A Case Study of Bellandur Lake in Bangalore

Deepak N1, Divij Krishna M.D2, J.S Sujan Reddy3, Jayanth Raj R4
Department of Mechanical Engineering
PES Institution of Technology-Bangalore South Campus
Hosur Road, Electronic city, Bangalore 560 100
Karnataka, India

Abstract: Water is a transparent and universal chemical substance that is the main constituent of water bodies and the fluids of most living organisms on this planet. Fresh water is the most important human resource and seventy five percent of the earth is filled with water out of which most water is containing salt. Less than five percent amount of water is available in the form of fresh and remaining amount of water is in preserved in ice caps, glaciers and ground water. Rivers, lakes water and soil moisture is freshwater that is available in the planet. About one third of this is lost mainly due to evaporation. This project is to analyze the heavy metal ions, contaminants and pollutants affecting the water of Bellandur Lake in the city of Bangalore.

Keywords: contaminations; pollutants; organisms

I. INTRODUCTION

India, being the second most populated country in this world, is facing a major crisis in managing water. There is an absence of significant and sustained attempts for managing the water quality and quantity at the central and the state levels. One main part is that, at present, India uses around 230-250 cubic kilometers of groundwater every year. On a side are garages with heap of car parts, bleeding paints, metals and oils that slope into the rivers and lakes. Even though, phosphate infused detergents have been banned in many countries due to their polluting nature, India continues the production and consumption of such detergents. As the government regulates the percentage of phosphate content in these consumer products, it has affected the aquatic environment severely.

Bangalore, being one of the metropolitan cities of India, is unaware of the dangerous consequences of pollution due to contamination of water on the public’s health and also confronts logistical and socio-economic problems.

Bellandur Lake, which is one of the oldest and largest lakes in Bangalore, was the lifeline for surrounding 18 villages a few decades ago. From the sea level, it is situated at an altitude of 921 m and has a catchment area of 110.94 square meters.

Bellandur tank is a part of the Bangalore drainage system that removes the waste water of the southern and the south-eastern parts of the city. The unchecked industrial and residential wastes, excess untreated sewage, as well as developing the city, leads to insufficient amount of fresh or rain water to reach the Bellandur lake. The sewage treatment plant set up by the Bangalore Water Supply and Sewerage Board (BWSSB) is not functional to its installed capacity. The sewage treatment plant (STP) has a capacity of 248 million liters per day (MLD) and of which only 30 MLD is treated at primary, secondary and tertiary levels. The remaining untreated sewage enters into the lake.

II. CASE 1

Based on the research done by Helen Roselene and Paneerselvam [1], on the parameters like pH, temperature, conductivity, turbidity, total solvents, Biological Oxygen Demand(BOD), Chemical Oxygen Demand(COD), alkalinity etc., the physical and chemical characteristics of Bellandur tank water were measured. In the months of August and September, the concentrations of these parameters of the water sample were high, indicating the favorable conditions for the growth of algae such as Microcystis because of which the quality of water becomes unfit for basic requirements of human beings and are indicators of organic or sewage pollution.

During the months of October and November, the readings of these parameters were little higher than the standard values which indicates the presence of certain micro-organisms. In august, the water showed maximum
hardness of 1360 mg/L, sulphate content was 1900 mg/L and content of iron metal was 0.8 mg/L. Then, later due to dilution of lake water by rainfall, the pollutant concentration decreased in month of September.

In a comparative analysis of lake water with ground water of Bellandur, it was observed that the ground water was three times more polluted than lake water.

In the month of June, 2007 the comparative analysis of Bellandur lake water and ground water was as follows:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BELLANDUR LAKE</th>
<th>BELLANDUR GROUND WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVITY</td>
<td>1.12 ms/cm</td>
<td>4.1 ms/cm</td>
</tr>
<tr>
<td>CHLORIDE</td>
<td>1483 mg/L</td>
<td>8297.42 mg/L</td>
</tr>
<tr>
<td>HARDNESS</td>
<td>320 mg/L</td>
<td>1600 mg/L</td>
</tr>
<tr>
<td>PHOSPATE</td>
<td>0.8 mg/L</td>
<td>1.2 mg/L</td>
</tr>
<tr>
<td>NITRATE</td>
<td>7.6 mg/L</td>
<td>16 mg/L</td>
</tr>
<tr>
<td>LEAD</td>
<td>0.04 mg/L</td>
<td>0.13 mg/L</td>
</tr>
</tbody>
</table>

Bellandur village is suffering from diseases because of this polluted water as it is the only source of drinking water. This leads to very dangerous unhealthy conditions like swollen legs, scabies in men and children who also work using lake water for construction needs.

