lake in the suburb of Bellandur in the southeast of the city of Bengaluru and is the largest lake in the city. It was used for landing amphibious aircraft during British rule. It is a part of Bellandur drainage system that drains the southern and the south-eastern parts of the city. The lake is a receptor from three chains of lakes upstream, and has a catchment area of about 148 square kilometres (37,000 acres). Water from this lake flows further east to the Varthur Lake, from where it flows down the plateau and eventually into the Pinakani river basin. It is currently highly polluted with sewage, and in May 2015 the foam covering the water surface caught fire and burned for hours.

Fig.2 :Top view of Bellandur lake

Fig.3: Bellandur lake channel

3.1.2. Geography:

Bellandur Lake is believed to be originally a tributary of the Dakshina Pinakini river (also known as the Ponnaiyar River). The lake itself was constructed during the reign of the Western Ganga Dynasty, who ruled between the 4-5th century to the 10th century CE. Evidences of early human settlement have been excavated along the bed of the Bellandur Lake by historian Dr. PV Krishnamurthy.

Bellandur Lake is a major water body which is located in one of the three main valleys of Bengaluru. It forms a part of the Ponnaiyar River catchment, and water from Bellandur flows to Varthur Lake, ultimately joining the Pennar River. Currently, most of Bangalore's treated and untreated sewage is released into Bellandur Lake, severely polluting it, resulting in a depletion of wildlife in and around the lake. Residential and commercial activities in the region have resulted in increasing the silt deposition in the lake and have caused loss of underground water recharge.

3.1.3. Flora and fauna:

The Bellandur Lake was a prominent catchment area with a good green cover and was a watering hole for the regions numerous, indigenous wildlife. But 30 years of unplanned urbanization have taken a toll on the lake, now several species are gone from the area, including kingfishers, parakeets, wood pigeons, kites, cobras, rat snakes, monitor lizards. As more and larger apartment complexes come up on the lakes shores, more such species will disappear.

3.1.4. Impact of urbanization:

The problem goes back to 1980s when unplanned growth broke the chain of tanks and lakes feeding the Bellandur Lake. This reduced the amount of rain water reaching the lake to recharge it. The development also resulted in letting in untreated sewage water from housing societies and using the lake surrounding area to dump solid waste. Even industries from surrounding areas started dumping their waste into the lake.The combination of all these factors has led to a decline in the once robust ecosystem of the lake which now resembles a stinking cesspool. Residents in neighboring areas complain of an odious stench that rises from the lake as a result of uninhibited sewage and chemical dumping from nearby industrial units.The presence of industrial chemicals in the water causes the lake surface to catch fire regularly.

The main source of the problem comes from the fact that the lake doesn't completely come under any one civic body. The lake is under the jurisdiction of multiple agencies and civic bodies thus leading to lack of accountability.

3.1.5. Background:

Bellandur Lake is 130 years old and spreads across an area of 892 acres. It is located at latitude of 12°58' N and longitude of 77°35' E at an altitude of 921 m above mean sea level. It is the largest lake in east Bangalore.

Bellandur tank is part of the Bellandur drainage system that drains the southern and the South-eastern parts of the city. The tank is a receptor from three chains of tanks. One chain, originates in the north, from Jayamahal, covers the eastern portion and has been referred to as the eastern stream. Another chain originates from the central part of the city, from around the K.R.Market area and covers the central portion and is called the central stream. The other chain, that reaches the tank is through the south-western region and is called the western stream. The catchment area of Bellandur tank is an area of about 148 sq kms. Water from this tank flows further east to the Varthur tank, from where it flows down the plateau and eventually into the Pinakani river basin.

3.2. Surya city lake :

3.2.1. Introduction and geography:

Surya city lake is located behind Nisarga sarovara apartment, which was artificially created in 19th century by the local inmates in order to create a water source that would fulfil the domestic needs.

People use this for bathing, washing clothes, bathing animals and domestic uses. The water in the lake was mainly formed for domestic purpose during those times. It is situated in about 2 acres land.

It is locally called as LAAVU.

The lake water is very alkaline.

3.2.2. Flora and Fauna:

The lake basin is covered by many number of eucalyptus trees. There are many parasites, algae, amphibians that breed this lake. Many times even reptiles have been spotted. Primarily many cat fishes are found in this lake.

3.2.3. Impact of urbanization:

Due to the construction of Nisarga sarovara apartment tremendous amount of waste materials are dumped into this lake. The entire sewage is discharged into the lake there by polluting it. Due to drying up of the lake during summer season the local men dug up a bore well in the lake and this action has depleted and polluted the ground water table.

4. PROCUREMENT OF MATERIALS AND SETTING UP OF TREATMENT PLANT

- Order was placed for two tanks at the aquarium shop ("D pet's gallery") , one flocculation tank (rectangular) made up of glass of capacity 20 litres and second a sedimetation tank (rectangular on the top and trapezoidal at the bottom) made up of glass of capacity 20 litres.

Fig.4: D'Pets gallery

Fig.5: Making of sedimentation tank

- Moringa oleifera powder of 2kg was purchased from a dealer from Coimbatore.

Fig.6. Moringa oleifera seed powder

- Samples were collected from two lakes, Bellandur and Surya city. Each lake sample comprising of 80 litres.
- Flocculators of the jar test apparatus were used to carry out the process of flocculation.

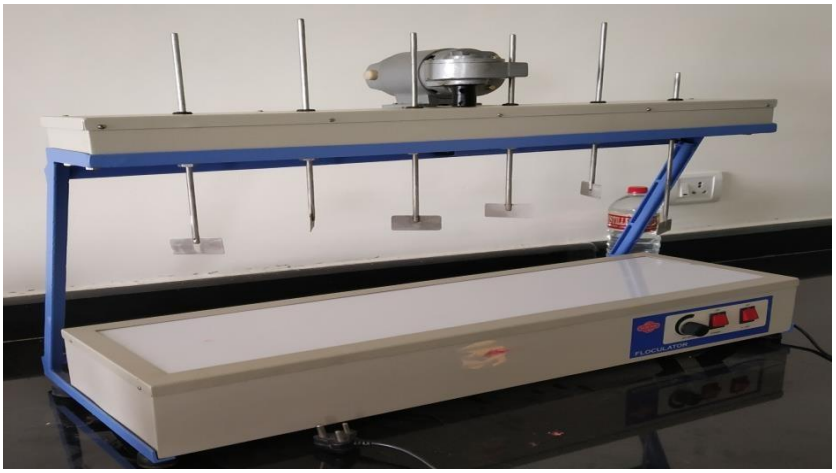


Fig.7: Flocculators

- An iron stand was setup and a ply-wood board was fixed on it.
- A rectangular hole was made at the centre of plywood board to hold the sedimentation tank in the proper position above the ground level.

- All the tanks were arranged accordingly and the setup was made as shown in the figure.

