Studies On Physicochemical Parameters Of Lakes In And Around Hyderabad, Andhra Pradesh, India

Sayed Tasin[1], Shaikh Parveen R. [2], & Sirisha D. [3]

[1]Department of Civil Engineering, VIF College of Engineering & Technology, Hyderabad,
Andhra Pradesh, India.
[2]School of Earth Sciences, Solapur University, Solapur, Maharashtra, India
[3]Department of Environmental Science, Jawaharlal Nehru Institute of Advance studies, Secunderabad, Andhra
Pradesh, India.
shaikh_parveen100@yahoo.com

Abstract: A study was conducted to investigate the water quality of five important lakes - Osman Sagar, Himayat Sagar, Langer House Lake, Jeedimetla Lake, Patan Cheruvu Lake which are located in and around Hyderabad. The sampling points were selected on the basis of their importance. The surface water samples were taken from the above said lakes during the period of winter in the month of October and November 2011. Water samples were analyzed for various physico-chemical parameters like pH, conductivity, turbidity, chlorides, hardness, alkalinity, total dissolved solids (TDS), dissolved oxygen (DO), phosphate, sulphate, biological oxygen demand (BOD) and chemical oxygen demand (COD). The present study showed detailed physico-chemical characteristics and quality of water of five studied important lakes. From the present investigation, it indicated that Langer House Lake, Jeedimetla Lake and Patancheru Lake are polluted, hence making it unsuitable for human consumption. The Lakes Osman Sagar and Hiamayat Sagar shows concentrations of all the physicochemical parameters well below the desirable limit recommended by BIS, thus the water of Osman Sagar and Himayat Sagar most suitable for survival of the fishes and for supply of drinking water to the Hyderabad city. A direct effect of human activities on the pollution status was observed in all the lakes. The overall objective of this work was to investigate the lake water quality and suggests the means to improve the lake water quality.

Keywords: Hyderabad, Lake Pollution; Physico-chemical Parameters; water Quality

1. Introduction

The landscape of historical city of Hyderabad is dotted with a number of small and big water bodies, impounded as a part of scientifically developed irrigation system in this semi-arid region. However, in the last 50 years or so progressive urbanization and industrialization has taken a toll of surface water resources in which a number of lakes have totally disappeared due to massive reclamation by addition of garbage, silt and solid waste, while others are facing progressive destruction due to factors like encroachment, siltation and pollution from domestic sewage and/or industrial effluents. Lakes Langer house Cheruvu, Jeedimetla Cheruvu and Patan Cheruvu are the classic example of this process. Little work has been done on Osman Sagar, Himayat Sagar, Langer house Cheruvu, Jeedimetla Cheruvu and Patan Cheruvu which are present in and around Hyderabad.

2. Study Area

The topographical locations of the lakes are presented in Figure 1. Osman Sagar popularly known as Gandipet, is an artificial lake in the Hyderabad city outskirts. The lake is around 46 km², and the reservoir is around 29 km². It was created by damming the Musi

River in 1920, for providing drinking water source for Hyderabad, and also saving the city from floods, on the lines of which Hyderabad suffered in 1908. It was during the reign of The Last Nizam of Hyderabad, Osman Ali Khan, hence the name.
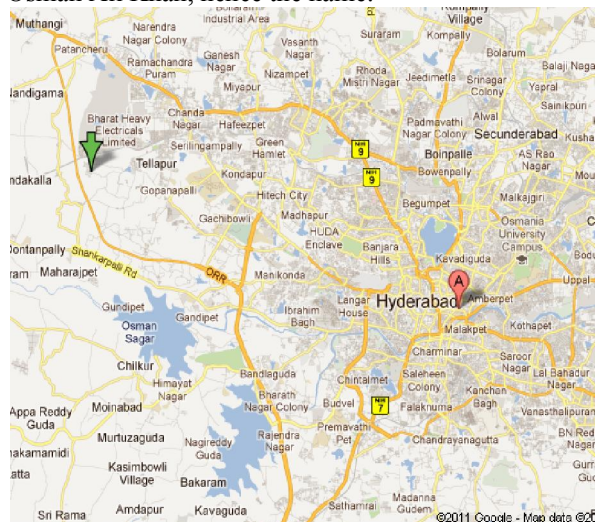

Figure 1: Graphical and Google satellite visualization of Hyderabad showing the study area and location of lake.