It was observed that the descriptive statistics of the lake shows that the conductivity, turbidity, Total Dissolved Solids(TDS), Dissolved Oxygen(DO), hardness, alkalinity, phosphate, nitrate and BOD values are above ISI standards. Other parameters of pH, potassium, chloride, sulphate and COD are above the permissible limit.

The natural water turbidity increases because of the contamination of clay, organic matter, silt, phytoplankton and microorganisms in the lakes. The oxygen content of water is depending upon various factors which include the atmosphere, photosynthesis, respiration, decomposition and several organic impurities. Therefore, the oxygen content level in water reduces, and because of the higher concentration of chloride ions in the water increases the degree of pollution. Phosphorus is considered as the critical limiting nutrient that causes eutrophication in fresh waters. As observed, the electrical conductivity is higher which causes increment in turbidity of water. The alkalinity of water was due to salt of carbonates, bicarbonates, borates, silicates and phosphates along with hydroxyl ions. The high alkalinity was mainly due to presence of sodium carbonate and use of soaps which in turn increases the COD.

The correlation analysis between the variables of water quality parameters of Bellandur Lake showed a positive significant correlation between conductivity and turbidity; TDS and Hardness; Turbidity and Hardness; Potassium and Chloride, Sulphate; BOD and COD; Alkalinity and COD.

Physio-chemical analysis of Bellandur lake in different months:

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>MONTHS</th>
<th>AUG</th>
<th>OCT</th>
<th>DEC</th>
<th>FEB</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td></td>
<td>29°C</td>
<td>30°C</td>
<td>25°C</td>
<td>21°C</td>
</tr>
<tr>
<td>pH</td>
<td>6.5-8.5</td>
<td>7.02</td>
<td>7.15</td>
<td>7.6</td>
<td>7</td>
</tr>
<tr>
<td>CONDUCTIVITY</td>
<td>300</td>
<td>840</td>
<td>866</td>
<td>684</td>
<td>946</td>
</tr>
<tr>
<td>TURBIDITY</td>
<td>5 NTU</td>
<td>13</td>
<td>34</td>
<td>23</td>
<td>12.2</td>
</tr>
<tr>
<td>DISSOLVED OXYGEN</td>
<td>0.5 mg/L</td>
<td>0.5</td>
<td>1.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BOD</td>
<td>30 mg/L</td>
<td>28</td>
<td>239</td>
<td>326</td>
<td>400</td>
</tr>
<tr>
<td>COD</td>
<td>250 mg/L</td>
<td>140</td>
<td>525</td>
<td>710</td>
<td>780</td>
</tr>
<tr>
<td>ALKALINITY</td>
<td>200 mg/L</td>
<td>550</td>
<td>130</td>
<td>430</td>
<td>180</td>
</tr>
<tr>
<td>HARDNESS</td>
<td>300 mg/L</td>
<td>1360</td>
<td>420</td>
<td>66.3</td>
<td>380</td>
</tr>
<tr>
<td>IRON</td>
<td>0.3 mg/L</td>
<td>0.8</td>
<td>BDL</td>
<td>0</td>
<td>0.92</td>
</tr>
</tbody>
</table>
Graphical representation of physio-chemical analysis of Bellandur lake in different months:
III. CASE 2

