Physicochemical studies of water quality of treated and polluted Hussainsagar lake water Hyderabad, Telangana state, India

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Abbreviations:
WHO: World health organisation, IS: Indian Standards

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Abstract
Hussainsagar Lake underwent extensive environmental degradation due to pollution from untreated domestic sewage and toxic industrial effluents. The degradation was evident in the form of shrinkage of lake area due to encroachments, hyper-eutrophication, extensive groundwater pollution, loss of biodiversity, breeding of vectors and recurrent fish kills. So this type of water can be treated by CV technology and analysed to water quality parameters. The present study was carried out on water quality of polluted Hussainsagar lake water and treated Hussainsagar lake water (Treated by C.V. Technology) in Hyderabad, Telangana state during 2012-2013. This water is collected and stored as a Hussainsagar lake polluted water tank and after treatment by CV technology it is stored as treated Hussainsagar lake water tank and compared to control water tank filled with bore water of Osmania University. Four sites are selected to study the physico-chemical parameters of three tanks and are compared with standards of WHO and Indian Standards. Pollution was high in Hussainsagar Lake water tank and after treatment (by CV Technology) there were no pollutants in Hussainsagar water tank. This treatment was very useful for treatment of waste waters based on the results.

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1. Introduction

Drinking water is one of the basic needs of life and essential for survival. Still more than one billion people all over the world do not have ready access to an adequate and safe water supply and more than 800 million of those unsaved live in rural areas (Manoj Kumar and Avinash Puri, 2012). Existence of life on earth that contains minerals, important for humans as well as for terrestrial and aquatic life (Agarwal et al., 2011). In India ground water is being used as raw water for 85% public water supply. Lakes and surface water reservoirs are the planets freshwater resources that provide infinite benefits. They are used for domestic and irrigation purposes and provide ecosystems for aquatic life especially fish (Duran, 2006). Water pollution now a days is conserved, not only in terms of public health but also in terms of its conservation, aesthetics and preservation of natural beauty and resources. 70-80 percent of Indian water sources are polluted and different enteric diseases affect millions of people even today. Water contamination due to pathogenic agents, heavy metals, chemicals, pesticides and industrial and agricultural activities. Human activities are also hazardous to human health. A healthy lake ecosystem could conserve natural and social balance by contributing healthy environment to its location. Nowadays naturally existing dynamic equilibrium of water bodies like rivers, lakes and estuaries are
affected by the human activities (Mahananda et al. 2010; Mehari and Mulu, 2013).

2. Objective of Research

To determine the water quality.
To study the pollution level, if any, in the tanks.
To observe whether water is useful for drinking, irrigation, and fishing and to support biotic life.

3. Justification of Research

This type of research is better to solve the society problems from waste water, Industrial waste waters and domestic waste waters etc. Waste water can be treated by CV technology and re use it properly. After treatment the Hussainsagar lake water purified and showed normal range of values and permissible limits within the WHO and Indian Standards. The treated water and control water were same values in almost.

4. Materials and Methods

4.1. Study Area

Hyderabad is the capital of Telangana state. The water body selected for the present investigation is a manmade tank (17°25′02.32″N, 78°31′57.43″E) formed due to the construction for fish culture. Water spread area of the control tank was 14,508 lts, Hussainsagar lake water tank was 14,280 lts and treated Hussainsagar Lake water tank was 14,293 lts. Climate is tropical wet and dry with most rainfall from June to October. The samples were collected in four places of the tank and analyzed.

4.2 Methods


Permissible limits for drinking water quality according to American Health Association (APHA), World Health Organization (WHO) and Indian Standard Institution (ISI) are compared in this article.

5. Result and Discussion

The variations in physico-chemical parameters of fish tanks are depicted in table 1.

5.1 pH

The pH of treated Hussainsagar lake water and control water was found to be moderate i.e., within the permissible limits of WHO and ISI values, this states that the water is of very good quality. On the contrary untreated Hussainsagar lake water showed a higher pH within the permissible level which when compared to other two samples is not good. After treatment the untreated Hussainsagar lake water have shown pH ranges near to that of control water.

pH maintain the acidic or basic property, is a vital characteristic of any aquatic ecosystem since all the biochemical activities and retention of physico-chemical attributes of the water are greatly dependent on pH of the surrounding water (Jalal and Sanal Kumar, 2013). pH is considered as an important ecological factor and is the result of the interaction of various substances in solution in the water and also of numerous biological phenomenon (Rajashekar A. V et al, 2012).

5.2 Electro Conductivity (EC)

The EC of the control and treated Hussainsagar water tank were within the permissible levels and untreated Hussainsagar water tank was exceeding the range specified by ISI value. So the untreated Hussainsagar water was not of good quality and polluted too. This type of polluted water (Hussainsagar lake water) can be treated and converted in to potable water by C.V. technology. After treatment the EC value have reduced and come down to the control water range.