Himayat Sagar is an artificial lake located about 20 km from Hyderabad. It lies parallel to another artificial lake Osman Sagar and it is smaller in size among both. The storage capacity of the reservoir is about 3.0 TMC. The construction of reservoir on Esi a tributary of Musi River was completed in 1927, for providing drinking water source for Hyderabad, and also saving the city from floods, which Hyderabad suffered in 1908. It was built during the reign of the last Nizam of Hyderabad, Nizam VII and so it is named after his youngest son Himayat Ali Khan. Langer House Lake located in the Hyderabad city.

In a study done for HUDA, it was found that 18 water bodies were identified as the most polluted while 67 were polluted to a lesser extent. One major lake in the highly polluted category Langer House Lake has been cleaned up and is being conserved with a green belt around.

Jeedimetla Lake situated (18° 30'–18° 20' N and 77° 30'–79° 30' E) 1 km west of Hyderabad–Nizamabad road at a distance of 15 km from the Hyderabad city. The gross capacity of the lake is ten million cubic meters when full and total area of this wetland is 4700 ha.

The water bodies Patan Cheruvu Lake present in Patancheru, an industrial zone in the Hyderabad city outskirts.

In the present investigation an attempt has been made to assess the physico-chemical characteristics in above five different lakes.

3. Material and Methods

The research work consists of study of lake water in and around Hyderabad. It mainly includes Osman Sagar, Himayat Sagar, Langer House Lake, Jeedimetla Lake, Patancheru Lake. The brief observation, result and discussion are explained. The survey was carried out during the period of winter in the month of October and November 2011. During survey of the lakes the water samples were collected with help of local fishermen or boat. The samples were collected from a depth of 5-10 cm below the surface of water and stored in two liter cleaned plastic bottles. Sample collection was usually completed during morning hours between 9.00 am to 11.00.

The water temperature, dissolved oxygen were determined in the field at the time of sampling by using digital thermometer, digital DO meter respectively (Trivedy & Goel, 1984) while other parameters of the Lake water like Color, Turbidity, pH, Total Dissolved solids (TDS), Salinity, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Hardness, Sulphate, Phosphate (Manivasakam, 2005), Total Alkalinity, Chlorides were determined in the laboratory as per standard methods (APHA, 1998). Various methods

used are listed in table 1. Several studies have been conducted so far to understand the physico-chemical properties of various lakes in Andhra Pradesh (Chandrasekhar and Kodarkar, 2007; Chinnaiah, 2011; Pandey et. al., 1993; Ramachandraiah et. al., 2007).

Table 1. Physico-chemical analysis by different method.

Parameter	Method/Equipment Used
Temperature	Thermometer
Colour	Apparent Color
Turbidity	Turbidity Tube
pH, EC, TDS, Salinity	Kit
DO	Digital DO meter
Total Alkalinity, Total Hardness, Chloride, BOD, COD	Titrometry method
Phosphate, Sulphate	U.V. visible Spectrophotometry

4. Results & Discussions

The results of the physico-chemical analysis of the water samples collected from all the Lakes were presented in Table 2. The physico-chemical parameters are considered as the most important principles in the identification of the nature, quality and type of the water for any aquatic ecosystem.

Physico-chemical characteristics:

Color:

The Langer house and Patancheru lake water was observed to be slightly turbid with yellowish color and Jeedimetla lake water with grayish shade and slight odour. The Osman Sagar and Himayat Sagar lake water was observed to be colorless without any odour. According to ISI colorless water is potable.

