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EXPERIMENTAL STUDY ON THE WATER QUALITY OF SURSAGAR LAKE

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ABSTRACT

Sursagar Lake is the largest and oldest lake in the city of Vadodara, unarguably charming in its earlier years. During the festival of Ganesh Chaturthi, locals immerse the idol of Lord Ganesha in the lake over a period of ten days causing almost irrevocable harm in the form of pollution to the lake. This paper focuses on the quality of water determined by experimental methods before and during the festival of Ganesh Chaturthi (August 2015). It also discusses plausible methods for improving the water quality of the lake. Water samples were collected in order to analyze chemical parameters (COD, DO, pH and TDS) and the results were compared with the respective regulatory values. A high level of variation of TDS was observed in the lake, post the celebrations as a result of aforementioned idol immersion.

Keywords: Chemical Oxygen Demand, Chemical Parameters, Dissolved Oxygen, Improving water quality, pH , Sursagar Lake, Total Dissolved Solids, Water quality.

I. INTRODUCTION

Sursagar Lake, formerly known as Chandan Talao, lies in the heart of Vadodara. The physical appearance of the lake water has a tinge of green over the course of years. Locals of Vadodara use the lake for immersing Ganesha idols (also known as Ganesh Visarjan) over a period of ten days. The statues of the Lord Ganesha comprise largely of Plaster of Paris ($CaSO_4 \cdot 0.5H_2O$, or Calcium Sulphate), fibres of coconut shells, sand and wall paints. Immersing idols causes significant pollution during Ganesh Chaturthi. *Table 1* shows the influence of various contaminants disposed in the lake as a result of chemical pollutants. The various chemical parameters determined are Chemical Oxygen Demand (COD), pH, Dissolved Oxygen (DO) and Total Dissolved Solids (TDS) of the water.

Table 1: Effect of various materials on the quality of water

Sr. No.	Contaminants	Impact on water quality
1	Clay/Plaster of Paris	Increase in dissolved solids and suspended solids in water, sludge.
2	Decoration material (clothes, paints, etc)	Adds suspended matter, trace metals (zinc, lead, iron, arsenic, mercury, etc), metalloids and various organic and inorganic matter, oil and grease, etc.
3	Flowers, Garland, oily substance	Increases floating suspended matter, organic contamination, oil and grease and various organic and inorganic matter.
4	Bamboo sticks, beauty articles	Big pieces get collected and recycled while small pieces remain floating in the water or settle at the lake bottom inhabiting lake flow.
5	Polyethylene bags/ plastic items	Contribute suspended solids, settleable matter and hazardous material to water.
6	Eatables, food items, etc	Contributes oil and grease, organic matter to water bodies.

