

Seasonal variation in the water quality of upper lake with respect to its phytoplankton diversity

¹Neha Nigam and ²Anil Sharma

¹Asst. Professor, ²HOD (CIVIL)

¹Department of Civil engineering

¹Truba institute of Engineering & Information Technology, Bhopal

Abstract - Water is a transparent fluid which forms the worlds streams, lakes, oceans and rain ,and is the major constituent of the fluids of living things. The upper lake is a major source of portable water for the city of Bhopal, Madhya Pradesh, India. The study of phytoplankton gives the number of kinds and occurrence of phytoplankton in a habitat. The studies physico-chemical analysis of the Bhopal city was carried out from December 2012 to April-2013. It has been concluded that Bhopal Lake is highly eutrophic and biologically 'dead' in term of its un ability to provide the aesthetic pleasures of swimming, boating, fishing and the effluent of fertilizer industrial due to luxuriant growth of micro and macro flora and fauna.

Key words - Water-quality, Eutrophic, Physico-Chemical, Organic Pollution ,sewage

I. INTRODUCTION

Water resources in India have reached a point of crises due to improper urbanization and industrialization. Water quality parameter provides the basis for judging the suitability of water for different uses. Therefore it has become obligatory to analyze important water parameters of water bodies in regular interval of time. Bhopal district, the capital town of the largest state of India, was carved out of the erstwhile Sehore district of Bhopal division on December 8, 1976. The geographical area of Bhopal Municipal corporation is 284.9 Km² (Census report, 1991) and its altitude above sea is 505 m. The city lies between Latitude 23 degree 07 inches to 23 degree 34 inches N and longitude 77 degree 10 inches to 77 degree 10 inches to E.

The Bhopal Lake is facing the problem of organic pollution due to the major discharge of effluent of fertilizer industries, raw sewage, and detergents etc. The Upper lake emanates foul smell in summer season due to effluent accumulation there by causing health hazards to the surrounding human population. Keeping in view the above facts, an attempt has been made to examine the suitability of Upper Lake water for drinking and other purposes. Hence the present work was undertaken to evaluate the status of organic pollution and assessment of water quality was carried out through the physico-chemical analysis of the water samples. Some notable work on this aspect has been done recently by Dhamija and Jain (1994), Kumar (1995), Rao et al (1996), Khare (1998,1999) and Kumar and Singh (1998).

II. MATERIALS AND METHODS

Water sample was collected twice in a month of years 2012-2013. They were analyzed for Physico-Chemical (Adoni, 1985, Trivedi and Goal, 1986) and Biological parameters (Michael, 1973 and Adoni, 1985). Water quality parameters such as temperature of water and air around lake, transparency, pH, TDS, total alkalinity, Dissolved oxygen, free carbon di-oxide, electrical conductivity (EC) were determined in the field itself by using digital thermometers for determining air and water temperatures, sacchi disc for transparency, digital pH meter for determining pH, digital conductivity for determining conductivity, digital portable TDS meter for determining TDS, Dissolved Oxygen was determined by the Winkler's method with Azide modification. While for the analysis of chloride, calcium and magnesium hardness, nitrate and orthophosphates the were brought to the laboratory in plastic bottles of one liter capacity and analyzed using the standard APHA (1995) and Adoni (1985) methods Plankton samples were collected by standard methods from predetermined sampling sites and preserved in 2-5% formaline and few drops of glycerin. Counting and identification of plankton were done as per APHA (1985), Adoni (1985) and Michael (1973).

III. RESULT AND DISCUSSION:

The result of physicochemical analysis of various water samples of Upper lake are during December 2012 to April 2013 have been displayed in **Table-1** to **Table-5** as follows:

Table1.

