Cost Effective Method to Reduce Turbidity and pH level of Korattur Lake water situated in Chennai Metropolitan city

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Abstract - Clean water is absolutely essential for human survival. Changes coupled with increasing population in urban areas have the potential to impact the design and operation of future water treatment plants. It is necessary to provide clean potable water at low cost with high reliability in such areas. To accomplish these objectives. There is a great need to supply environmentally sound technology for the provision of potable water. We have developed an effective water filtration system using the coagulants such as moringa, alum, ferric alum and lime, charcoal as adsorption media. The main focus is to get the pH and turbidity levels within the permissible limits and the colour and odour are taken care such that it doesn't affect the water quality

Keywords: pH – power of hydrogen concentration, NTU – Nephelometric turbidity unit, Alum – Aluminium sulphate Al2(SO4)3, Acidity – pH level lessthan 7, Basicity – pH level greater than 7

I. INTRODUCTION

Lakes are the important part of urban ecosystem. Water in lakes is an easily available source of water for the needs of many sectors of economy such as agriculture, domestic and industrial. These water bodies, whether man-made or natural, fresh water or brackish plays a very vital role in maintaining environmental sustainability particularly in urban environments especially in today's context when the cities are facing the challenges of un planned rapid urbanization. Despite knowing their environmental, social and economic significance, city planners have fully neglected and destroyed these water bodies.

Today these water bodies are encroached, and plenty of sewage and garbage are accumulated. Because of unplanned urbanization, much of the landscape around the lakes has been covered by impervious surfaces. Considering the present bleak water scenario of Indian cities, today we need our urban lakes and wetlands more than ever. Although, there is a over plus of policies and acts for the protection and restoration of urban lakes and wetlands, urban water bodies are in extremely poor condition.[1,2]

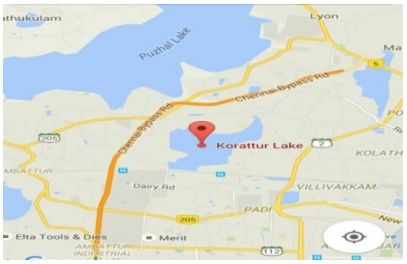
Considering this alarming situation of urban water bodies, this study discusses the present status of protection and management of urban lakes .The study also highlights some positive examples of lake protection and management.

II. METHODOLOGY

Study Area

Korattur Lake is one of the largest lakes situated in the western part of Chennai. It is a part of the Chennai corporation and located along the Chennai – Mumbai railroad about 12 km from the Chennai Central. The Korattur lake is one of the chain of three water bodies including the Ambattur lake and Madhavaram lake where surplus water from one is transported to the another.

Image of korattur lake.



Location of korattur lake

Physical characteristics

- *Turbidity*
- *Colour*
- *Odour*

Chemical characteristics

- *pH level*
- *Dissolved oxygen*
- *Total solids*
- *Biochemical oxygen demand*
- *Phosphorous*
- *Chloride*
- *Hardness*
- *Total fixed and volatile solids*
- *Iron*
- *Nitrate*
- *Sulphate*
- *Calcium*

TABLE 1

REPORT OF THE RAW WATER SAMPLE

CHARACTERISTICS	INFERENCE	PERMISSIBLE LIMIT (IS 456/2000)
Colour	Greenish	--
Chlorides (mg/lit)	1260	2000
Fluoride	0.4	400
Ignited residue	300	3000
Sulphate	100	400
Iron	0.15	--
Ph	9.3	Not less than 6.0 (Desirable - 6.5 Permissible - 8.2)
Turbidity (NTU)	95	10
Total hardness	320	600
Organic solids	30	200
Calcium	32	200
Phosphate	0.025	--

pH Value

The pH of a solution is measured as negative logarithm of hydrogen ion concentration. At a given temperature, the intensity of the acidic or basic character of a solution is indicated by pH or hydrogen ion concentration. pH values from 0 to 7 are diminishing acidic, 7 to 14 increasingly alkaline and 7 is neutral.[8]

Materials and reagents used:

a. pH meter
b. Standard buffer solution of known pH
c. Distilled water.
d. Samples.

