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Monitoring the dissolved oxygen content with the installation of aeration units at Upper Lake of Bhopal

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ABSTRACT

The present study is undertaken to evaluate the impact of aeration units on the physicochemical characteristics of Upper Lake situated in Bhopal. The lake receives a large amount of sewage from its densely populated habitation. The continuous input of biologically active nutrients (phosphates and nitrates) through inflow of sewage has changes the water body into eutrophic lake resulting frequent oxygen depletion. The installation of aeration units have been found to have significant in increasing the oxygen concentrations, changing the species diversity besides reducing the pathogenic microbial population.

Key words: Upper lake, Bhopal, oxygen content, aeration units.

INTRODUCTION

Ponds and lakes are valuable natural resources. They add to the beauty of the landscapes, provide recreation, are a habitat for fish and wildlife and an additional water sources if needed. However, the good health of a pond is held in a delicate balance. A ponds condition deteriorates when the bottom environment cannot support animal life[2]. The bottom is the area that runs out of oxygen first, it is where the most oxygen is used and it is the farthest from the surface where it is replenished. Withough oxygen a lake or ponds self purification capability is not only reduced, it is reserved.

Water quality is closely linked to water use and to the state of economic development. In industrialized countries, bacterial contamination of surface water caused serious health problems in major cities throughout the mid 1800's. The rapid growth of the urban population (especially in Latin America and Asia) has out paced the ability of governments to expand sewage and water infrastrcture. While waterborne diseases have been eliminated in the developed world, outbreaks of cholera and other similar diseases still occur with alarming frequency in the developing countries. Since World War II and the birth of the "chemical age", industrial and agricultural chemicals have heavily impacted water quality worldwide. Eutrophication of surface waters from human and agricultural practices has greatly affected large parts of the world. Acidification of surface waters by air pollution is a recent phenomenon and threatens aquatic life in many regions of the world.

Cultural eutrophication is one of the major problems affecting the water bodies include: increased sedimentation rates, phytoplankton blooms (predominantly bluegreen algae), increased biomass of aquatic plants and deterioration of water quality that can result in fish kills and human health hazards[3]. Anaerobic conditions predominate through extensive areas of eutrophic lakes. Aeration shows promise as a lake restoration technique to relive many of the problems associated with hypolimnetic anoxia.

Lake eutrophication begins when the BOD (Biological oxygen demand) of a lake cannot be oxygen down to the lake bottom. Once the lake is full of oxygen near the bottom beneficial aquatic insect larvae, snails, fresh water shrimps and other fish food can begin to live on the bottom and littoral zone (Light zone).

The water quality status of lakes every where has become a very important and burning topic. The quality standard include the fast rate of oxygen depletion due to industrial effluents, domestic wastewaters and religious wastes through transportation[5].

Raja Bhoj, the King of Dhar in Central India created the upper lake (Latitude 23°12'-23°16' N, Longitude 77° 18'-77°23') in the 11th century by constructing an earthen dam across the Kolans river. The Kolans was originally a tributary of the Halali river, which in turns joins Betwa river near Vidisha. With the construction of the earthern dam and a spill channel a major change in the hydrological basins was affected almost about 900 years back, in the sense that the Kolans basin was linked to the Betwa river directly through Kaliasote river and finds its way to Yamuna river through the river Betwa. A waste weir at Bhadbhada, constructed in 1965 to increase the storage capacity of the upper lake, now controls the flow.

The upper lake, in a linear west alignment, has catchment area of 361 sq km and at present catchment on the eastern and while the remainder is rural. The upper lake of Bhopal receives large amount untreated sewage from its densely populated residential area. The water body is one the examples of Urban lakes where the amount of nutrients is very high and anaerobic condition is very much prominent. The phenomenon of oxygen depletion is more prominent in the summer seasons.

