

Monthly variation of physico-chemical and microbiological characteristics of Sambhaji lake Solapur, Maharashtra

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ABSTRACT

Sambhaji Lake, known for its beauty and richness of aquatic life in Solapur, Maharashtra. But due to urbanization, lake becomes polluted. On account of lake importance, Physical, chemical and microbiological parameters in Sambhaji lake were measured monthly at three stations (Sewage outlet, Dhobi ghat, and Ganapati ghat) in July 2013 to September 2013. The physical parameter such as temperature, color, odor, TDS, TSS and TS, chemical parameter, pH, Chlorides, sulphate, free CO₂, Total hardness, dissolved oxygen, chemical oxygen demand, Phosphate, Biological oxygen demand, nitrate, oil and grease, heavy metal, microbiological parameter, total coliform, Gram negative microorganism were found. The nutrient content of lake water apparently indicated that lake had a eutrophic characteristic. Dissolved oxygen was determined as a limiting factor in lake. PH, temperature, free CO₂, hardness, nitrate, was within permissible limits as per CPCB (central pollution control board). But TDS, TSS and TS, Chlorides, sulphate and BOD were above permissible limits. After microbiological analysis and MPN Gram negative E.coli were found in lake water. Eutrophic characteristic of the lake and contaminant accumulation in water will probably affect the future use of the lake. Therefore, pollution parameters must be regularly monitored and evaluated according to aquatic living and local regulations.

Key words: Physico-chemical and microbiological Characteristics, Sambhaji Lake, Solapur

INTRODUCTION

Sambhaji Lake is situated on the southwest side of Solapur in the direction of Vijapur. It is one of the important lakes of Solapur city. The Lake extends between the latitudes 17°38'55" North and 17°38'48" North and longitudes 75°54'07" East and 75°54'21" East.

MATERIALS AND METHODS

STUDY AREA

The Sambhaji Lake is a mesotrophic perennial lake and has a maximum depth of 4.30 M. The catchment area of the lake is about 2500 acres. The water spread area of the lake about 42 acres. The mean annual rainfall of the area is 617 mm. The lake is polluted by unabated entry of sewage, washing of cloths and animals, bathing, disposal of domestic and biomedical solid waste into the lake. At present, the lake supports diverse aquatic flora and fauna. It also attracts many bird species of local and migratory types. The lake has a great Socio-cultural, aesthetic and recreational value. Presently, various nallas are discharging wastewater incessantly in the lake. Further, activities like animal washing, disposing religious offerings and solid waste in the lake, washing of cloths are also observed.

Collection and Analysis of Water Samples

Total 29 water samples were collected from 9 sampling points viz Sewage (S1, S2, and S3) Dhobi ghat (D1, D2, D3) Ganapati ghat (G1, G2, G3) in Sambhaji Lake during period of 3months i.e. July, August, September 2013. Various water quality parameters such as Total Solids, Total Dissolved Solids, Total Suspended Solids, pH, Chloride, Free CO₂, Chloride (Cl⁻), Total Hardness (TH), Sulphate, Phosphate, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Nitrate, Oil and Grease were estimated by standard method of APHA [13].

Physical Parameters

The Physical Parameters such as Color, Odor, Temperature, Total Solids, Total Dissolved Solids, and Total Suspended Solids were analyzed.

Chemical Parameters

The chemical parameters measured include pH, Chlorides, Free CO₂, Total Hardness, Sulphate, Phosphate, Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Nitrate, Oil and Grease etc.

Microbiological Parameters

Total Coliform numbers were determined by Most Probable Number. For confirmatory test IMViC were performed.

