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Seasonal Variations in Physico-chemical Characteristics in Upper Lake of Bhopal

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Abstract : Water intended for human consumption should be "safe" and "wholesome" *i.e.* free from pathogenic agent and harmful chemicals, pleasant to taste and usable for domestic purpose. The study area selected was Upper lake of Bhopal, the city of lakes, Madhya Pradesh. It is a life line of Bhopal created by Raja Bhoj in eleventh century. The physico-chemical parameters like temperature, pH, DO, total hardness, total alkalinity and turbidity were studied to analyse the potable water quality of the lake. Better water quality was found in winter season than summer. Extent of pollution that has occurred due to urbanization, anthropogenic activities; increased human interventions in the water bodies have been ascertained.

Key words : lake, physico-chemical parameters, seasonal variations.

Introduction :

Availability of clean and potable water has become a key issue in several developing countries. Burgeoning population and water scarcity is affecting the quality of life significantly, India is no exception to this. Providing water in adequate quantity and quality for domestic water supply, irrigation and industrial requirements in all parts of the country is a tremendous challenge from several angles-economic, technical management and social.

The global water scenario is very much alarming. It is predicted that if at all a third world war takes place, the reason for it will be water. There are reliable reasons to believe that the prediction may not go wrong and symptoms for the same are cropping up. In India itself water disputes between Kerala and Tamil Nadu, Tamil Nadu and Karnatak and between other states have cropped up and still remain unsettled despite various interventions from many government levels.

Water intended for human consumption should be "safe" and "wholesome" i.e. free from pathogenic agent and harmful chemicals, pleasant to taste and usable for domestic purpose. The study area selected was Upper lake of Bhopal, the city of lakes, Madhya Pradesh. It is a life line of Bhopal created by Raja Bhoj in eleventh century. The physico-chemical parameters like temperature, pH, DO, total hardness, total alkalinity and turbidity were studied to analyse the potable water quality of the lake.

Water supports life on earth and around which the entire fabric of life is woven. The requirement of water in all lives, from micro-organism to man, is a serious problem today because all water resources have been reached to a point of crisis due to unplanned urbanization and industrialization (Singh *et al*., 2002).

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Generally speaking, water pollution is a state of deviation from pure condition, whereby its normal functioning and properties are affected. Aggravated environmental problems often reflect the misuse or misunderstanding of technology (Petak, 1980). In one of the studies the effectiveness of aeration units was selected for the Lower Lake in Bhopal, the capital city of Madhya Pradesh, India. The Lower lake (Lat 230 16' 00" N and Long 770 25' 00" E) is an artificial lake and is situated towards the east end of the Upper lake and is an integral part of the latter (Verma et al, 2006). It has a small catchment area 9.60 Sq.Km. and water spread of 1.29 Sq.Km. The pollution of this lake is a matter of great concern, since it has reached an alarming level due to inflow of large volume sewage and solid wastes. The quality of water in Lower Lake has far more deteriorated than that in the Upper Lake (Pani and Mishra, 2000). The Lower Lake receives a large amount of raw sewage from its densely populated habitation. The water body is an urban eutrophic lake where the amount of nutrient is very high and O_2 depletion is very prominent (Varughese *et al*., 2004). The untreated wastewater contains effluent rich in phosphate, caustic soda and detergent, etc. Organic enrichment of the lake through floral offerings, idol immersion and decomposition of aquatic weeds are also the significant causes of its eutrophication. The lower lake is naturally affecting the present state of Upper Lake. The physico-chemical status of Upper Lake (Bhopal, India) with special reference to phosphate and nitrate has been investigated during the year 2003-2004. The phosphate and nitrate are two important nutrients in the lake loading through point and non-point pollution sources such as washing, bathing, agricultural activities in fringe area, joining of domestic raw sewage, cultivation of trapa and huge growth of aquatic macrophytes. These nutrients support the fast growth of the aquatic plants (mainly Eichhornia crassipes, Hydrilla, Ceratophyllum etc.) as a result these plants lead to gradual shrinking of wetland area along with other complications like low light penetration, reduces oxygen concentration, clogging of water channels, lowers entertainment value of lake and some time the level of oxygen depletes so that it can lead to fish mortality also (Tamot and Sharma, 2006).