Temperature:

During the investigation, the water temperature ranged from 24.8^0 C to 26.3^0C. Temperature is a factor of great important for aquatic ecosystem, as it affects the organisms, as well as the chemical and physical characteristics of water (Delince, 1992).

pH:

The pH value of the entire studied lakes ranged from 6.9-8.28 fell within the desirable range (6.5-8.5) for drinking water as per the BIS guideline. The pH 6.9 in Langer House Lake sowing acidic nature while others was showing alkaline nature of lake. pH regulates most of the biological processes and biochemical reactions. The pH, free CO_2 and ammonia are more critical factors in the survival of aquatic plants and fishes than the oxygen supply.

Total dissolved solids (TDS):

In the present study, The TDS values found (10-690 mg/L) of which maximum values of TDS was Recorded in Patan cheru Lake that exceeded the

desirable limit for drinking water as per BIS guideline. The TDS present in the water affects its aesthetic value as well as its physico-chemical and biological properties.

Electrical conductivity (EC):

The electric conductivity ranged between 0.03 to 1.08 ms/cm. Electric conductivity was maximum in Patancheru Lake water (1.08 ms/cm) and minimum in Osman Sagar Lake water (0.03 ms/cm). Specific conductivity is a numerical expression of its ability to carry an electric current. The factors such as rainfall and biodiversity changes in ionic composition and nature of bottom deposits influence the conductivity. The conductivity increased with the increase in total dissolved solids and water temperature.

Salinity:

During the study the salinity ranges between (0.0 - 7 %) The salinity of the lake Patancheru was higher than that of other studied Lakes during the investigation period. This is due to the increase in the concentrations of TDS as shown in Tables-2. The fluctuation in salinity plays a key role in establishing the distribution and dynamics of the chemical water quality. It has a strong influence on the distribution of biological species.

Turbidity:

In the present survey, turbidity in the lake water varied from 10 to 150 NTU (Table-2). The higher value of turbidity was recorded in Langer House Lake (150 NTU) and the lowest value in Osman Sagar (10 NTU). Turbidity in natural water is caused by clay, silt, organic matter, phytoplankton and other microscopic organism etc. According to BIS the turbidity permissible limit is up to10 NTU for drinking water

Dissolved Oxygen (DO)

In the present investigation, dissolved oxygen concentration varied from 2.5 mg/L to 10.5 mg/L in month of November 2011. At Langer House Lake, the minimum value of dissolved oxygen was recorded, 2.5 mg/l, while maximum value was recorded, 10.5 mg/l at Osman Sagar.

Dissolved oxygen in water is of great importance to all aquatic organisms and is considered to be the factor which reflects physical and biological process taking place in a water body. It is important in the production and support of life. Concentration of dissolved oxygen also depends on surface agitation due to temperature, respiration rate of the living organisms and decomposition rate of dead organic matters.

Biochemical Oxygen Demand (BOD):

Biochemical oxygen demand (BOD) is defined as the amount of oxygen required by microorganisms while stabilizing biologically decomposable organic matter in water under aerobic conditions. During the

winter season study (November 2011) the BOD values were ranged, Nil to 28.5 mg/l. The minimum value of BOD was recorded Nil mg/l in the Osman Sagar and Himayat Sagar while maximum value was recorded, 28.5 mg/l in the Langer House Lake.

Chemical Oxygen Demand (COD):

COD is defined as the amount of oxygen consumed for the oxidation of organic matter with the help of chemical oxidant. During the winter season study (November 2011) the COD values were ranged, Nil to 64 mg/L. The minimum value of COD was recorded Nil mg/L in the Osman Sagar and Himayat Sagar while maximum value was recorded, 64 mg/L in the Langer House Lake.