Fig.8: Setup of treatment plant

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

4. RESULTS AND DISCUSSION

Observation:

Tabular Column:

Bellandur lake water sample:

Table.5 (A): Raw water:

TRIAL NO.	TURBIDITY (NTU)
1.	58

Table.5 (B): Water treated with 25% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	47.4

Table.5 (C): Water treated with 50% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	17.5

Table.5 (D): Water treated with 75% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	15.7

Table.5 (E): Water treated with 100% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	12.8

Surya city lake water sample:

Table.5 (F): Raw water:

TRIAL NO.	TURBIDITY (NTU)
1.	43.2

Table.5 (G): Water treated with 25% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	39.6

Table.5 (H): Water treated with 50% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	33

Table.5 (I): Water treated with 75% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	18.8

Table.5 (J): Water treated with 100% of Moringa oleifera:

TRIAL NO.	TURBIDITY (NTU)
1.	12.3

Observation:
Tabular Column:

Bellandur lake water sample:

Table.6 (A): Raw water:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	9.5	9.5	9.5
2.	203	9.5	19	9.5	9.5

Table.6 (B): Water treated with 25% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	7.5	7.5	7.5
2.	203	7.5	15	7.5	7.5

Table.6 (C): Water treated with 50% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	6.3	6.3	6.3
2.	203	6.3	12.6	6.3	6.3

Table.6 (D): Water treated with 75% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	5.4	5.4	5.4
2.	203	5.4	10.8	5.4	5.4

Table.6 (E): Water treated with 100% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	3.9	3.9	3.9
2.	203	3.9	7.8	3.9	3.9

Surya city lake water sample:

Table.6 (F): Raw water:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	18.1	18.1	18.1
2.	203	18.1	36.2	18.1	18.1

Table.6 (G): Water treated with 25% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	14	14	14
2.	203	14	28	14	14

Table.6 (H): Water treated with 50% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	11.3	11.3	11.3
2.	203	11.3	22.6	11.3	11.3

Table.6 (I): Water treated with 75% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	7.9	7.9	7.9
2.	203	7.9	15.8	7.9	7.9

Table.6 (J): Water treated with 100% of Moringa oleifera:

SAMPLE	VOLUME OF SAMPLE	INITIAL BURETTE READING (ML)	FINAL BURETTE READING (ML)	VOLUME OF SODIUM THIOSULPHATE (ML)	DISSOLVED OXYGEN (PPM)
1.	203	0	7.1	7.1	7.1
2.	203	7.1	14.2	7.1	7.1

Fig.25: Floc settlement during DO experiment

Observation:

Formula:

Chlorides in mg/L =(V_1-V_2)*N*MW*1000/V Where,

V_1= Volume of $AgNO_3$ rundown for sample

V_2= Volume of $AgNO_3$ rundown for blank(distilled water) V= Volume of sample

N= Normality of of $AgNO_3$ =0.0141

M.W = Molecular weight=35.46 1000= Correction factor **Tabular Column:**

Bellandur lake water sample:

Table.7 (A): Raw water:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	24	24	479.9
2.	25	24	48	24	479.9

Table.7 (B): Water treated with 25% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	21	21	419.9
2.	25	21	42	21	419.9

Table.7 (C): Water treated with 50% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	20	20	399.98
2.	25	20	40	20	399.98

Table.7 (D): Water treated with 75% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	18.2	18.2	363.98
2.	25	18.2	36.4	18.2	363.98

Table.7 (E): Water treated with 100% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	16	16	319.99
2.	25	16	32	16	319.99

Surya city lake water sample:

Table.7 (F): Raw water:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	33	33	655.3
2.	25	33	66	33	655.3

Table.7 (G): Water treated with 25% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	30	30	599.98
2.	25	30	60	30	599.98

Table.7 (H): Water treated with 50% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	29	29	579.98
2.	25	29	58	29	579.98

Table.7 (I): Water treated with 75% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	26	26	519.9
2.	25	26	52	26	519.9

Table.7 (J): Water treated with 100% of Moringa oleifera:

TRIAL NO.	VOLUME OF SAMPLE	INITIAL BURETTE READING(ml)	FINAL BURETTE READING (ml)	VOL. OF TITRANT (ml)	CHLORIDE (mg/l)
1.	25	0	24	24	479.98
2.	25	24	48	24	479.98

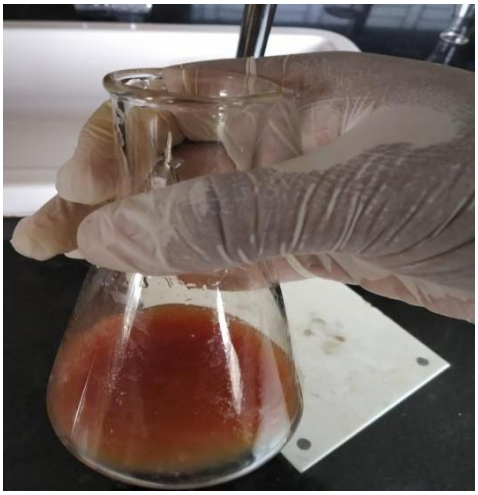
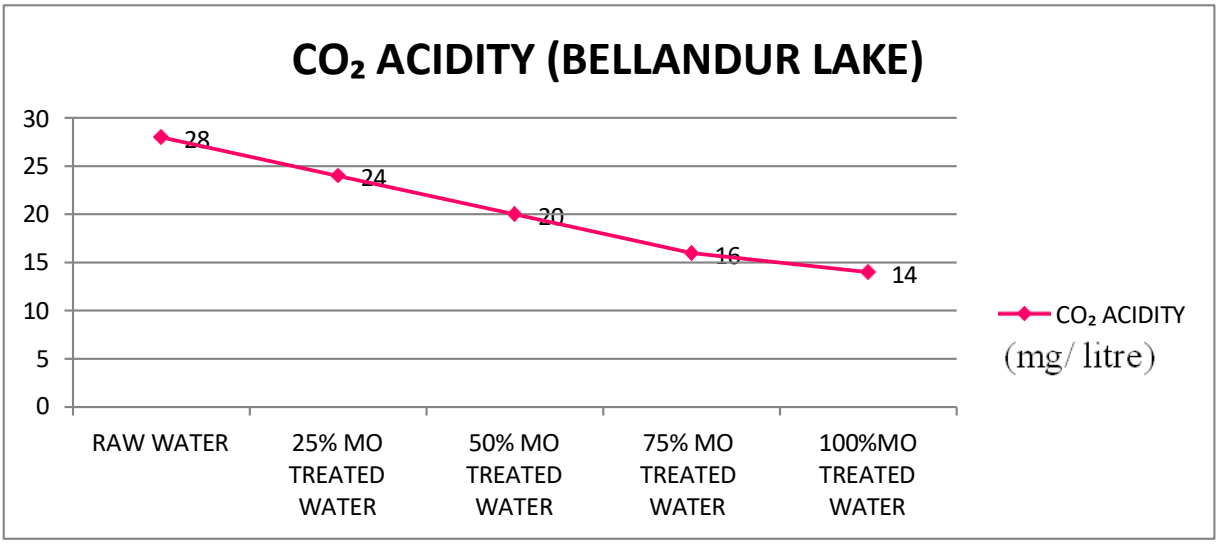