Conductivity is the capacity of water to carry an electrical current and varies both with number and types of ions the solution contains, which in turn is related to the concentration of ionized substances in the water. Conductivity reflects the nutrient status of the water and the distribution of macrophytes. Minimum conductivity may be due to dilution of water caused by monsoon rains and utilization of ions by the living community of the reservoir. Higher values of conductivity may be due to decomposition of macrophytes, dead animals present in the reservoir, evaporation and evapo-transpiration of the reservoir. Higher the value of dissolved solids, greater will be the amount of ions in water (Bhatt et al, 1999; Piska 2000).
5.3 Total Dissolved Solids (TDS)
It is being observed that Hussainsagar lake water show high value of TDS when compared to other two type of water. After the treatment TDS value have reduced two to three times in this water. The treated water have shown TDS values nearer in range to that of control water. The variation may be due to exposure of water to atmosphere in different seasons. Minimum values recorded post monsoon may be due to high metabolic rate of organisms. Maximum values reported during in monsoon period, may be due to low atmospheric temperature.

5.4 Dissolved Oxygen (DO)
The Dissolved oxygen was found to be more in treated water sample when compared with control and untreated Hussainsagar lake water tanks so the organisms’ growth was very good in treated Hussainsagar lake water tank. The treatment helps all type of waste material to settle down and purify the water. Oxygen gets into water by diffusion from the surrounding air by, aeration (rapid movements) and as a waste product of photosynthesis. Total dissolved solids, gas concentration in water should not exceed 110% (above 13-14 mg/l) concentration can be harmful to aquatic life. Fish in waters containing excessive dissolved gases may suffer from “gas bubble disease” (Manoj Kumar and Avinash Puri, 2012).

5.5 Chemical Oxygen Demand (COD)
When compared amongst the three, the least value of COD was found in treated water sample, moderate value was found in control water and maximum value was found in untreated water. The untreated Hussainsagar lake water tank showed high value of chemical oxygen demand because of organic metals, decomposition and respiration of bacteria. The treatment helps in neutralizing the many chemicals added to Hussainsagar lake water so the COD decrease in treated Hussainsagar lake water tank.

Due to less water in river and high value of organic metal, the decomposition of organic metals and respiration of bacteria more oxygen was used and hence, chemical oxygen demand was high in summer season (Swetha Sao, 2015).

5.6 Biological Oxygen Demand (BOD)
Due to the contamination by heavy municipal waste and industrial discharge the Biological Oxygen Demand was high in Hussainsagar lake water tank when compared to control and treated Hussainsagar lake water tanks. BOD is usually used for determining the oxygen demand of municipal or industrial discharge. High BOD indicates high scale contamination of organic matter in the water (Lodh et al., 2014).

5.7 Calcium and Magnesium (Ca & Mg)
The total hardness of control and treated Hussainsagar Lake water tanks were in the permissible range specified by WHO and ISI. Whereas untreated Hussainsagar lake water tank showed higher value.

The total hardness is often employed as indication of waste water quality depends on the concentration of carbonate and bicarbonate salts of calcium and magnesium or sulphate, chloride or other anions of mineral acids. The main source of magnesium is sewage inflows and minerals generated due to soil erosion and are important for enzyme activation, growth of chlorophyll and phytoplankton (Ramesh and Seeta, 2013; Verma et al, 2012). Biologically temporary hardness plays a key role in buffering capacity, thus neutralizing the pH due to addition of acidic products. This has a great effect on biodiversity of an ecosystem. The concentration of Ca and Mg ions in water is less than 40ppm then it is soft water and more than 40ppm then it is hard water. The hardness of water with 15ppm more is satisfactory for growth of fishes (Rajaskekar et al., 2007). Effect of the major cations on the growth of flora is of ecological significance (Ansar, 2010; Piska and Rao, 2005).

5.8 Chlorides (Cl)
The Chlorides concentration is high due to pollution by metals, domestic waste and industrial effluents in Hussainsagar lake water tank and is in permissible levels in control and treated Hussainsagar lake water tanks that is within the levels specified by WHO and ISI. Chlorides mainly come from inorganic salts like NaCl, KCl and CaCl2 etc. which are generally provided by soil, natural layers of chloride salts, municipal and industrial sewage and animal wastes (Gopalkrushna, 2011). The fluctuations of chloride in the point source of pollution are usually governed by the dilution due to inflow of water, concentration by evapo-transpiration and inputs from surface run-off during the early monsoon showers. The minimum chloride values found during monsoon months, due to dilution by the monsoon floods with the decrease of inflow in winter, chloride concentration increase due to increase in evapo-transpiration (Srinivas, 2005 and Ansar, 2010).