Total Alkalinity:

In the present investigation total alkalinity ranged between 150-460 mg/L. The higher value was observed at Langer House Lake (460 mg/l) and the Lower value was observed at Jeedimetla Lake (150 mg/l), except Jeedimetla Lake the total alkalinity of all the studied lakes exceeded the desirable limit (200 mg/l) for drinking water as per BIS guideline. Total Alkalinity of water refers to the quality and kinds of components present such as bicarbonate, carbonate and hydroxide.

Total Hardness:

In the present survey, hardness ranges from 150 mg/l to 350 mg/L. Observations reveal that the values of hardness are in decreasing order from Langer House > Patancheru > Himayat Sagar > Jeedimetla > Osman Sagar of which hardness concentration of Langer House Lake (350 mg/l) found to be more than that of desirable limit (300 mg/L) for drinking water by BIS guideline. Water hardness is commonly defined as the sum of the polyvalent cations dissolved in water. The most common cations are calcium and magnesium; although iron and manganese may be contribute.

Chlorides:

During the winter season study (November 2011) the Chlorides values were ranged, 35.45 to 233.97 mg/L. At Osman Sagar, minimum value of Chlorides was recorded, 35.45 mg/l, while maximum value was recorded, 233.97 mg/l in the Jeedimetla Lake. Observations reveal that all the studied lakes shows chloride values below the desirable limit (250 mg/L) for drinking water recommended by BIS. The presence of chloride in water in excess amounts is not desirable. Chlorides are present in all potable waters, usually present in the sewage as a metallic salt.

Sulphate:

Sulphate ranged between 0.4 to 60 mg/L. The higher values of sulphate were recorded in Jeedimetla Lake 60 mg/l and lower in Himayat Sagar 0.4 mg/l. Observations reveal that the concentrations of phosphate in all the studied lakes were found to be

well below the desirable limit (200 mg/L) for drinking water as per BIS guideline. The presence sulphate in water in excess amounts is not desirable. Odorous condition is easily erected when water is over loaded with organic waste to the point that is removed, then SO_2 as electron acceptor is often used for the breakdown of organic matter and produces H_2S and a rotten egg smell.

Phosphate:

In the present investigation, Phosphate concentration ranged between Nil to 0.008 mg/L. The phosphate value was recorded Nil in Osman Sagar and maximum was recorded 0.008 mg/l in Jeedimetla Lake during winter season (November 2011). In natural water, phosphates are present in small quantities. Normally phosphate acts as a limiting nutrient in the process of eutrophication and lakes can be aesthetically classified in to good, fair and bad on the basis of % phosphates loading.

Some other researchers studied water quality of lakes (Njenga et. al., 2003; Mohamed, 2005 Patra et al., 2010; Yeole & Patil, 2005; Yesim et al., 2004).

Table 2. Physico-chemical characteristics of the lake water.

Water quality parameter	Sample collection in the Lakes					BIS guideline value for drinking water
	Osman Sagar	Hiamayat Sagar	Langer House Lake	Jeedimetla Lake	Patancheru Lake	
	Mean Value					
Color	Colorless	Colorless	Slightly Yellow	Slightly Grey	Slightly Yellow	-----------
Temperature(^{0}C)	24.8	25	25.7	25.9	26.3	No Guideline
Turbidity(NTU)	10	15	150	50	40	5
pH	8.2	8.28	6.9	7.40	8.03	6.5 To 8.5
EC(ms/cm)	0.03	0.031	0.74	0.81	1.08	No Guideline
TDS(mg/L)	10	21	470	500	690	500
Salinity (%)	0.0	0.0	0.5	0.5	0.7	No Guideline
Total Alkalinity (mg/L)	240	250	460	150	350	200
Total Hardness (mg/L)	150	230	350	160	270	300
DO (mg/L)	10.5	9.5	2.5	2.9	3.5	No Guideline
BOD (mg/L)	----	-----	28.5	26	20.2	No Guideline
COD (mg/L)	----	----	64	60	44	No Guideline
Chloride (mg/L)	35.45	42.54	106.35	233.97	223.33	250
Sulphate (mg/L)	0.8	0.4	10	60	1.2	200
Phosphate (mg/L)	------	0.0004	0.0042	0.008	0.0026	No Guideline