Fig.26:Colour change during chloride test

6. RESULTS AND CONCLUSIONS

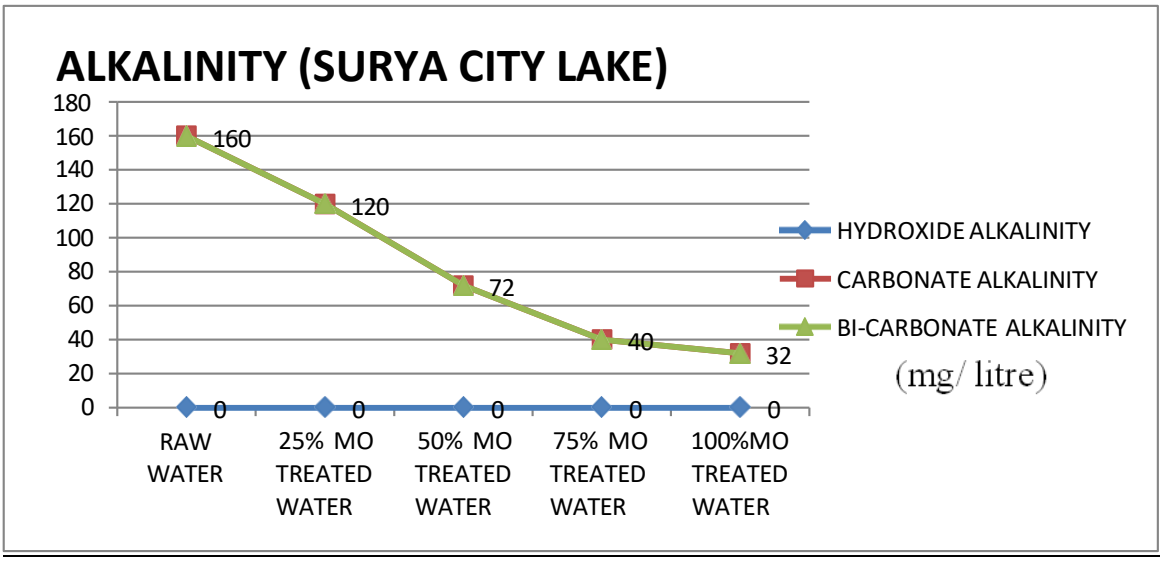
(A) : Graph for Acidity:



Acidity was observed only in Bellandur lake where as the Surya city lake was found to be alkaline and therefore exhibited 0 mg/litre acidity.

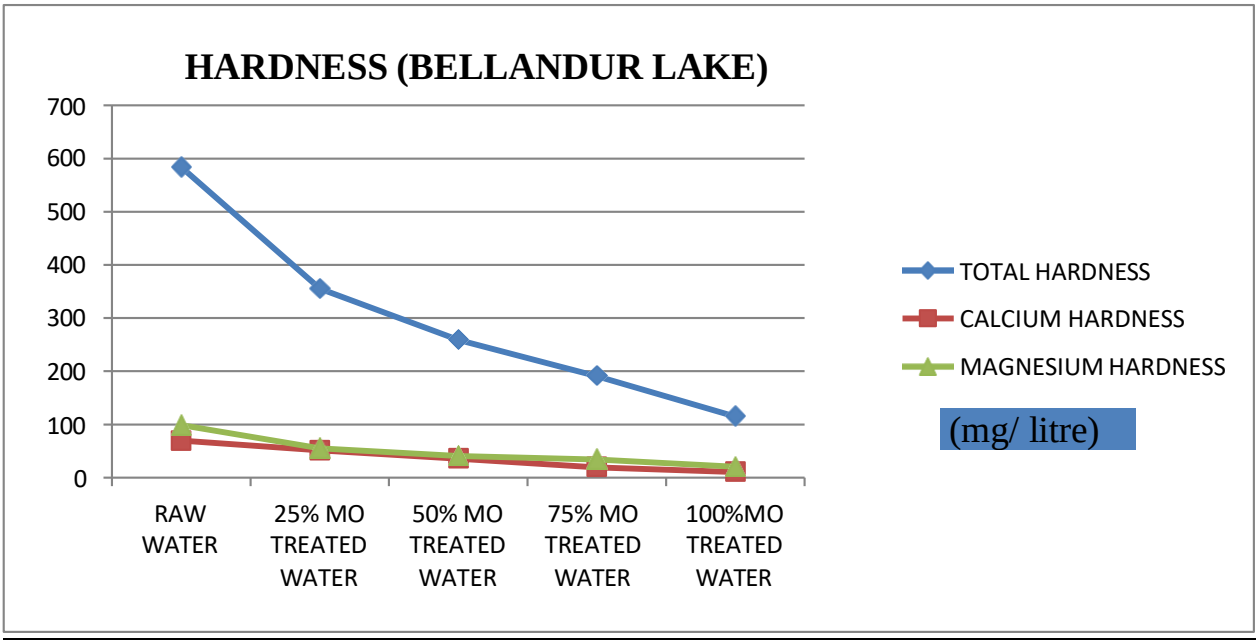
From the above graph it can be stated that acidity gradually decreased with increase in the concentration of Moringa Oleifera powder. Hence, this proves that Moringa Oleifera is a good acidity reducer.

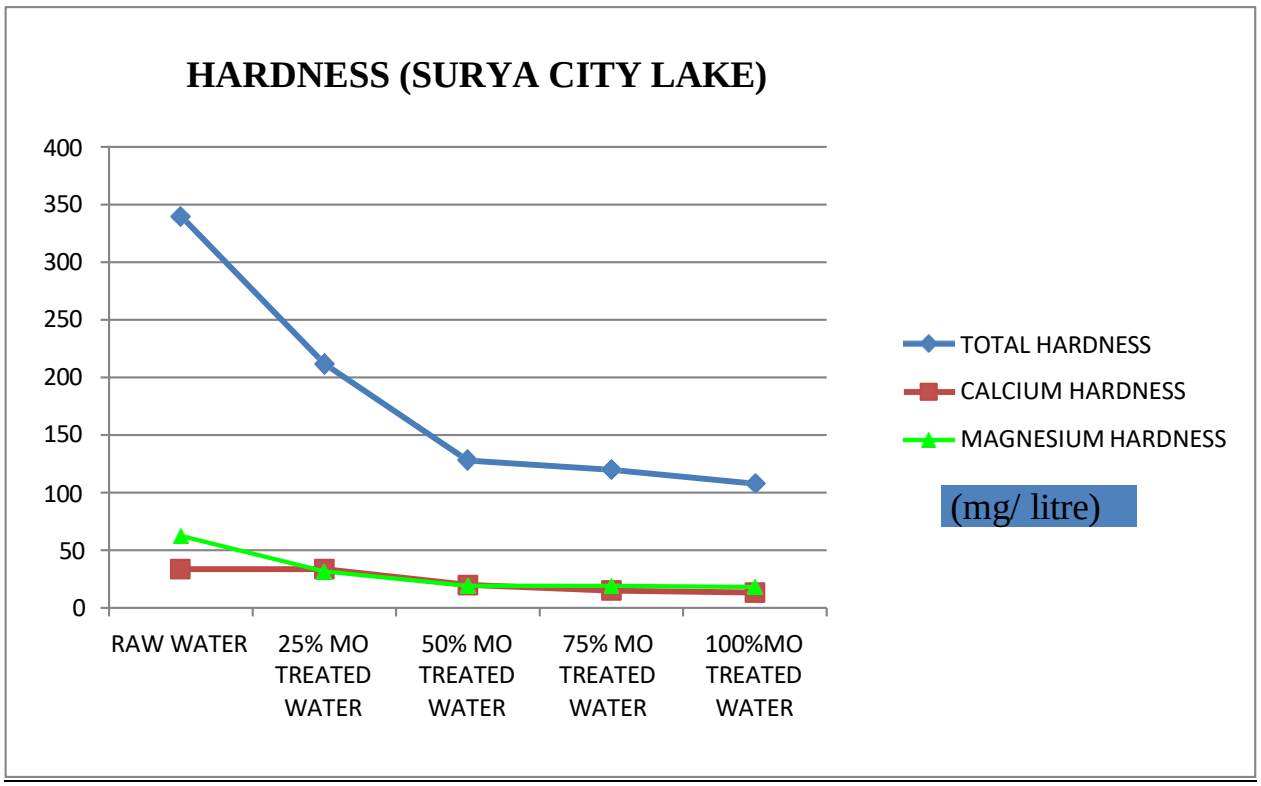
(B) : Graph for Alkalinity:



From the above graph, it is clearly observed that there is a considerable reduction in the alkalinity values of the Surya city lake. As all the results are within the WHO standards which is 200mg/l. Hence, this proves that the Moringa Oleifera is a good alkalinity reducer in the treatment process.