Method and Materials :

Study Area : The study area selected was Upper Lake located in the city of lakes Bhopal, Madhya Pradesh, India. (lattitude 23º 12' to 23º 16' N and longitude 77º 18' to 77º 23' E). The total area covered is 31 Sq. Km and the depth varies from 4 to 8 metres. The lake is fed by Kolans river in rainy season The maximum length of the Upper Lake is 10.6 km while the width comes out to be 3.25Km Maximum elongation is in the east- west direction

The testing of samples were done according to the procedure prescribed by NEERI (1991) and APHA (1995)

Present study comprises of interpretation and analysis of water sample collected from 3 stations. From 3 stations in Upper Lake samples were taken for surface in winter and summer. The present work was divided into three parts.

(i) Pre-field interpretation
(ii) Field work
(iii) Post-field interpretation.

Pre-field study consisted of marking of sampling stations for water sample collection. During fieldwork stations were established and water samples were collected. The samples were analyzed for different chemical, physical and biological parameters. Post-field interpretation

includes compilation of data collected and generated after the testing of samples. The results were carefully studied and analyzed. The information and data generated from fieldwork throws light on various aspects.

Result and Discussion :

The water quality analysis of Upper Lake has been carried out for temperature, pH, DO, total hardness, total alkalinity and turbidity.

Temperature : The temperature was in the range of 26.4º to 26.5º in winter and 31.0º to 32.3º in summer. The variation in the water temperature may be due to different timing of collection and influence of season. (Jayaraman *et al.* 2003).

Hydrogen Ion concentration (pH) : pH was found to be all alkaline in nature in the range between 8.70 to 8.71 in winter and 8.77 to 8.92 in summer. WHO has recommended maximum permissible limit of pH from 6.5 to 9.2 (De, 2002). On the whole the lake has pH values within the desirable and suitable range. pH correction after the treatment of water can significantly reduce the corrosion and incrustration problems. The high pH values during summer may be due to high photosynthesis of micro and macro vegetation resulting in high production of free CO_2, shifting the equilibrium towards alkaline side (Trivedi, 1989). The pH controls the chemical state of many nutrient including dissolved oxygen, phosphate, nitrate etc. (Goldmann and Horne, 1983). It regulates most of the biological processes and biochemical reaction. (Verma *et al.*, 2006).

Dissolved Oxygen (DO) : The Council on Environmental Quality defines the threshold for water pollution alert as dissolved oxygen content of less than 5 mg/l of water. The results of DO are under satisfactory limit for all the quality classes. The DO reflects the biological activity taking place in a water body and determines the biological changes which are brought about by aerobic or anaerobic organisms. The DO concentration of all the stations were in the range of 7.00 mg/l to 7.30 mg/l in winter and 6.50 mg/l to 7.20 mg/l in summer. Value of DO increased in winter due to circulation of cold water as well as high solubility of oxygen at low temperature (Suthara *et al.*, 2005).

Alkalinity : Alkalinity was found in the range of 76 mg/l to 80 mg/l in winter and 88 mg/l to 90 mg/l in summer. A decline in alkalinity was observed which might be due to decomposition of organic matter during winter. Alkaline water may decrease the solubility of metals. The alkalinity fluctuated in accordance with the fluctuation in the pollution load.

Total Hardness : Hardness is an important parameter in decreasing the toxic effects of poisonous elements. The hardness was found to be in the range of 73 mg/l to 75 mg/l in winter and 70 mg/l to72 mg/l in summer. It is within desirable limit. BIS has prescribed desirable limit of total hardness 300 mg/l and permissible limit in the absence of alternate source 600 mg/l (De, 2002).