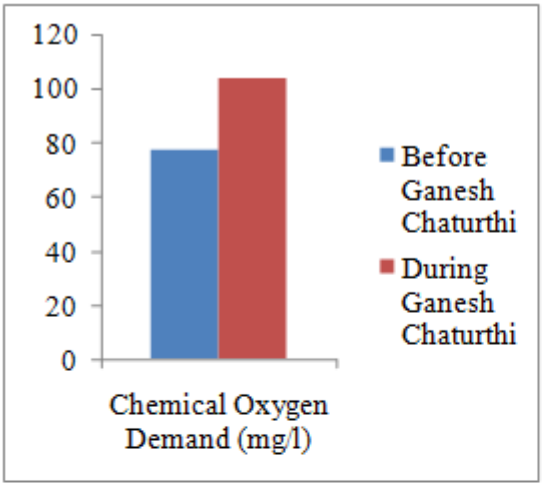
II. MATERIALS AND METHODS

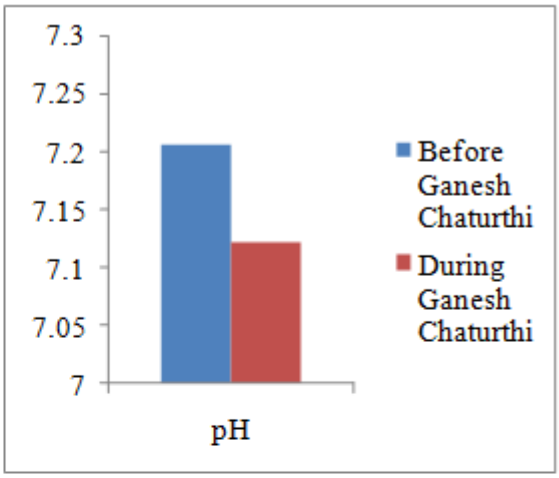
The experimental study for determining the quality of water was carried out for Sursagar Lake. The water samples from the lake were collected in polyethylene bottles during the morning hours from four different areas of the lake and mixed together to prepare an integrated sample. To negate any significant change in characteristics, the experiments were performed within a bracket of two to three hours from the collection of water samples since there is a slight possibility of change in chemical characteristics or even physical characteristics between the time of collection of the water samples to the time of performing the experiments. In case the experiments were not performed within two to three hours, the oxygen content was fixed by adding chemicals to the water sample[1].

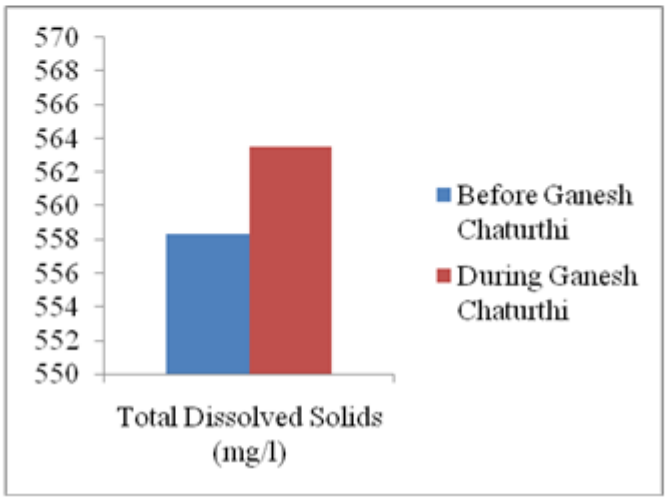
Chemical Oxygen Demand [in accordance to IS:3025 (Part 58) - Reaffirmed 2006], Dissolved Oxygen [in accordance to IS: 3025 (Part 38) - Reaffirmed 2003], pH [in accordance to IS:3025 (Part 11) - Reaffirmed 2002] and Total Dissolved Solids [in accordance to IS: 3025 (Part 16)] were determined of the water samples that were collected. The physical appearance of the water samples was turbid. The water samples also contained flower petals and other solid impurities. The values obtained of the parameters from the experimental study are as observed in Table 2.

Table 2: Experimental values obtained of Chemical Oxygen Demand, Dissolved Oxygen, pH and Total Dissolved Solids.

	Parameters	Chemical Oxygen Demand (mg/l)	Dissolved Oxygen (mg/l)	pH	Total Dissolved Solids (mg/l)
Before Ganesh Chaturthi	Day 1	20		7.24	600
	Day 2	120		6.93	430
	Day 3	92		7.45	645
During Ganesh Chaturthi	Day1	100	4.2	7.15	500
	Day 2	140	5	6.99	480
	Day 3	96	4.5	7.20	525
	Day 4	112	6.4	7.11	595
	Day 5	136	10	7.23	635
	Day 6	80	8.2	7.07	495
	Day 7	108	4.8	6.87	705
	Day 8	88	7.7	7.05	465
	Day 9	60	5.4	7.24	515
	Day 10	116	9.3	7.30	720







III. POSSIBLE SOLUTIONS TO IMPROVE WATER QUALITY

In light of recent years, pollution, as well as exhaustion of natural resources has rapidly increased resulting in deterioration of the quality of water. Therefore, it is important to identify certain parameters which reduce the water quality and in turn improve upon them in freshwater as well as man-made sources for a sustainable water supply. It should be noted that while taking these steps to improve the quality of water, there should not be an adverse effect on the surrounding environment. A lot of research has been conducted around the globe for the betterment of water quality.