RESULTS AND DISCUSSION**MONTHLY VARIATION OF DIFFERENT PHYSIC-CHEMICAL PARAMETERS**

| Parameters | Sewage | | | Dhobi Ghat | | | Ganapati Ghat | | |
|----------------------|---------|----------|---------|------------|----------|---------|---------------|----------|---------|
| | JUL | AUG | SEPT | JUL | AUG | SEPT | JUL | AUG | SEPT |
| Temp. | 18.1 | 26 | 28.6 | 17.3 | 24.83 | 28.6 | 20.6 | 26.67 | 28.6 |
| TS | 666.67 | 11000 | 625 | 1666.67 | 5583.33 | 1333.33 | 1500 | 2000 | 1666.67 |
| TDS | 1000 | 2000 | 500 | 2333.33 | 13666.67 | 1166.67 | 7833.33 | 1666.67 | 500 |
| TSS | 3666.67 | 3000 | 4833.33 | 2000 | 3333.33 | 3500 | 16833.33 | 2500 | 3500 |
| pH | 7.5 | 7 | 7 | 7.5 | 7 | 7 | 7.5 | 7 | 7 |
| Chlorides | 242.24 | 267.05 | 232.69 | 303.69 | 264.69 | 288.33 | 309.59 | 232.79 | 271.78 |
| Free CO ₂ | 47.67 | 44 | 17.6 | 44 | 22 | 8.8 | 47.67 | 14.67 | 5.87 |
| Total Hardness | 6.47 | 7.5 | 5.18 | 6.83 | 8.13 | 5.28 | 7.43 | 8.55 | 4.92 |
| Sulphate | 1566.67 | 14166.67 | 3033.33 | 1566.67 | 20100 | 2866.67 | 1166.67 | 19633.33 | 3333.33 |
| Phosphate | 23 | 62 | 28 | 16.33 | 54 | 30.33 | 12 | 68 | 30 |
| DO | 0 | 6 | 0 | 4 | 12 | 67 | 4 | 22 | 29 |
| BOD | 0 | 6 | 0 | 4 | 12 | 67 | 4 | 22 | 29 |
| COD | 16 | 16 | 20 | 10.67 | 4 | 16 | 18.67 | 16 | 22.67 |
| Nitrate | 20 | 5.67 | 3.47 | 46.67 | 2.13 | 2 | 38.33 | 3.33 | 6 |
| Oil And Grease | 1400 | 63500 | 213000 | 800 | 69350 | 106500 | 1000 | 68750 | 102000 |
| MPN/100ml | 280 | 49 | 1600 | 7 | 1600 | 920 | 540 | 1600 | 1600 |

*The units of measurement of all parameters are in mg/lit. Except PH, temperature and MPN count.

In the present investigation maximum rainfall was received in the months of July (266.3mm) and September (134.4mm) and minimum rainfall was received during August (56.2mm). The maximum Temperature was (28.6⁰C) recorded in the month of September and minimum during July at Dhobi ghat (17.3⁰C). Water temperature plays an important factor which influences the chemical biological characteristics of water body. Total Dissolved Solids ranges from 500 to 13666 mg/lit. The minimum value observed 500 mg/lit due to heavy rainfall in September. The pH value of water is important indication of water quality. PH determines the suitability of water for various purposes, including toxicity to animals and plants [8]. The pH of lake was found to be alkaline during July and neutral during august and September. Ranging from 7 to 7.5 pH. The pH values are supporting the phytoplankton growth. The pH values are within the acceptance range according to CPCB is 6.5 to 8.5. Chlorides values are maximum during July at Ganapati Ghat 309.59 mg/lit and minimum during September at site sewage is 232.69 mg/lit. It indicates that average chloride values are above the limits of CPCB i.e. 250 mg/lit. High concentration of free CO₂ (>20 mg/L) are toxic to fishes and other aquatic life[6]. The value of free CO₂ ranges from 5.87 to 47.67 mg/lit. The maximum values of Free CO₂ found during month of July and minimum during September at all sites. This may be depending upon alkalinity and hardness of water body. The value of CO₂ was high during July. This would be related to the high rate of decomposition in the warmer months[9]. Low level of free CO₂ might be either due to its consumption in carbon assimilation or its complete conversion into carbonic acid and ultimately into stable