EXPERIMENTAL

Collection of water samples

Collection of water samples for analysis of physico-chemical parameters were done at Yatch club, Takia island, Prempura and Khanugaon. It is situated at the bank of Upper lake from middle layer at a distance of 0 m, 10m, 20m, and 30m and at a distance of more than 100mts. from the aeration units. The water samples were collected in acid washed plastic cans with 5 liters capacity from lake. For estimation of dissolved oxygen separate samples were collected in 250ml glass bottles[4]. Microbiological samples were collected in washed and sterilized glass bottles. Samples were taken from the location as given in the Table -1.

Table -1

Sampling distance from the aeration units	Location
At 0 mts	This point is right at the place where the unit is installed.
At 10 mts.	This point is 10mts away from the unit.
At 20 mts.	This point distance of 20 mts from the unit.
At 30 mts.	This point is at a distance of 30 mts from the unit.
At a distance of more than 100 mts.	This point is at a distance of more than 100 mts. from the aeration unit.

Table - 2: Results of water samples from the site Yatch club of Upper Lake

Distance from aeration units	At 0 mts.	At 10 mts.	At 20 mts.	At 30 mts.	At distance more than 100 mts.	BIS Standards
Parameters						
DO mg/lit.	7.8	8.9	8.3	8.8	7.6	> 6.0 mg/L
COD mg/lit.	25.0	21.0	22.0	23.0	23.0	250 mg/L
BOD mg/lit.	8.3	7.1	7.5	7.2	7.5	2.0 mg/L

Methods of analysis

The Standard methods for the analysis of water will be followed as prescribed in APHA (1995) and NEERI manual[1].

- **Dissolved oxygen:** Winkler's method
- **COD** Potassium dichromate reflux method
- **BOD** Incubation method

RESULTS AND DISCUSSION

The results of the study are given in the Table 2,3,4 and 5.

Table - 3: Results of water samples from the site Takia island of Upper Lake

Distance from aeration units	At 0 mts	At 10 mts	At 20 mts	At 30 mts	At distance more than 100 mts	BIS Standards
Parameters						
DO mg/lit	8.1	8.4	8.1	7.8	7.4	> 6.0 mg/l
COD mg/lit	22.0	21.0	25.0	23.0	26.0	250 mg/l
BOD mg/lit	7.1	8.1	8.6	7.2	7.0	2.0 mg/l

Table - 3: Results of water samples from the site Prempura of Upper Lake

Distance from aeration units	At 0 mts	At 10 mts	At 20 mts	At 30 mts	At distance more than 100 mts	BIS Standards
Parameters						
DO mg/lit	9.0	9.1	8.9	8.6	8.5	> 6.0 mg/l
COD mg/lit	20.0	19.0	20.0	19.0	20.0	250 mg/l
BOD mg/lit	6.3	6.4	6.1	6.2	6.5	2.0 mg/l

Table - 5: Results of water samples from the site Khanugaon of Upper Lake

Distance from aeration units	At 0 mts	At 10 mts	At 20 mts	At 30 mts	At distance more than 100 mts	BIS Standards
Parameters						
DO mg/lit	8.5	8.9	8.9	8.3	8.4	> 6.0 mg/l
COD mg/lit	19.0	20.0	20.0	21.0	22.0	250 mg/l
BOD mg/lit	6.7	6.2	6.2	6.5	6.8	2.0 mg/l

Conclusion

1. Dissolved oxygen is one of the important parameters, which indicates the extent of industrial and domestic pollution load in a water body. Dissolved oxygen ranged from 7.6 mg/lit to 9.1 mg/lit and was maximum at a distance of 10 mts. This trend in the DO shows that the aeration units have been a successful tool in elevating the water quality.
2. The COD of all the samples ranged from 19.0 to 26.0 mg/lit. Here was a sharp decline in COD at 20 mts showing that COD content reduces due to aeration. It is high at 0mts., 10mts., 30mts., and 100mts., because near the aeration unit the effect of aeration is little less and at 30 and 100mts the water becomes stable.
3. The BOD ranged from 6.1 to 8.6 mg/lit. The BOD is least at a distance of 10 mts. showing that effective aeration is happening in the area of 10mts. 20 mts and beyond which water becomes stable.

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