Procedure :

The instrument is switched on. The probe is washed and blotted using tissue paper. Check –Temp = 30◦ is switched the buttons to pH and stand by at the bottom. Buffer solution pH- 4 is taken and the probe is inserted. The cal control is adjusted to read 4. After 1 min, standby is obtained and the probe is washed and blotted using tissue paper. The Buffer pH- 7 is taken and the probe is inserted. . After the instrument shows 7, standby is to be obtained, probe is washed and blotted using tissue paper. One sample is taken, the probe is inserted, and pH is measured. The standby is obtained, the probe is washed and blotted using the tissue paper and repeat the same for other samples. Finally, the probe is washed and blotted using tissue paper, and dipped in distilled water.

Inference:

Accepted pH for water is between 6.5 to 8.5. If the pH is outside of this range, there is almost definitely something negatively affecting the water.[10]

TURBIDITY

Turbidity measures water clarity, which allows sunlight to penetrate to a greater depth. The main sources of turbidity are erosion, living organisms and those from human endeavors.

Materials and reagents used:

a. Turbidity meter.
b. Water sample.
c. 100 NTU stock solution.
d. Distilled water.

Procedure: Mix 5ml of solution 1 with 5ml of solution 2. Allow to stand for 24 hours at 25 ± 3ºC, then make up this solution to 200ml with distilled water. This is 100 NTU. This solution has a shelf life of 4 weeks if kept in a dark place.

The instrument is switched on. The test tubes with distilled water are taken and the zero knob is adjusted to display 0.00 .The test tube is taken with stock solution of 100 NTU and use 0 –200 NTU range. The control knob is adjusted to read 100 NTU. Then the test tube is filled with the solution of unknown value and the displayed value is measured. Repeat the same for other samples and clean.

Inference:

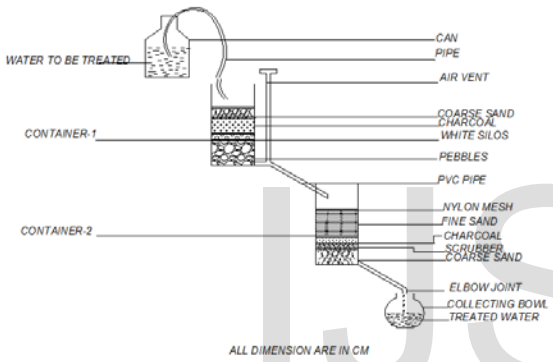
According to World Health Organization standards turbidity is 5 NTU.[5]

III. FILTRATION MODEL DEVELOPMENT

A simple filtration apparatus is prepared with the following details :

- Length = 48 cm. (2 containers)
- Each layer in both the containers is covered with fine nylon mesh.
- From the base of the container 1, the outlet pipe is extended for the flow of water to the container 2.
- From the base of the container 2, the outlet pipe is extended to collect the water in the collecting bowl.
- Water to be treated is introduced to the container 1 through an inlet pipe.
- An air vent is provided for the free flow of water from the container 1 to container 2.
- A hole of 12 mm diameter is made to connect the outlet pipe.

DIAGRAMATIC REPRESENTATION OF ORIGINAL SETUP

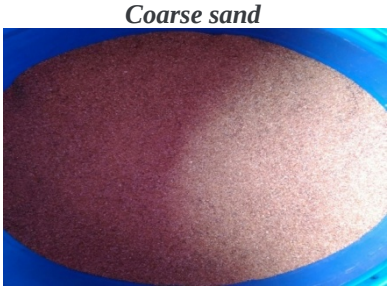


MATERIALS USED AND ADSORPTION MEDIA

Pebbles

White silos

Coarse sand



Fine sand

Scrubber

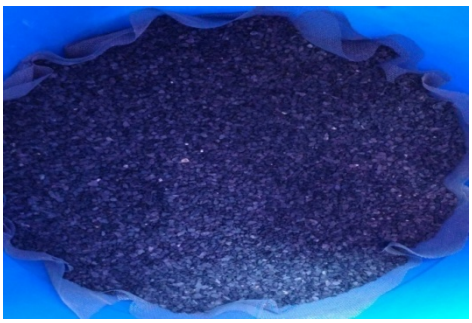


Fig 2.7 Charcoal

Moringa

The Moringa oleifera tree grows abundantly throughout many tropical and subtropical regions of the world. It reaches fruition in only six months and is already being used in many areas as a food source. The seedpods, seeds, leaves, roots and flowers are all edible and nutritious. The tree's seed has the ability to kill bacteria and clarify water. Moringa seeds on their clay water pots, and dried powder from crushed seeds has been used as a hand wash for many years.