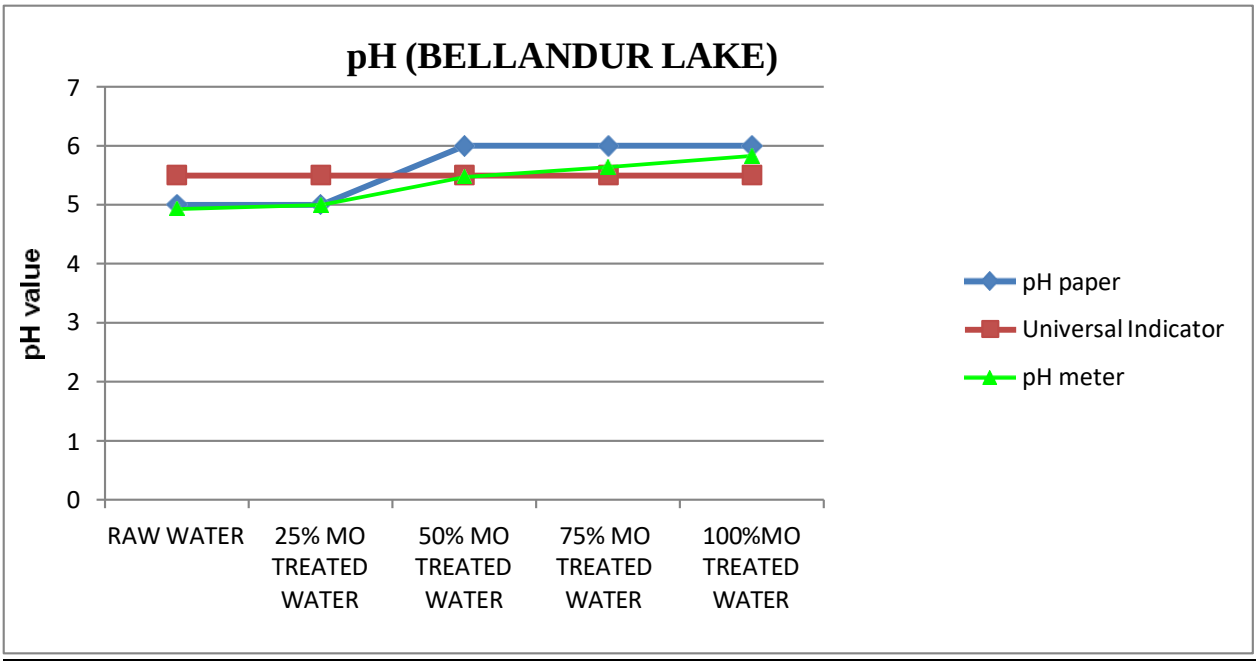
(C) : Graph for Hardness:

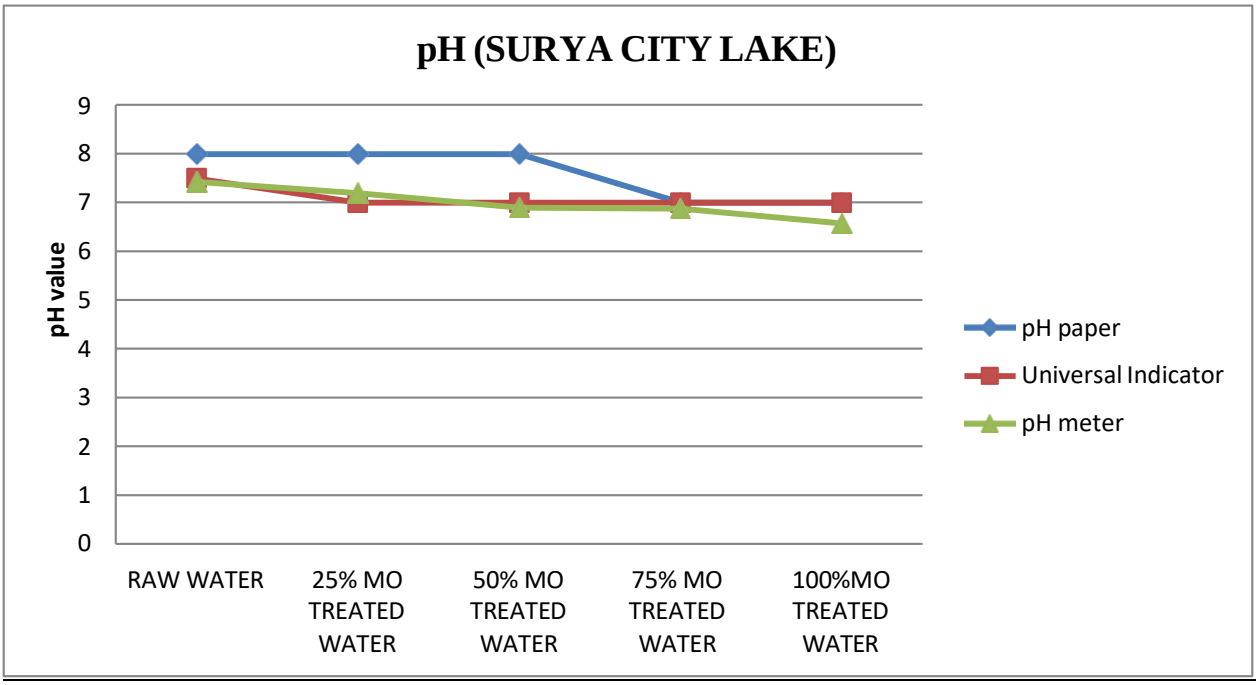




The total, calcium as well as magnesium hardness has decreased after the addition of moringa oleifera in increasing concentrations. Thus, the seed powder is effective to bring down the hardness of the sample as well.