Turbidity : Water is considered to be of improved quality when it contains turbidity value of 1 NTU or below. Turbidity level exceeding 10 NTU in the drinking water, affects the aesthetic quality of water, significantly. Water may not be safe from hygienic point of view as under such conditions it becomes very difficult to maintain the minimum desirable limit of chlorine in the water. Turbidity was found in the range of 4.2

to 4.8 NTU in winter and 7.3 to 9.0 NTU in summer.

Lake, a large body of water surrounded by land and inhabited by various aquatic life forms, is subjected to various natural processes taking place in the environment and anthropogenic activities. Humans are responsible for choking several lakes to death due to a consequence of unprecedented development. Eutrophication is accelerated as a result of human activities near or in a body of water that generates residential wastes, untreated or partially treated sewage, agricultural runoff, urban pollutants, and so forth. Sewage or residential waste, consisting largely of phosphate-containing detergents, is a major source of nutrients in bodies of water. The flow of nutrients in the water may over-stimulate the growth of algae. This creates conditions that interfere with the recreational use of lakes and adversely affect the diversity of indigenous fish, plant and animal populations. The concept of nutrient overloading has a great impact on all subsequent eutrophication research and lake management. It is fair to state that nitrates and phosphates are probably the key nutrients in controlling aquatic plant growth.

The nitrate and phosphate are two important constituents that immensely help in the growth of the plants where they present. If they are present in lake and ponds they are excessively promote the growth of aquatic weeds and polluting our aquatic resources. International studies on the nitrates and phosphates in the surface waters of various bodies of water have expressed their concern and drawn the attention of scientists around the globe. These constituents are immensely help in the growth of the macrophytes like water hyacinth (Eichhornia crassipes) which is the most troublesome aquatic weed in the world. The major sources of nitrate in lakes and ponds are from the catchment area by rainfall, sewage effluents, agro waste, suspended organic matter when algae and other suspended micro-organisms die and settle down to the bottom. They carry their nitrogen and phosphorous with them, during decomposition. This nitrogen is released and becomes available for subsequent growth of aquatic biota (Singh and Mahajan, 1987). Presence of nitrate in water indicates the final stage of mineralization (Nema *et al*., 1984). Phosphorous is present in many forms among them orthophosphate plays important role in the aquatic ecosystem. Orthophosphate is the soluble reactive phosphorous which is also termed as inorganic phosphate. It plays a dynamic role in aquatic ecosystem which is taken up widely by phytoplankton (Goldman, 1965). The physico-chemical status of Upper Lake (Bhopal, India) with special reference to phosphate and nitrate has been investigated during the year 2003-2004. The phosphate and nitrate are two important nutrients in the lake loading through point and non-point pollution sources such as washing, bathing, agricultural activities in fringe area, joining of domestic raw sewage, cultivation of trapa and huge growth of aquatic macrophytes. These nutrients support the fast growth of the aquatic plants (mainly Eichhornia crassipes, Hydrilla, Cerato-phyllum etc.) as a result these plants lead to gradual shrinking of wetland area along with other complications like low light penetration, reduces oxygen concentration, clogging of water channels, lowers entertainment value of lake and some time the level of oxygen depletes so that it can lead to fish mortality also (Tamot and Sharma, 2006).

Table : Physico Chemical Parameters of Upper Lake of Bhopal during Winter (W) and Summer (S) at three stations

Stations	Temp (degree)		pH		DO (mg/l)		Total Alkalinity (mg/l)		Total Hardness (mg/l)		Turbidity N.T.U.	
	W	S	W	S	W	S	W	S	W	S	W	S
St. 1	26.5	31.0	8.71	8.92	7.0	6.5	80	90	75	70	4.5	7.3
St. 2	26.4	32.3	8.70	8.86	7.2	6.8	76	88	73	72	4.8	9.0
St. 3	26.5	32.0	8.70	8.77	7.3	7.2	78	88	74	72	4.2	7.5

The present study reveales that the assessment of water quality deterioration is due to various reasons. The water quality of Upper Lake is evaluated which is one of the major potable water source of Bhopal city during winter and summer. Better water quality was found in winter season than summer. Extent of pollution that has occurred due to urbanization, anthropogenic activities; increased human interventions in the water bodies have been ascertained.

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