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Assessment of Physico- Chemical Parameters of Upper Lake Bhopal M.P. India

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Abstract: The present study assesses the various physico-chemical parameters of Upper Lake Bhopal. For the analysis, methodology as given in APHA (1995) was followed. The results obtained revealed higher values for some parameters such as free CO_2, indicating higher trophic status of the lake as were also reported by Wanganeo and Wanganeo (2006). Chloride values were also recorded on the higher side indicating that the lake waters are fed with sewage and other run-off materials from its catchment area. The calcium and magnesium hardness revealed less hard waters of the lake. The pH values recorded were also of near neutral to alkaline range suggesting well buffered lake waters.

Key Words: Physico-chemical parameters, APHA, Sewage, Free CO_2, Chloride, Trophic status, pH values.

Introduction: Water is one of the most important natural resource available to mankind. Knowing importance of water for sustenance of life, the need for conservation of water bodies espacially the fresh water bodies is being realised everywhere in the world. Our planet is sometimes known as water planet as 2/3rd of earths surface is covered by water. However only 1% of the water resource is available as fresh water i.e surface water, rivers, lakes, streams, ground water for human consumption and other useful activities.

Lakes also prove a useful source of fresh water in various parts of the world and hence it becomes necessary to check and maintain their water quality for a healthy survival. Lakes have been at the center of human attention. Several cities, industrial infrastucture and other complexes have been built in the vicinity of lakes, rivers and other water bodies. Development of human communities has deteriorated lake and river water qualities. Bearing the idea in mind it is inevitable to analyse and understand quality of surface water for various purposes such as for drinking, agriculture and industries.

In the current study, some of the important physico-chemical characteristics of Upper Lake Bhopal were analysed and studied inorder to have an idea about its water quality as it is an important source of water espacially for drinking purpose to the urban population of Bhopal city.

Study Area: Bhopal, the picturesque capital of the state of Madhya Pradesh, is also known as "City of Lakes" on account of a large number of water bodies present in and around Bhopal. The upper lake is the source of drinking water to urban populations,and is also known as "Badah talab". Upper lake is surrounded by Van Vihar National Park on the south, human settlements on the east and north, and agricultural fields on the west. The water of the Upper Lake was used for drinking purposes up to year 1947 without any treatment, which proves that the waterquality was very good. After Bhopal become the capital of Madhya Pradesh in 1956, it noticed tremendous population inflow and consequent rapid urban development which adversely affected the lake. Upper lake in Bhopal is arguably the oldest man-made lake in India, and was created by Raja Bhoj in the 11th century by constructing an earthen dam across the Kolans River.The Upper Lake is a major source of portable water for the people of the city of Bhopal, Madhya Pradesh, India. For the present work water samples were taken from two sites of Upper Lake named as Site-I, at the shore of the lake and Site-II, at the center of the lake

Climate: Bhopal, experiences a tropical climate with tropic of cancer passing through the state. It has hot summers and air temperature varies between 40-45degrees, winters are moderate. The maximum temperature recorded during the season is 45 degree.

Methodology

The methods employed for analysis of various physico-chemical characteristics of water were followed from APHA(1995).

Temperature:

The atmospheric temperature at the sampling site was recorded with the help of Celsius thermometer, avoiding its exposure of mercury bulb to direct sunlight. Water temperature was recorded by immersing the thermometer into the sampler soon after it was taken (alongwith sample) out of water. Inorder to estimate the depth wise distribution of temperature, samples were collected vertically from top to bottom at regular depth intervals of one meter with help of Ruttner sampler.

Transparency:

A standard secchi disc (diameter 20 cm), tied to graduated nylon rope, and was used for obtaining the extent of light penetration in water. Mean of the depth at which secchi disc disappeared and then re-appeared was taken as transparency of water.

Hydrogen ion concentration (pH):

It was measured by digital pH meter-Systronics.

Electrical conductivity:

The electrical conductivity has been measured by digital conductivity meter.

Dissolved oxygen (DO):

Modified Wrinkler`s method as given in the APHA (1995) was followed for determination of the DO content. To a sample collected in a 250 ml glassbottle,1 ml of each manganous sulphates solution and alkaline iodide azide solution was added one after the other with separate pippets.The precipitate (manganous hydroxide floc) formed was dissolved after about five minutes with the help of concentrated sulphuric acid. The fixed samples were carried to the laboratory where these were titrated against 0.025 N sodium thiosulphate solution, using starch solution as indicator.The end point was noted at the first disappearance of blue colour. The amount of DO present was then calculated by using the formula:

DO (mg/l) = Volume of the titrant x 0.2 x 1000/Volume ofsample

Where 0.2 value represent 1 ml of sodiumthiosulphate equivalent to 0.2mg of oxygen.