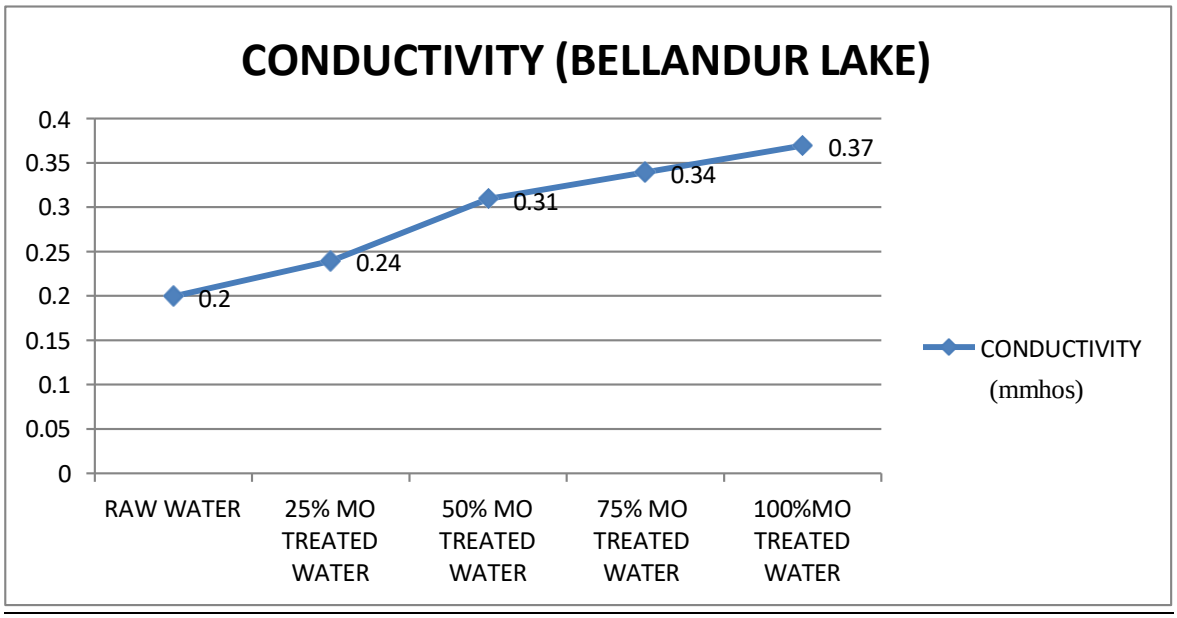
(D) : Graph for pH

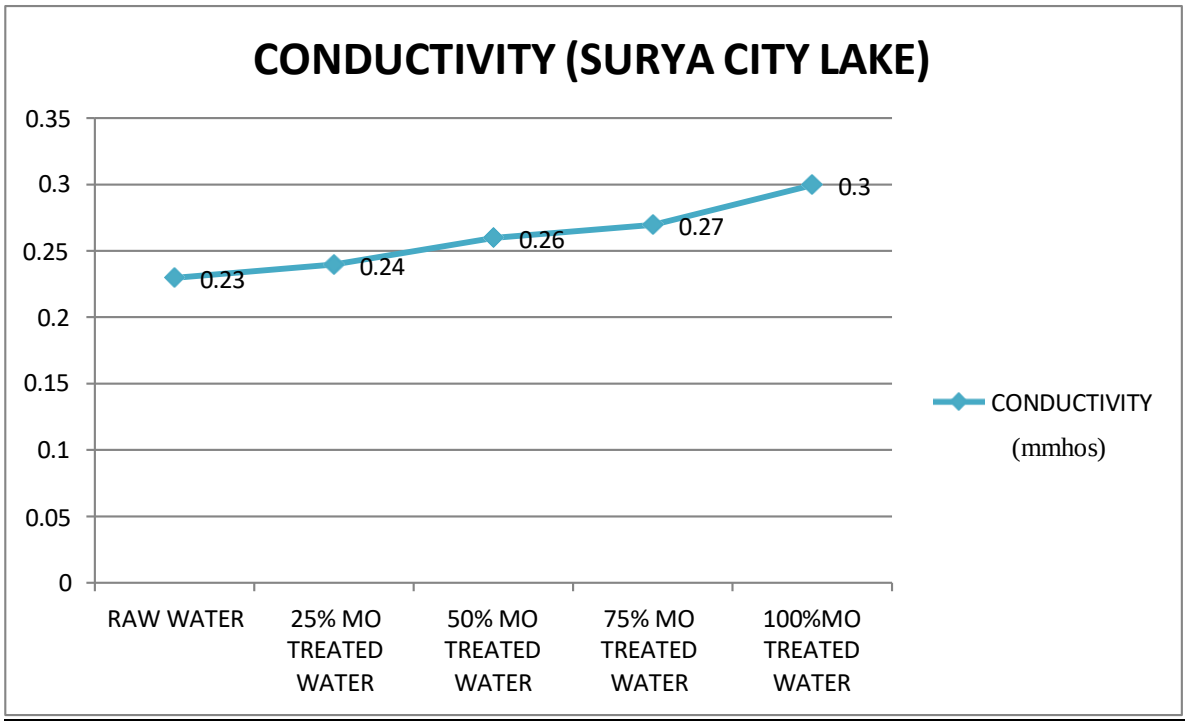




The pH of Bellandur lake has increased thereby reducing the acidity in water where as the pH of Surya city lake has decreased and the values of pH fall in the WHO standards which range between 6.5-8.5.

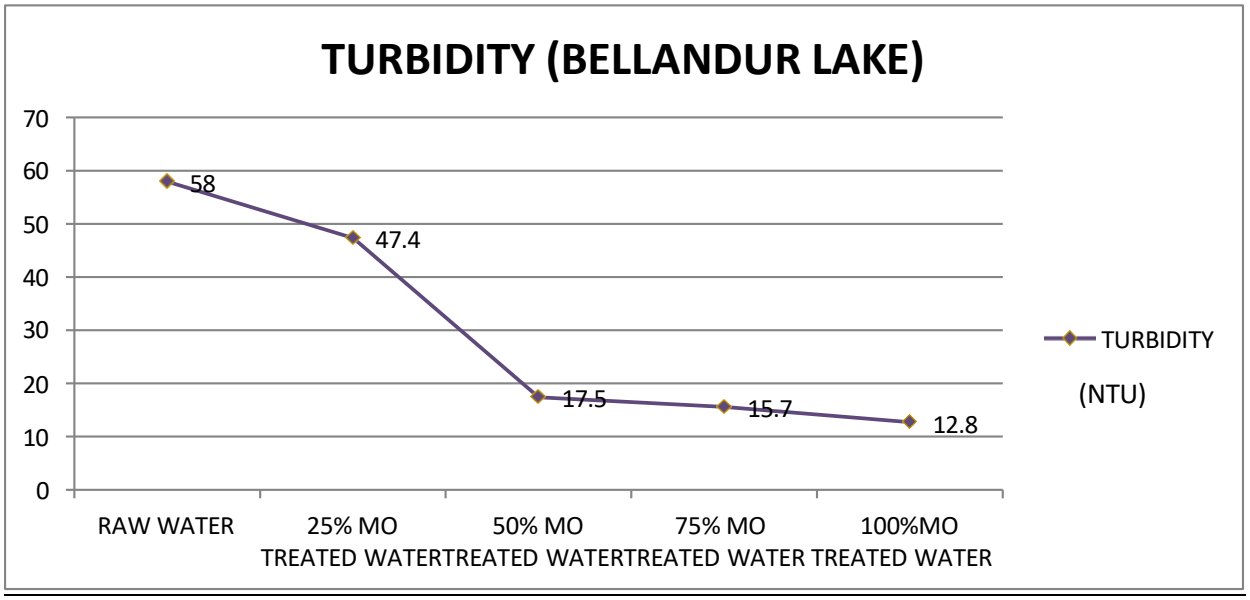
(E) : Graph for Conductivity:

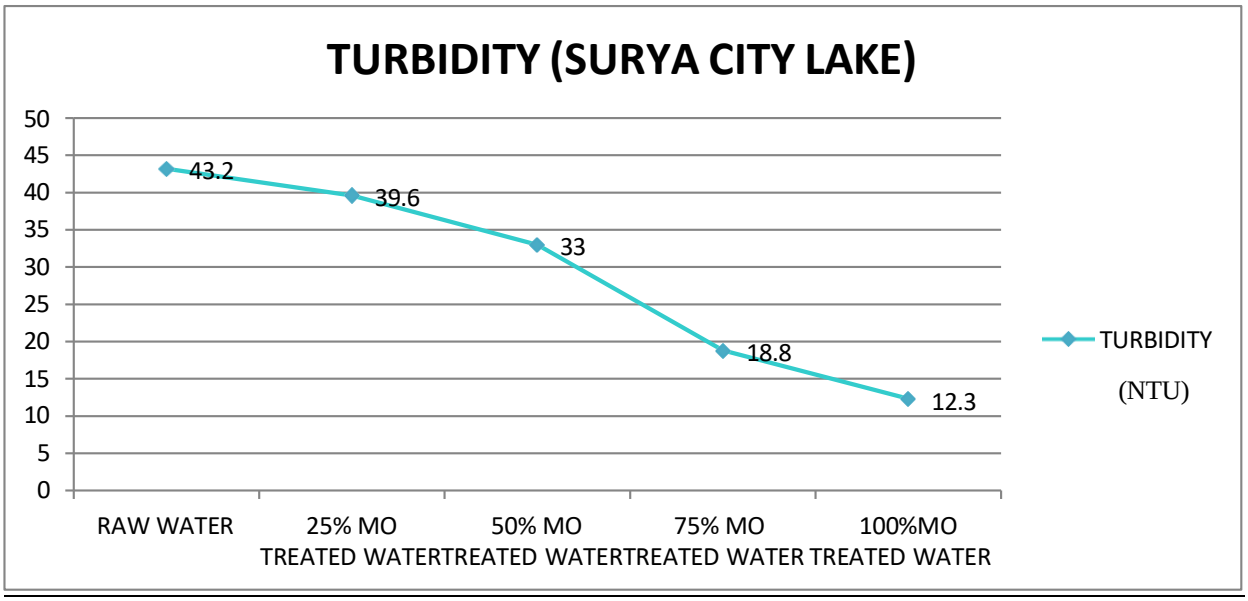




The conductivity of both the lake samples have increased due to the presence of certain charged ions.

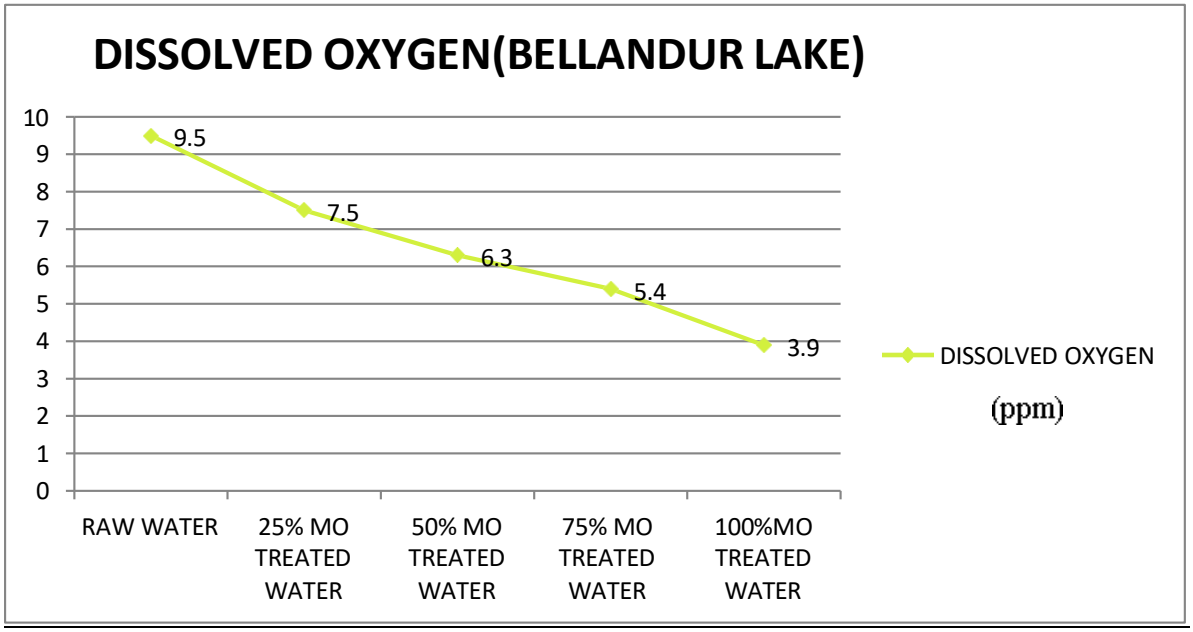
(F) : Graph for Turbidity:

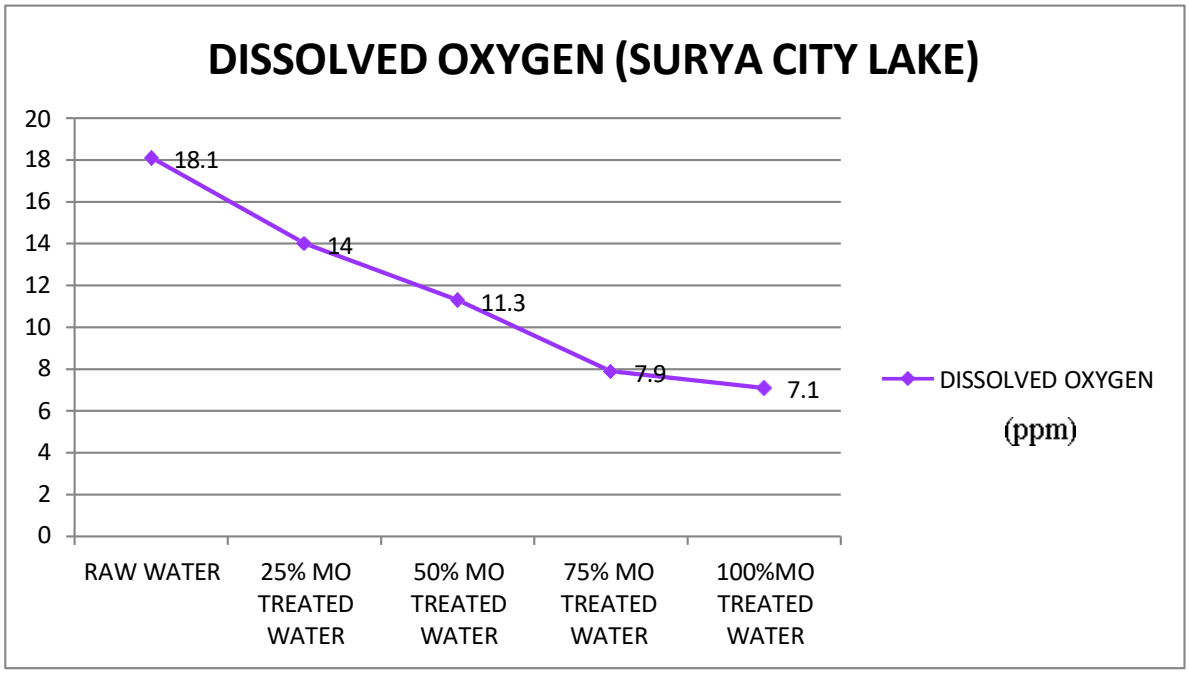




The addition of Moringa Oleifera in increasing concentrations led to the decrease in the level of turbidity of the samples. When the water is passed through filtration paper and then checked for turbidity it would meet the WHO standards of NTU value being 5 and below.