5.9 Nitrates (NO3)
All the three water samples showed values in permissible limits given by WHO and ISI, but when observed specifically the Hussainsagar lake water tank has shown higher value than the other two samples. In urban areas sewage water rich in nitrates contaminate surface water thus increases
Table 1: Physico-chemical parameters of CON, UHW and THW during the year 2012-2013

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameter</th>
<th>Mean ± SD</th>
<th>CON</th>
<th>UHW</th>
<th>THW</th>
<th>WHO standards</th>
<th>ISI standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PH</td>
<td>7.45±0.202</td>
<td>8.33±0.264</td>
<td>7.440.209</td>
<td>6.5-8.5</td>
<td>6.5-8.5</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>EC</td>
<td>778.6±35.85</td>
<td>2222.7±17.541</td>
<td>831.267±12.925</td>
<td>-</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>TDS</td>
<td>656.1±13.111</td>
<td>1163.7±5.864</td>
<td>546.867±1.361</td>
<td>-</td>
<td>500-2000</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>DO</td>
<td>5.533±0.245</td>
<td>4.208±0.309</td>
<td>6.233±0.276</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>COD</td>
<td>46.75±5.18</td>
<td>114.93±7.387</td>
<td>13.417±2.266</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>BOD</td>
<td>14.417±2.209</td>
<td>34.167±3.513</td>
<td>11.167±1.291</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Ca+2</td>
<td>71.417±3.738</td>
<td>135.67±2.571</td>
<td>93.917±3.151</td>
<td>75</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Mg+2</td>
<td>34.417±2.752</td>
<td>44.667±2.896</td>
<td>35.667±2.408</td>
<td>50</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Cl</td>
<td>206.7±3.453</td>
<td>394.43±2.036</td>
<td>154.67±2.294</td>
<td>250</td>
<td>250-1000</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>NO3</td>
<td>8.533±0.221</td>
<td>14.5±2.716</td>
<td>6.783±0.34</td>
<td>50</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>PO4</td>
<td>0.609±0.037</td>
<td>12.67±1.246</td>
<td>1.508±0.189</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

All values are expressed in mg/l, except pH, EC=ms/cm

○ CON=Control (Osmania University bore water)
○ UHW=Untreated Hussain Sagar Water
○ THW=Treated Hussain Sagar Water

Figure 1: SATILITE IMAGE OF HUSSAINSAGAR
the nitrate amount (Gopalkrushna, 2011). Nitrate is the most highly oxidized form of nitrogen compounds, commonly present in natural waters, because it is the product of aerobic decomposition of organic nitrogenous matter. Significant sources of nitrate are domestic effluents, sewage sludge’s, industrial discharges and decayed vegetable and animal matter. These sources can contaminate lakes, rivers and seas (Rajashekar et al., 2012). The nitrogen pool of limnotic environment comprises of two components namely the organic component consisting of organic materials liberated by the biota or generated in the heterotrophic bacterial activity upon proteinaceous substrates. The second component is made up of inorganic compounds of nitrogen such as ammonia, nitrite and nitrate. A great deal of work on the distribution pattern of different forms of nitrogen and their interrelationship in fresh waters have been made (Piska and Rao, 2005; Srinivas, 2005 and Ansar, 2010).

5.10 Phosphates (PO₄):
Both control and treated Hussainsagar lake water tanks has shown values lesser when compared to Hussainsagar Lake water tank. The PO₄ concentration was reduced after the treatment. In aquatic ecosystem phosphorus occurs both in inorganic and organic forms, the inorganic phosphorus as orthophosphate plays a dynamic role by acting as a nutrient along with nitrates. On oxidation the orthophosphate gets precipitated and is trapped in the sediment, while in reducing conditions as obtained in most of the eutrophic water bodies some sedimentary phosphorus is recycled insoluble (Rajashekar et al., 2012). A small concentration of phosphates is tolerable even though it is harmful to humans and animals as it is an essential constituent of bones and some of the enzyme system. This may be due to discharge of effluent containing soil organic matter and use of fertilizer (Rajashekar et al., 2007).
Conclusion
All water quality parameters are within the permissible limits in Control and treated Hussainsagar lake water but on contrary the polluted Hussainsagar lake water have shown high values. These results indicate that, the Hussainsagar lake water is alkaline, less productive in nature and polluted.

If in future the water is polluted by sewage and industrial effluents etc. that water can be treated by using this technology and such treated water can be reused for irrigation, fishing and generation of hydroelectricity etc.

Research Highlights
The waste water can be treated easily by CV technology process. This type of technology is very useful to the society. It can remove all types of waste material by settling them at the bottom of the water body. The chemicals used in this technology are not harmful. The used chemicals can be revived easily.

Limitations
The treatment process was patented. So the process was not mentioned here. The technology used in this can be purchased at a less cost for further utilization.

Recommendations
This technology is effective both for the treatment and in regard to cost also. So as pollution has become a major crisis and which has to be addressed at the earliest, using this technology will solve the problem much effectively.

Policy Aspects
The government have to take special steps to form organisations at village level to control all types of pollution. Special training programs should be designed to educate children from school level itself.

Authors’ Contribution
The author developed the concept of this article and was successful in treating the polluted water and also have used the water for raring of fish which had economic value.

Acknowledgement
I thank Prof. C. Venkateswar for giving the opportunity to treat the waste water by his patented technology. The Department of Zoology, Osmania University, Telangana has provided the required financial support, technical support and space to compile the data, so it is highly acknowledged.

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