carbonates and bicarbonates. Higher value of free CO₂ generally coincided with minimum dissolved oxygen. Hardness of water is due to presence of calcium and magnesium ions. Water containing hardness concentration up to 60 mg/lit are called soft water and those containing 120-180 mg/lit as hard water [8]. The hardness observed in the range of 4.92 to 8.55 mg/lit hence it is classified as a soft water. Maximum hardness was observed during August at Ganapati ghat and minimum in September at Same site due to dilution of water due to rain. Phosphate content in a lake may be due to release of phosphate from bottom sediment and organic load of the water, this help in growth of the phytoplankton and weeds in the lake [8]. Washing of clothes and bathing was seen during the study period which might be due to highest value of PO₄. Maximum values observed during August at sewage site 68 mg/lit and minimum values observed during august at site sewage 12 mg/lit. House hold detergents, domestic sewage leaching of phosphate fertilizer may be reason for phosphate level increase. The high values of phosphate are mainly due to rain, surface water runoff, agriculture run off; washer man activity could have also contributed to the inorganic phosphate content [9]. Higher concentration of Nitrate favored growth of phytoplankton [8]. The nitrate observed during month of July to September ranges from 2 to 46.67 mg/lit. The maximum nitrate was observed during July 46.67 mg/lit and minimum value found to be 2 mg/lit during September at Site Dhobi Ghat. Dissolved oxygen (DO) is an important indicator of ability of a water body to support aquatic life. The maximum DO observed (67 mg/lit) during September after Ganapati Visarjan at Site Dhobi Ghat and Minimum DO observed was 0 during July and September at Site Sewage. It may be due to change in season and presence of more domestic sewage [5]. Average values of DO of all sites are above the limits of CPCB except at sewage site. The High level of DO may be attributed to the self purification capacity of flowing water, aquatic plants photosynthetic efficiency and air flow etc. The maximum value was recorded during month of September at site Dhobi Ghat because of good sunshine and excessive amount of primary production. The low level of DO in water is stressful and benthic organisms may become vulnerable to hypoxia. Such low levels of DO in aquatic ecosystems are common during late summer months [8]. Dissolved oxygen is essential and in some cases even limiting factor for maintaining aquatic life; its depletion in water is probably the most frequent result of certain forms of water pollution [3]. Biochemical oxygen demand (BOD) is most important parameter used to assess the quality of water. It was applicable in measuring organic loading on water bodies. The BOD values indicate high concentration of biodegradable matter and high oxygen consumption by heterotrophic organism [5]. The BOD values observed between the ranges of 0 to 67 is same as that of dissolved oxygen and average values are above the limits of CPCB which was 2 mg/lit indicates water pollution. Chemical Oxygen Demand is used as a measurement of pollutants in natural water. Both organic and inorganic component are to be analyzed by these method [5]. The COD values are within the range of 4 to 22.67 mg/lit. The higher values of COD indicate pollution due to oxidisable organic matter. In the present study, the presence of total coliform, *Escherichia coli*, was observed. In the monthly sample collections revealed the occurrence of pollution by the community activities. Generally the water samples showed a highest MPN value during the rainy seasons (July to September) as the bacteria is mainly derived from the soil and sewage that gain access to the lake through rain water or storm water. Presence of coli form count in the water sample also point towards pollution of the lake and leads to pathogenic fish diseases[8]. Fecal discharge from human and animals may transport a variety of human pathogenic microorganisms i.e. bacteria, viruses, protozoa [5]. Most Probable Number (MPN) values were in the range of 7 to 1600 and above /100 ml. The average MPN values were found to be 1600/100ml. It may be due to discharge of domestic sewage and organic pollution. The values of MPN shows that this water is not suitable for drinking as per limit zero MPN/100ml for drinking.

CONCLUSION

Not only great efforts were needed for recovery of the purity and healthy of the lake, but also an additional information were needed to provide a data base for optimal fisheries and water quality status that help the proper management of the lake. Although it is difficult to judge about the degree of long term pollution and water quality from short period measurements yet, they supply seasonal information about the lake water quality. The results showed that Sambhaji Lake has a faced eutrophic condition. The uses of Sambhaji Lake for different purposes (fishing, gardening) are great importance for Solapur city. For conservation of lake pollution parameters must be regularly monitored and evaluated according to aquatic life and local regulations. In future, management strategies may be developing to provide sustainability of Sambhaji Lake. In addition, an effective coordination among the related Non Governmental and local agencies would give beneficial results.

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The enrichment of ponds and lakes with PO₄ and NO₃ are result in enhancement of weeds and algae. The consumption of fishes grown in eutrophicated lake will cause health disturbances to human by biomagnifications. When contaminations are ignored, the water source may reach derelict stage, whereby the whole ecosystem becomes unfit for either augmentation of fishery culture activities or for human consumption. Considering the need and amount of water supply for the ever expanding human population, and also taking in view of the freshwater budget, these water bodies seem to be the future resources which are in need of strict management and bioremediation activities. [8]From the present study, it emerges that Sambhaji lake must conserve by local communities and Solapur Municipal Corporation.

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