Physico-Chemical characteristics of water of Bhopal Lake, Bhopal (M.P.) December 2012

Parameters	S1	S2	S3	S4	S5
Air Temperature	22	24	28	25	23
Water temperature ⁰ C	22	20	21	23	24
Transparency In cm	24	22	22.5	21	23

pH	9.5	8,6	9.0	9.0	8.2
Total dissolved solid (ppm)	150	150	140	130	120
DO (ppm)	8.8	9.6	11	12.8	10
Free Co2 in (ppm)	189	194	Abs	Abs	218
Total Alkalinity(ppm)	78	42	58	22	24
Total Hardness	104	110	120	108	88
Ca hardness in ppm	76	99	97	88	91
Mg hardness in ppm	12	16	19.1	13.7	14.1
Phosphate in ppm	0.03	0.06	0.04	0.08	0.02
Nitrate in ppm	4.6	3.8	4.2	1.6	1.8
Chloride in ppm	39.5	43.5	55.8	42.6	24.8

Table-2

Physico-Chemical characteristics of water of Bhopal Lake, Bhopal (M.P.) January 2013

Parameters	S1	S2	S3	S4	S5
Air Temperature	23	29	25	24	24
Water temperature °C	18	17.5	19	18	18
Transparency In cm	34	24	26	24	28
pH	9.5	8,6	9.0	9.0	8.2
Total dissolved solid (ppm)	110	120	100	100	120
DO (ppm)	8.8	9.6	8.3	7.3	10
Free Co2 in (ppm)	148	194	Abs	Abs	203
Total Alkalinity(ppm)	78	42	66	55	80
Total Hardness	104	110	120	116	100
Ca hardness in ppm	106	108	110	112	101
Mg hardness in ppm	12	16	19.1	16.9	18.1
Phosphate in ppm	0.05	0.06	0.03	0.09	0.02
Nitrate in ppm	5.8	4.8	4.2	2.8	2.1
Chloride in ppm	44.7	43.5	58.7	42.6	25.2

Table-3

Physico-Chemical characteristics of water of Bhopal Lake, Bhopal (M.P.) February 2013

Parameters	S1	S2	S3	S4	S5
Air Temperature	22	24	23	24	23
Water temperature °C	19	17.5	19	19	18
Transparency In cm	35	39	48	50	46
pH	8.5	8,6	7.9	9.0	8.2
Total dissolved solid (ppm)	110	150	140	130	119
DO (ppm)	5.8	4.6	6	7.8	8.5
Free Co2 in (ppm)	14	10	Abs	Abs	16
Total Alkalinity(ppm)	110	94	85	73	82
Total Hardness	110	83	73	128	54
Ca hardness in ppm	106	98	97	84	110
Mg hardness in ppm	14	16	14.8	17.2	9.7
Phosphate in ppm	0.08	0.10	0.03	0.04	0.02
Nitrate in ppm	3.4	5.6	4.8	1.9	2.1
Chloride in ppm	23.1	21.5	20.8	19.1	15.4

Table-4

Physico-Chemical characteristics of water of Bhopal Lake, Bhopal (M.P.) March 2013

Parameters	S1	S2	S3	S4	S5
Air Temperature	35	37	36	34	38
Water temperature °C	23.9	24	25	24	25
Transparency In cm	34	32	39	48	59
pH	7.2	8.0	8.4	9.0	8.2
Total dissolved solid (ppm)	156	160	140	100	110
DO (ppm)	5.2	6.6	8.3	8.5	10
Free Co2 in (ppm)	15	24	Abs	Abs	12
Total Alkalinity(ppm)	118	112	100	90	64
Total Hardness	120	125	120	89	68

Ca hardness in ppm	102	101	118	74	66
Mg hardness in ppm	17	15	12.8	11.7	10.1
Phosphate in ppm	0.09	0.06	0.08	0.08	0.02
Nitrate in ppm	4.9	3.8	3.2	2.8	1.2
Chloride in ppm	24.6	25.2	26.8	22.1	16.31

Table-5

Physico-Chemical characteristics of water of Bhopal Lake, Bhopal (M.P.) April 2013

Parameters	Dec. (2012)	Jan. (2013)	Feb. (2013)	Mar. (2013)	Apr. (2013)
Air Temperature	37	39	38	35	40
Water Temperature °C	26	27	25	26	27
Transparency cm	37	35	42	51	59
pH	8.2	8.4	8.6	8.9	8.5
Total dissolved solid (ppm)	152	158	138	98	96
DO (ppm)	4.8	5.2	6.4	6.9	8.2
Free Co ₂ in (ppm)	18	29	Abs	Abs	16
Total Alkalinity (ppm)	119	118	99	95	76
Total Hardness	125	131	122	94	70.2
Ca hardness in ppm	108	111	120	78	75
Mg hardness in ppm	19	18	14.5	12.3	14.2
Phosphate in ppm	0.06	0.08	0.07	0.09	0.04
Nitrate in ppm	5.2	4.3	3.8	3.6	2.5
Chloride in ppm	29.2	28.1	27.4	23.4	19.8

The various species of phytoplankton and zooplanktons have been enlisted in **Table 6** and **Table 7**.