From the observations and results based on the research done by H Lokeshwari and G.T Chandrappa[2], it was observed that all heavy contaminations of metals were present in Bellandur lake water. As compared with other contaminants in the lake water, iron concentration was two times higher than the specific limit. It was also showed that the metal concentration average values (mg l⁻¹) in lake water were: 1087 (Fe), 132 (Zn), 12 (Cu), 3 (Ni), 6 (Cr), 9 (Pb) and 0.7 (Cd) and that of the natural elemental levels were: (500 (Fe), 15 (Zn), 3 (Cu), 0.5 (Ni), 1 (Cr), 1 (Pb) and 0.03 (Cd) in freshwater which depicted that the obtained concentration levels were 2, 9, 4, 6, 9, and 23-times higher than standard levels respectively. This clearly reveals, the heavy metal ion concentration in Bellandur lake water increases. This was due to direct discharge of industrial, sewage, domestic, municipal and other activities in the surrounding neighbourhood. It was also observed that Iron, Chromium and Lead concentration during monsoon was increased up to 50 percent, whereas the concentration of Cadmium increased during summer. Biomass availability depends upon the percentage amount of negative ions and chelating organic ligands present in the water and physical factors namely pH, reduction and oxidation status and the absorbent sediments. The total metal content in the biomass(%) was observed in the literature as: Fe–25, Zn–42, Cu–25, Ni–33, Cr–3, Pb–6 and Cd–19. As compared to other metal ion concentration, the higher amount of Zinc was observed in biomass.

Highest TF values are obtained for Zinc, Copper, Lead and Cadmium. Cadmium occurs with Zinc in water bodies and the accumulation of Cadmium (II) is less in the soil than other toxic positive metallic ions which is the reason behind the high TF values. The highest TF values were observed for Cadmium and Zinc because of their higher mobility nature and were 2.5 and 1.1 respectively.

According to the observations, all the seven metals that were considered in the study showed their presence in the soil of irrigated land. Other than Cadmium and Zinc, the remaining metal ions content were lower in vegetable samples than in the soil. The total metal ion concentration in the soil was less than the threshold limit based on their effect on animals. It was observed that the concentrations of heavy metals namely Copper and Cadmium in the surface soils were 2.5 and 6 times higher than the natural concentrations respectively.

IV. EXISTING CONDITION OF BELLANDUR LAKE

In reality, the Bellandur lake water is opaque and dark in nature. There are hardly any birds visible near the lake due to this condition. During the excess water floating and down streaming parts of the lake, leads to the formation of heavy foaming indicating the presence of effluents. Due to the indiscriminate or random disposal of various wastes into the lake, environmental degradation is taking place. Discharge of sewage, other wastewater and solid wastes into the water drains pollute the lake. The lake contains raw sewage, industrial effluents and domestic garbage.

V. CONCLUSION

As per the literature surveys in the cases mentioned above, the major source of water pollution is untreated waste water and heavy metal contaminations. And also due to the enormous amount of organic impurities present in the sewage water, the decomposition of the waste leads to the formation of gaseous fuel molecules which will burn and release smoke and hence affects the public health. Sometimes due to the presence of soaps, detergents and surfactant molecules in the water which contains high amounts of sulphuric acid, enormous amount of froth is produced on the surface of water. And that froth contains poisonous and toxic gases which causes unhealthy environment. Discharge of untreated effluents along with accidental fires like throwing cigarettes has lead to the catch of fire on the surface of the lake. Incidence of the foam catching fire is also due to the compounds of high inflammability, mostly higher hydrocarbons and organic polymers from nearby industries. Also, the excess amount of produced froth starts flowing toward the roads, thereby leading to heavy traffic and many accidents on the path. Even the residents nearby to the lake are affected by this froth entering into their buildings and causing huge risks. By knowing these facts, in the present Bellandur lake water, certain extent of organic impurities can be removed, and by taking the same organic impurities and mixing it with certain amount cow dung, it is possible...
to produce methane gas and utilize for the domestic purposes. By using this technology, we can reduce the burdening of usage of fossil fuels. Based on the further processes of tests done on these organic impurities, it is possible to identify the types of gases produced during combustion. If these gases are environmentally friendly, then they can be used for domestic purposes, otherwise they can be utilized as a fuel for the production of electrical energy using the latest technology and can be supplied to major parts of the city which is facing difficulties due to power-cut crisis.

REFERENCES


ACKNOWLEDGEMENT

This case study was supported by Dr. Revanasiddappa M, Department of Science and Humanities, PES Institute of Technology-Bangalore South Campus, Bangalore 560100. We would also like to show our gratitude to the institution for sharing pearls of wisdom during the course of this study.