Water Treatment with Moringa Seeds

Solutions of Moringa seeds for water treatment[4] may be prepared from seed kernels or from the solid residue

left over after oil extraction (press cake). Moringa seeds, seed kernels or dried press cake can be stored for long periods but Moringa solutions for treating water should be prepared fresh each time. In general, 1 seed kernel will treat 1 liter of water.

Moringa seed powder

IV. EXPERIMENTAL PROCEDURE

- The raw water from the selected source i.e., korattur lake is collected.
- The collected water is then screened using a perforated cloth.
- The debris present in the water is removed after screening.

For removal of major impurities four coagulants have been used i.e., Moringa, Alum, Ferric Alum & lime and charcoal has been adopted. The standard solution has been prepared as follows.

Procedure for preparation of standard solution :

- The required samples of moringa, Alum, Ferric Alum and lime are collected in powder form in appropriate quantities**.**
- The powder sample is mixed in a small amount of clean water to form a paste**.**
- The paste is mixed with 500 ml of clean water in to a bottle and shook for 1min to activate te coagulant properties and to form a solution**.**
- The solution is filtered through a fine mesh screen to remove insoluble materials and into the water to be treated.
- Treated water is stirred rapidly for at least 1 min then slowly (15-20 rotations per min) for 15 -10 min.
- The treated water is left undisturbed for at least 1 -2 hours**.**
- When the particles and contaminants are settled to the bottom, the clean water is carefully taken to the treatment process.
- The materials for the experimentation as specified are taken into the containers as shown in appendices.
- The apparatus set up by the method of suction for introducing the water to be treated.
- During the treatment process ,the water is allowed to pass through different adsorbed media filled in the container 1and 2.
- Finally, the treated water is collected in the collecting bowl.
- This treated water is further tested for quality confirming to the standards.

V. RESULTS AND DISCUSSION

pH RESULTS

Ph value measurements using the different coagulants used are indicated in the table

Measurement of pH using pH meter

Table - Tabulation of pH values

Coagulants	pH value
Moringa	7.68
Alum	7.54
Ferric alum and lime	7.48
Charcoal	7.64

As, it can be observed, the pH value of the moringa , Alum, ferric alum and lime and charcoal are 7.68, 7.54, 7.48 and 7.64 respectively, which are within the permissible limits.[2]

TURBIDITY RESULTS

Turbidity value measurements using the different coagulants used are indicated in the table.

Measurement of Turbidity using Nephelometric Turbidity meter :

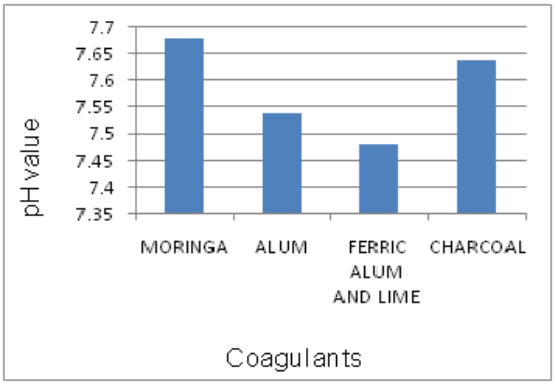
Tabulation of Turbidity values.

Coagulants	Turbidity (NTU)
Moringa	3.0
Alum	6.7
Ferric alum and lime	3.6
Charcoal	8.8

Comparison of results

pH RESULTS

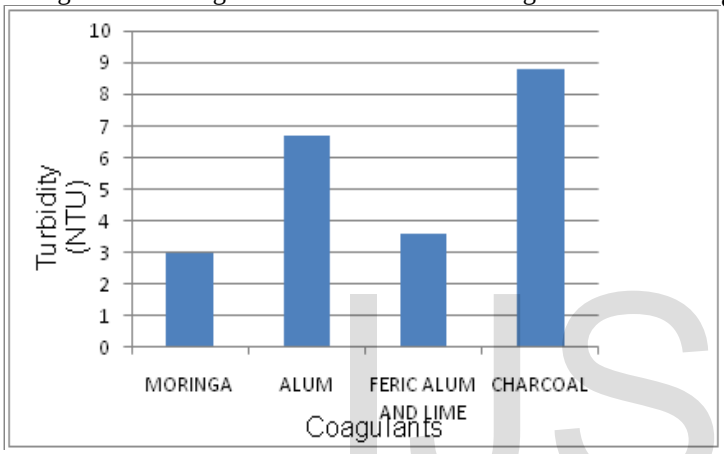
The pH values of the water after treatment using different coagulants are indicated in the fig 3.1