Table-6 List of phytoplankton population observed in Bhopal Lake during 2012-2013.

Class-Chlorophyceae	Class-Cyanophyceae
<ol style="list-style-type: none"> Eudorina sp. Chlorella P. duplex megen P. simplex meger Spirogyra sp. Mougeotia transeque collins Mougeotia gelatinosa wittrock Closterium sp. Casmarium sp. Micrasterias radiany 	<ol style="list-style-type: none"> Microcystis aeruginosa kuntz Microcystis cyanea Anabaena circinalis Rivularia gigantea Schmidle Nostoc sp.
	Class-Euglenophyceae
	<ol style="list-style-type: none"> Phacus platalac Dreg.

Table-7 List of zooplankton population observed in Bhopal Lake, during 2012-2013

Phylum: Protozoa	Phylum: Arthropoda
1. Amoeba	1. Basmanyia sp.
2. Paramecium Aurelia	2. Daphnia similis
3. Vorticella campanula	3. Moina sp.
4. Euglena sp.	4. Monostyla sp.
Phylum: Rotifera	5. Nauplius larvae
1. Asplanchna sp.	6. Cyclops viridis
2. Brachionus Falcatum	7. Mesocyclops sps.
3. Keratella tropica	
4. Lecane sp.	
5. Pterodina patina	

The air temperature was higher in month of April 2013, lower in December 2012 and medium in February 2013 which range between 22-40°C. The water temperature oscillated between 18-25°C. The temperature of Upper lake was highest in summer season of April 2013 and lowest in December 2012. The transparency in the water samples were found to range between 21- 59 cm which was maximum at station 5. Unni (1984) reported a range of 17 to 130 cm in different reservoirs of M.P. The Total dissolved solids in the water samples ranged between 98- 150 mg/l. Sreenivasan (1970) was of the opinion that waters containing

less than 50 mg/l of TDS are unproductive water. The comparison of all above values indicates highly productive condition of water of upper lake. This has an indirect effect on the toxicity, which intensifies deoxygenating and finally increasing the biomagnifications that is why, the dissolved oxygen depletion and plankton community have increased their span in month of April 2013. Eutrophic waters are characterized by blooms of cyano-bacteria (Kumar, 1995) this is true in case of Bhopal lake. The nature and health of the aquatic communities is an expression of the quality of water (APHA, 1985) Lake water was alkaline throughout the study period. The alkalinity was lower in the month of December (2012), higher in April (2013). The hardness content in the water samples ranged between 83-125 mg/l which was found within permissible limit. The free carbon dioxide was absent in many samples but was present in high range of month of Dec-Jan which indicates the increase organic contamination during this period. The chloride content ranged between 39-55 mg/l. According to Sreenivasan (1964) low chlorides 4 - 10 ppm indicate the purity of water and freedom from pollution, whereas high value of chloride is denoted as pollution of organic matter particularly that of animal origin.

The algal population has a direct relationship with the total solids (Rao et.al, 1996; Khare, 1999), which was also reflected in the Bhopal Lake investigation. The all data of clearly indicated that the water is contaminated by sewage and fertilizer due to high alkalinity, enriched with nutrients which favors the microbial growth and render it unsuitable for portable purpose. The sudden depletion of oxygen is the main cause for heavy mortality of organisms (April 2013). Extent of pollution that has occurred due to urbanization, anthropogenic activities; increased human interventions in the water bodies have been ascertained. Overstocking of organisms may also be described to the large scale destruction during anoxic condition of lake water in such a situation even a small fluctuation in dissolved oxygen will produce adverse effect.

IV CONCLUSION

The present study revealed that the Upper Lake is of a better quality, although there is a need to continuous monitoring in order to maintain the quality of drinking water. However government needs to take cognizance in order to prevent the decline and eutrophication of the lake. Thus, it has been concluded that the Bhopal Lake is highly eutrophic and biologically dead/ because the total production of biomass is many times greater in eutrophic lake than oligotrophic lake.

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