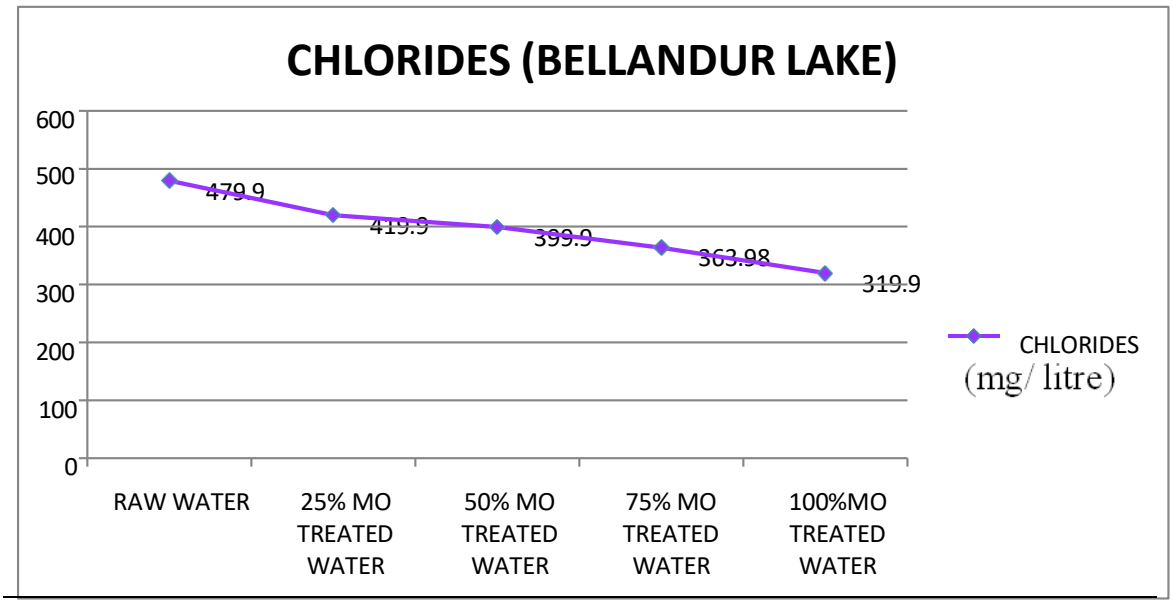
(G) : Graph for Dissolved Oxygen:

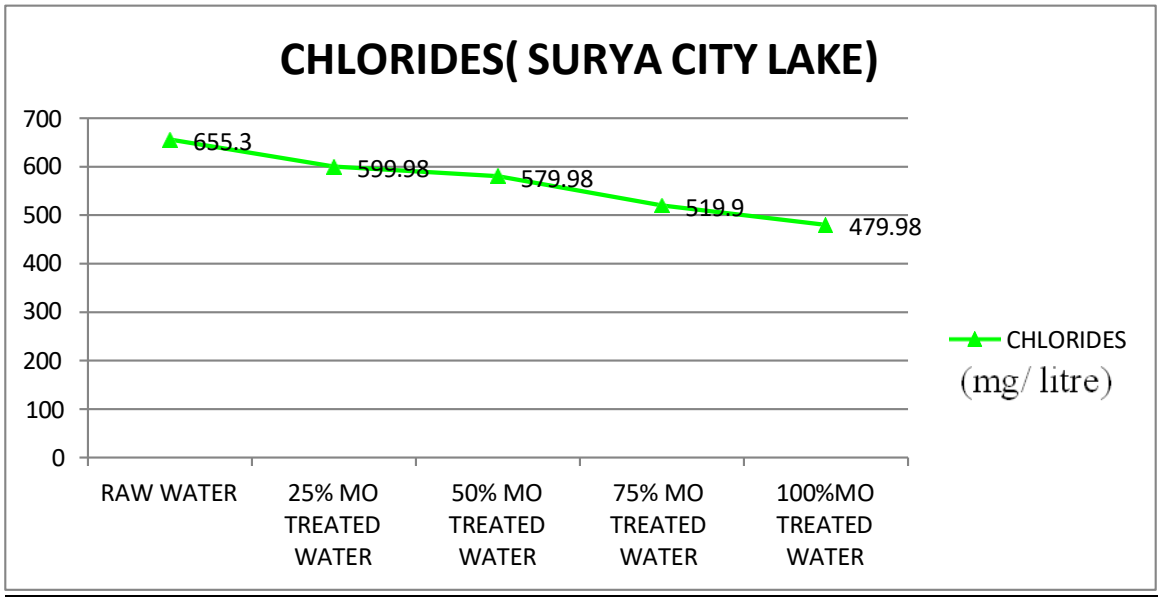




The DO content of both the samples has decreased after the addition of Moringa Oleifera in increasing concentrations.

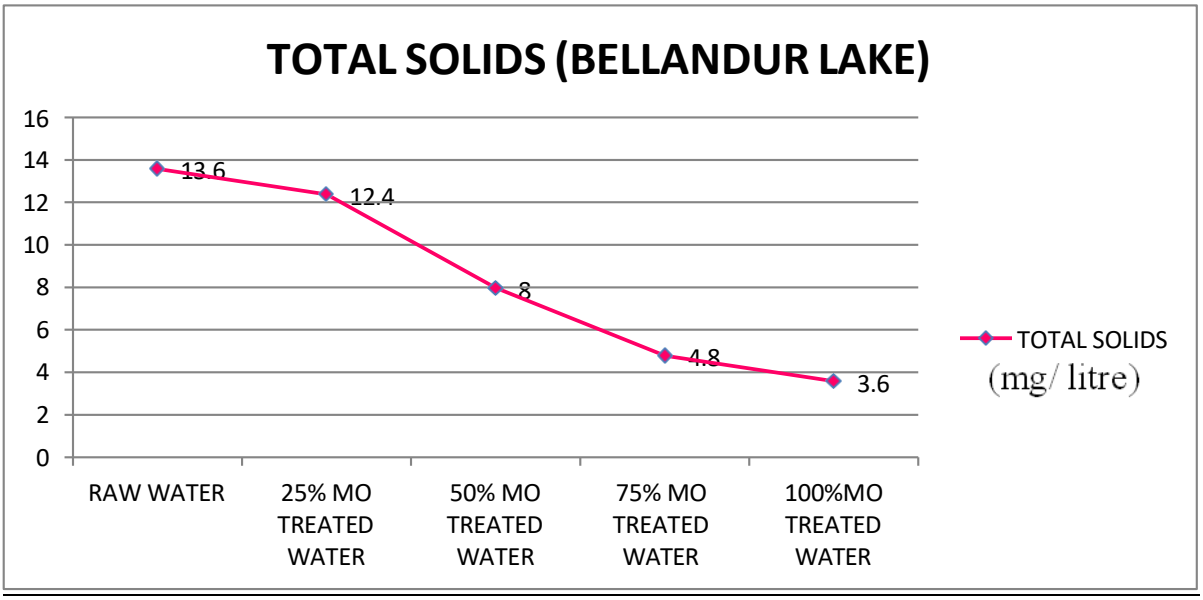
(H) : Graph for Chlorides:

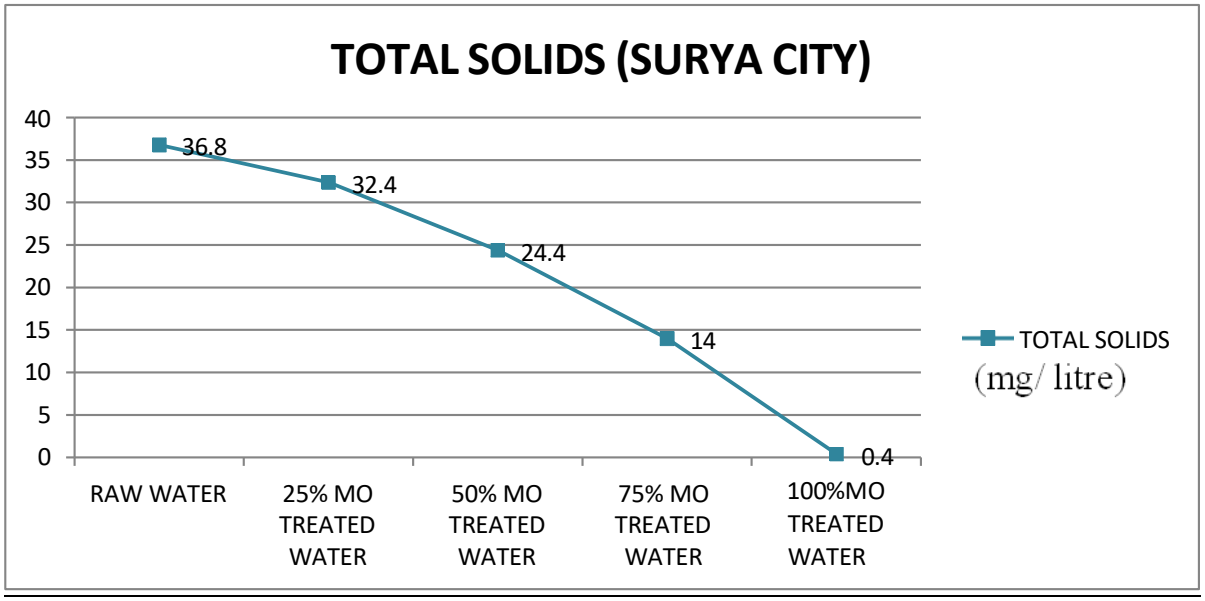




The chloride content of both the samples gradually decreased with the addition of Moringa Oleifera in increasing percentages.

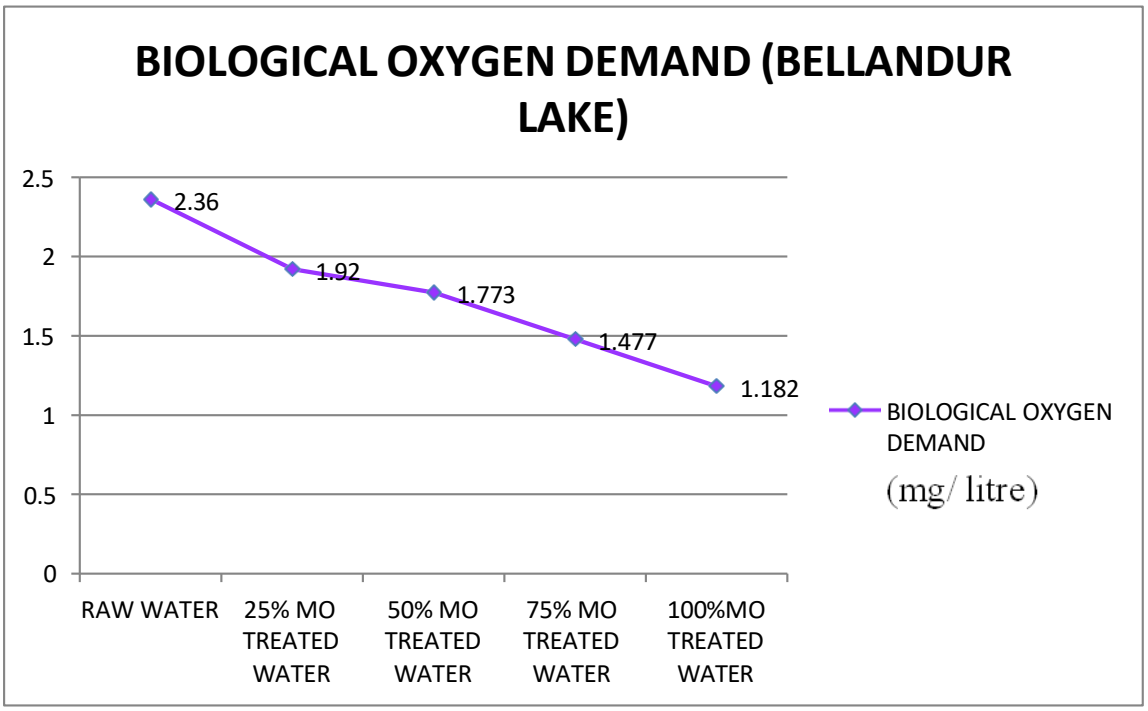
(I) : Graph for Total Solids:

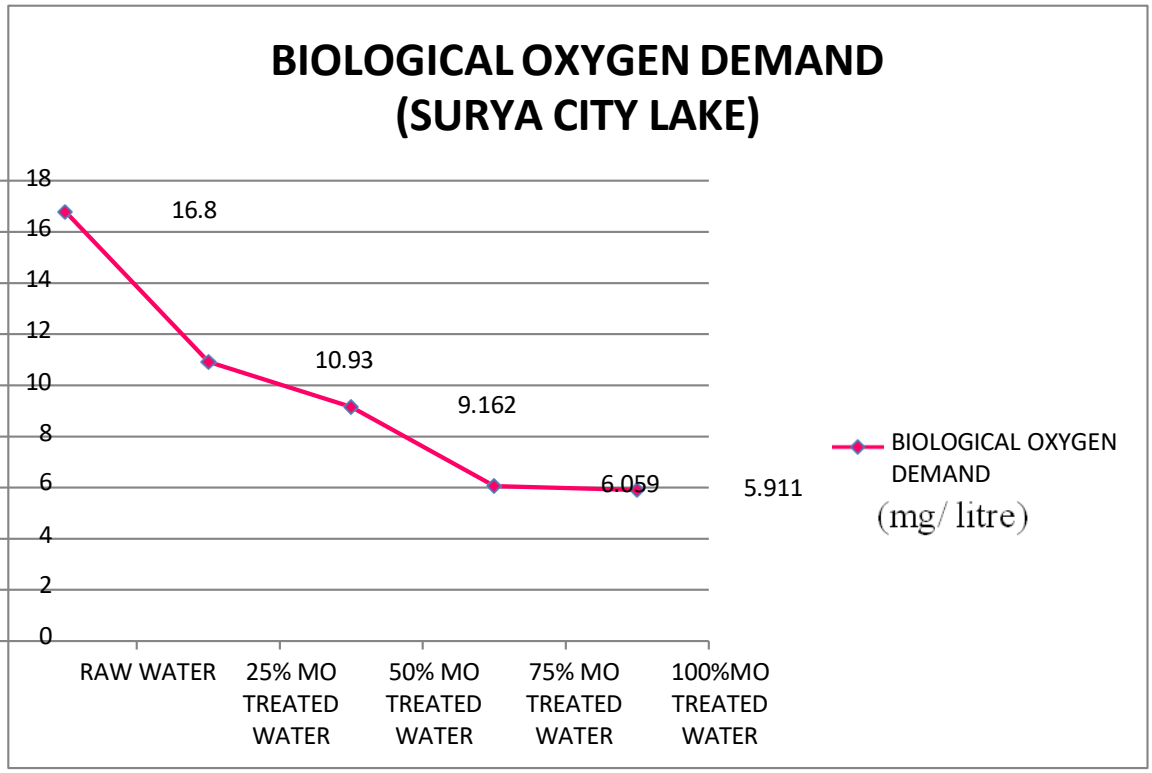




The total solids have decreased largely for both the samples and are well within the WHO standards i.e 500mg/litre. Hence, this proves that it is a good natural coagulant and can be used in the reduction of total solids.

(J) : Graph for Biological Oxygen Demand:





The BOD content of both the samples has decreased after the addition of Moringa Oleifera in increasing concentrations.

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