Free carbon dioxide:

The free CO2 content of the sample was determined by the samples against 0.227 N sodium hydroxide titrant using phenolphthalein as indicator till the faint pink colour developed. The CO2 present was calculated by usingthe formula given in APHA (1995) as:

Free CO2 (mg/l) =volume of titrant used x 1000/Volume of sample

Total hardness:

Total hardness of a water sample was estimated by titrating it against 0.01M EDTA titrant in presence of ammonium buffer solution and Eriochrome black-T as an indicator. Titration was continued till the colour of the sample changed from wine red to blue.The total hardness was then calculated by the formula given as:

Total hardness mg/l as CaCO3 = Used volumeof titrant (V1) x 1000/Volume ofsample

Calcium hardness:

For this purpose, an aliquot of water sample, after treating with N/10 NaOH followed by a pinch of muroxide indicator, was titrated against 0.01M EDTA solution until a colour changed salmon pink to purple end point. Titration was stopped and volume of titrant used was noted. The calcium hardness was then calculated by using the formula given below:

Calcium hardness as mg/l CaCO3

Volume of titrant used (V2) x 1000 x1.05 (mol. Wt. Of CaCO3)/Volume ofsample

Magnesium hardness:

The formula given in APHA (1995) was used to estimate the magnesium content of the water sample. The formula is given as:

Magnesium content as mg/l = V1 –V2 x 1000/Vol.ofsample

Where, V1= Volume of EDTA titrant used for estimation of total hardness.

And V2 = Volume of titrant used for estimation of calcium hardness.

Alkalinity:

For estimation of phenolphthalein alkalinity (i.e, alkalinity due to OH and CO_2) a sample volume of 50 ml was titrated against0.02 N H2SO4 in presence of phenolphthalein indicator till disappearance of pink colour .Volume of titrant used was noted .Then for estimation of total alkalinity (i.e. alkalinity due to OH, CO3 and HCO3) the same sample was titrated with 0.02 N NaOH in presence of methyl orange indicator till the colour changed from yellow to orange. The total volume of titrant was noted. On the other hand, when there was found no pink colour formation after addition of phenolphthalein indicator, the sample was run through the sample procedure followed by the addition of methyl orange indicator as mentioned above for total alkalinity. Then phenolphthalein alkalinity (P)and total alkalinity (T) were calculated by using the formula as given below

Phenolphthalein alkalinity (P) as mg/l CaCO3=Volume of titrant used x1000/Volumeof sample.

Chloride:

To 50 ml of water sample 2-3 drops of potassium chromate indicator were added. Once the yellow color was formed, the sample was titrated against standard silver nitrate solution (0.0141 N) till a faint brick red colour formation. Then in accordance with a formula given in APHA (1995), the chloride content of the sample was calculated. The formula is given as:

Chloride mg/l = Volume of titrant used x 35.46x 0.0141 x 1000/Volume ofsample

RESULTS

The results obtained for various physico-chemical parameters are shown in the below tables, from table 1 to table 11:

Table 1 Showing variation in Air and Water temperature (^{0}c) at two sites of Upper Lake

	Site I		Site II	
	Air	Water	Air	Water
Maximum	40.0	33.0	40.0	31.0
Minimum	30.0	24.0	30.5	25.0
Average	35.7	27.1	36.1	27.1

Table 2 Showing variation in Seechi transparency (m) at two sites of Upper Lake

	Site I	Site II
Maximum	1.3	1.5
Minimum	0.8	0.8
Average	1.0	1.2

Table 3 Showing variation in Total Dissolved Solids (mg/l) at two sites of Upper Lake

	Site I	Site II		
	Surface	Surface	Midlle	Bottom
Maximum	120	120	130	150
Minimum	80.0	90.0	90.0	120
Average	110	110	118	132

Table 4 Showing variation in Conductivity (µS) at two sites of Upper Lake

	Site I	Site II		
	Surface	Surface	Midlle	Bottom
Maximum	190	200	210	250
Minimum	120	140	140	160
Average	170	180	188	204

Table 5 Showing variation in pH at two sites of Upper Lake

	Site I	Site II		
	Surface	Surface	Midlle	Bottom
Maximum	8.9	9.2	8.8	8.0
Minimum	8.6	6.7	7.8	7.2
Average	8.8	8.3	8.2	7.7