Conclusion:

The present study showed detailed physico-chemical characteristics and quality of water of five studied important lakes. from the present investigation, It indicated that Langer House Lake is most polluted having high turbidity, alkalinity, total hardness, BOD, COD but low level of DO, Thus making it unsuitable for drinking, fish and biota. The Jeedimetla Lake shows high turbidity, BOD, COD, chloride and DO are relatively low, slight odour, thus making it unsuitable for human consumption. The Patancheru Lake is also having high concentration of turbidity, TDS, total alkalinity, hardness, BOD, COD, Chloride and DO are relatively low, hence making it unsuitable for human consumption. The Lakes Osman Sagar and Hiamayat Sagar shows concentrations of all the physicochemical parameters well below the desirable limit recommended by BIS, thus the water of Osman Sagar and Himayat Sagar most suitable for survival of the fishes and for supply of drinking water to the Hyderabad city.

Corresponding Author:
Parveen R. Shaikh
School of Earth Sciences, Solapur University, Solapur-413255, Maharashtra, India
E-mail: shaikh_parveen100@yahoo.com

References
1. APHA. Standard methods for the examination of water and wastewater, ed. 20. APHA, Washington USA: 1998.
2. Chandrasekhar S V A, Kodarkar M S.

Proceedings of Taal 2007: The 12th World Lake Conference. 2007; 2039-2043.

3. Chinnaiah B, Madhu V, Ramesh Babu M. Physico-chemical characterstics of khajana and darmasagar lakes, in Adilabad, AndhraPradesh, India. International Journal Of Pharmacy & Life Sciences 2011; 2(4): 674-6.

4. Delince G. The ecology of the fish pond ecosystem with special reference to Africa. Text book, Kluwer Academic Publishers 1992; 230.

5. Manivasakam N. Physico-chemical examination of water sewage and industrial effluents, Pragati Prakashan, Meerut: ed. 5, 2005.

6. Mohamed Abdo. Physico-chemical characteristics of Abu Za'baal Ponds, Egypt, Egyptian journal of aquatic research 2005; 31 (2): 1-15.

7. Njenga W., Ramanathan A L, Subramanian V. Comparative studies of water chemistry of three tropical lakes in Kenya and India. Proceedings of the International Conference on Water and Environment (WE-2003), Bhopal, India, 2003; 15-18.

8. Pandey A K, Siddiqi S Z, Rama Rao K V. Proceeding Academic Environmental Biology 1993; 2(2): 161-7.

9. Patra A P, Patra J K, Mahapatra N K, Das S Swain G C. Seasonal Variation in Physicochemical Parameters of Chilika Lake after Opening of New Mouth near Gabakunda, Orissa, India. World Journal of Fish and Marine Sciences 2010; 2 (2): 109-17.

10. Ramachandraiah, Chigurupati, Vedakumar, Manikonda. Hyderabad's Water Issues and the Musi River Need for Integrated Solutions, Draft version of the Paper presented in the International Water Conference, Berlin: 12-14 September 2007.

11. Trivedy R K, Goel P K. Chemical and biological methods for water pollution studies, Environmental Publications, Karad, India 1984; 122.

12. Yeole S M, Patil G P. Physico-chemical status of Yedshi Lake in relation to water pollution. Journal of Aquatic Biology, 2005; 20(1): 41-44.

13. Yesim Kara, Izzet Kara, Davut Basaran. Investigation of Some Physical and Chemical Parameters of Water in the Lake Isykli in Denizli, Turkey International Journal of Agriculture & Biology 2004; 6(2): 275–277.

11/25/2016