Comparison of pH bar chart

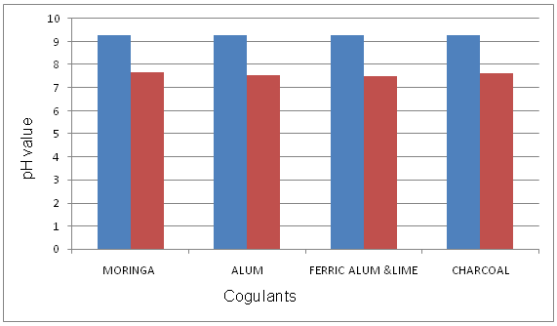
TURBIDITY RESULTS

The Turbidity values of the water after treatment using different coagulants are indicated in the fig 3.2



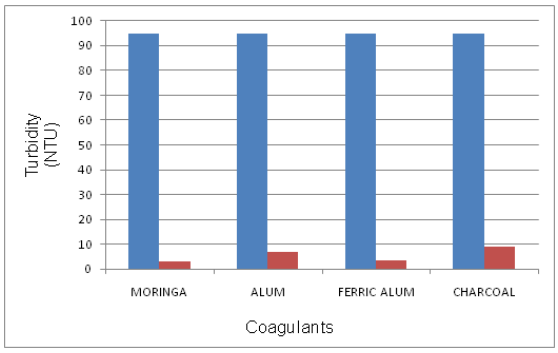
Comparison of Turbidity bar chart

The pH values of the water before and after treatment using different coagulants are shown in the fig 3.3.



Comparison of initial and final pH bar chart

Turbidity values of the water before and after treatment using different coagulants.



Comparison of initial and final turbidity level bar chart

PERFORMANCE ANALYSIS

- Of the four coagulants used for treatment of water, the Ferric alum and lime appears to be more effective for reducing the impurities in respect of pH value.
- The use of Moringa coagulant is more effective in the reduction of impurities in respective of the turbidity followed by Ferric alum and lime, Alum and Charcoal.

OTHER RELEVANT WORKS

The Neem leaves powder can be used to decrease the iron content in the water. In the same way, Tulasi leaves powder, Rice husk, Sugarcane baggase can be used for removal of iron in the water. Plant biomass of parthrnium species can be used to remove the chloride content. Along with the moringa oleifera proposed in the present study, cicer arietinium and Dolichos lablab can also help in removing turbidity. The plant materials such as Indian gooseberry bark (phyllanthus emblica), lemon peel (citrus Limon), peanut husk (arachis hypogeaea) and vetriver root (vetiveria zizanoides) for reducing the TDS in the water.[1]

CONCLUSION

- In the fresh water parched areas like the present study area the water treatment appears to be essential for different uses for the community.
- The herbal treatment of water is most effective than the treatment of water using the chemical coagulants.
- The use of herbal in the treatment process is desirable since this process does not cause any health effects.
- It is also essential to prevent the effluents from the industries and the waste water from the residents entering into the lake. If it is not done, the entire treatment becomes continuous and expensive.
- Surface water suffers everywhere mainly from eutrophication, caused by the lack of sewage treatment plants in the streams leaving the urban areas. Inside the urban area eutrification is caused by polluted storm water flowing off the sealed surfaces.
- This treatment process will be good for the people not only for construction purpose but also to meet the domestic needs to some extent.

This study provides information at a provincial level about the possibilities of using the Korattur Lake. While using this lake, korattur, Agraharam, Kachra kuppam, Mathala kuppam, Kolathur and other surrounding areas are benefitted in the past. This lake is an extremely a vast water body and consists of plenty of water. There are encroachments in this lake and due to these encroachments, the boundaries are decreasing. It is very much necessary to conserve this lake to meet the water demand of the city. The water filtration model used consists of moringa, alum, ferric alum, and charcoal as the coagulants. The moringa seed powder proved to be a good adsorbent media in reducing the turbidity level followed by ferric alum, alum and charcoal. The proposed filtration apparatus can be used in household level by the people residing in surrounding areas of the lake. The treated water thus obtained can be used by the people for daily purposes. The entry of the effluents is the main reason why the water in the lake is getting polluted. Certain measures are to be taken to put an end for the industrial effluents from the surrounding areas being let into the lake.

FUTURE SCOPE

There is a future scope for expanding this study by using advanced technologies for ensuring better purification and less expensive by way of establishing Research and Development (R &D) centers.[9,12]

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