Table 6 Showing variation in D.O (mg/l) at two sites of Upper Lake

	Site I	Site II		
	Surface	Surface	Midlle	Bottom
Maximum	12.5	16.0	9.6	4.4
Minimum	7.6	5.0	4.4	0.0
Average	9.8	10.1	6.1	1.7

Table 7 Showing variation in Free CO_2 at two sites of Upper Lake

	Site I	Site II		
		Surface	Midlle	Bottom
	Surface			
Maximum	22.0	24.0	14.0	26.0
Minimum	10.0	4.0	10.0	14.0
Average	13.6	13.8	12.0	18.8

Table 8 Showing variation in Calcium Hardness(mg/l) at two sites of Upper Lake

Site I		Site II		
Surface		Surface	Midlle	Bottom
Maximum	81.0	71.0	79.8	88.2
Minimum	51.0	65.1	54.6	54.6
Average	61.5	64.2	68.9	73.1

Table 9 Showing variation in Magnesium(mg/l) at two sites of Upper Lake

Site I		Site II		
Surface		Surface	Midlle	Bottom
Maximum	8.3	6.1	7.4	7.6
Minimum	0.2	0.3	3.0	4.0
Average	4.5	3.8	5.2	5.7

Table 10 Showing variation in Total Alkalinity (mg/l) at two sites of Upper Lake

Site I		Site II		
Surface		Surface	Midlle	Bottom
Maximum	112	122	116	192
Minimum	96	102	88	102
Average	101.2	110	104	130

Table 11 Showing variation in Chloride (mg/l) at two sites of Upper Lake

Site I		Site II		
Surface		Surface	Midlle	Bottom
Maximum	26.0	21.0	23.0	36.0
Minimum	15.0	14.0	14.0	20.0
Average	20.8	18.6	19.4	24.8

DISCUSSION:-The current study was conducted for a period of three months from February to May 2007, to investigate the various Physico- chemical characteristics of Upper Lake Bhopal. Due to the fluctuations in the Physico-chemical characteristics, the biologicaldiversity is affected. The limno chemistry and limno biology of various Indian fresh water bodies and wetlands have been studied and reported by various workers. During the present investigation, water temperature at site - I ranged from 24^0C - 33^0C while at site – II it ranged from 25^0C - 31^0C. The rise in atmospheric temperature caused enhancement in the evaporation rate which resulted in Colossal of water resulting in reduction in water depth. From February onwards atmospheric temperature recoded gradual increase with corresponding rise in surface water as well. Such a phenomena has also been recorded by Wanganeo et al., (1984 and 2006) in temperate lakes.Transparency is an important physical parameter in an aquatic ecosystem and thus directly affects the productivity. Even though the water body is shallow and overgrazed with macrophytes but its transparency values were relatively high signifying that the euphotic zone extends up till bottom at certain places. Wanganeo et al., 1997 also recorded high Secchi transparency in upper lake.Uniform distribution of total dissolved solids have been found at both the sites of upper lake. The total dissolved solids have been found to be of moderate nature in Upper Lake .Wanganeo1984 and 2006 also recorded such results.The conductivity values were recorded to be of moderate range in the present system. There was not much difference between bottom and surface conductivity values at site-II. Similar results were also recorded by Wanganeo (2006).The pH recorded during the present investigation were generally of near neutral to alkaline range suggesting that the lake water was well buffered through out the period. Wanganeo (1984) related high pH values (towards alkaline side) to enhancement of photosynthetic rate. Relatively high values of dissolved oxygen have been recorded in the present study. At site -II slight reduction in dissolved oxygen which was in no way a matter of concern as even at their value both flora and fauna could comfortably survive. The high secchi value have been found to be responsible for enhancing the photosynthesis of autotrophs in deeper water resulting in high oxygenated waters of upper lake, such reports were also recorded by Wanganeo et. al; (1997). During the present investigation, higher values of free Carbon dioxide was recorded at both the sites of upper lake. The maximum value of free carbondioxide that is 22.0 mg/l was recorded at site-I and a maximum value of 26.0 mg/l was recorded at site -II. The increase in free carbon dioxide values at both the sites of upper lake indicate higher trophic status. The higher value of free carbon dioxide was also recorded by Wanganeo andWanganeo (2006) while studying variation in zooplankton population in two morphologically dissimilar rural lakes of Kashmir Himalayas.The calcium and magnesium hardness values revealed less hard waters of the upper lake in comparison to other water bodies in the vicinity of the present water body.During the present investigation the chloride was in the range of 15-26 mg/l at site-I and 13-36 mg/l at site -II. Chloride values in the present study were not alarming, though slight enhancement is recorded in its value in the waters suggesting timely measures for stopping the entry of sewage and other run-off materials from its catchments area.

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