According to many researches conducted, the plausible solutions which can be implemented to improve the water quality of lakes are:

1. Water hyacinths: There are four types of water hyacinths (aquatic macrophytes/ aquatic plants) namely, (i) Emergent macrophytes (ii) Floating-leaved macrophytes (iii) Free-floating macrophytes and (iv) Submerged macrophytes. According to an experimental study conducted by Weiping Hu, Jorgen Salomonsen et.al in Lake Taihu, China, growing Eichhornia crassipes (free-floating) can improve the water quality of lake water (stagnant water)[2]. It is observed that these plants are effective in improving the water quality as they grow rapidly and also absorb significant amounts of harmful nutrients from water such as phosphorous, nitrogen, etc.

Furthermore, these plants also absorb heavy metal ions to metabolize the organic substances. In fact, free-floating macrophytes are one of the most efficient hyacinths for nutrient ion removal and metal ion removal. Water hyacinths also help in improving the transparency of the water[3][4][5][6].

2. Duckweed: This is another type of a floating aquatic plant. Duckweed-sewage lagoons remove organic matter through aerobic heterotrophic oxidation. It acts as a "biofilter" for aerobic heterotrophic oxidation by providing attachment opportunities. According to the results of a study performed by F. Al-Nozaily, G. Alaerts and S. Veenstra, it was observed that a medium-deep to deep duckweed-sewage lagoons system (50cm-150cm) act as a facultative system with respect to COD removal in a non-continuous batch reactor system. It was concluded that a depth of 1m-1.5m does not limit the effectiveness of duckweed-sewage lagoons for removal of COD but the depth should be determined on influent water quality and the desired water quality. Duckweed sewage lagoons can also effectively remove nitrogen and phosphorous content from the water[7].

3. Lime treatment: Lime, i.e, calcium hydroxide [$Ca(OH)_2$], is generally used in water treatment plants as a coagulant. Addition of lime in wastewater helps in increasing the pH of the water, in precipitating out phosphorous and metals (eg: aluminium, copper, iron, zinc, etc) from the water and in stabilizing sludge. According to a study on the effect of lime dosage on hardwater eutrophic lakes, it was observed that the application of lime had a positive impact on the quality of water over a long period[8]. The positive impact was in terms of reduction of phosphorous content, decrease in the content of chlorophyll, a decrease in macrophyte biomass and species composition. On the contrary, it was observed that the content of zooplankton and macrobenthos were not affected by lime treatments. It was concluded that the application of lime did not adversely affect the pH or the invertebrates while controlling macrophyte biomass, phytoplankton and phosphorous content temporarily. It is necessary to apply multiple treatments at moderate dosage for a long term reduction of macrophyte biomass, phosphorous content and phytoplankton. It was recorded that lime and oxygen treatments reduced the total phosphorous content by 35% and 52% respectively[9][10][11].

4. Biological activated carbon: According to experimental studies conducted for the treatment of wastewater, biologically activated carbon was extremely effective in reducing the COD of wastewater. Biologically activated carbon was set up as a membrane layer on the surface of the water. It was observed that the COD removal was averagely 74% (11 days) and 84% (15 days) as the activated carbon adsorbed the organic contents from the water. The layer of activated carbon having a depth between 0mm to 70mm is most effective in removing floatation reagents[12].

IV. CONCLUSION

From the experimental data that was obtained from the water samples, it is observed that the most of the chemical parameters (COD, pH and DO) are well within the acceptable range when compared with the maximum regulatory value but the observed value of TDS was beyond the maximum permissible limit. Even though these parameters indicate low pollution, there is need to treat the water with respect to the physical appearance and other chemical parameters. Water hyacinths can be used to increase the transparency of the water and reduce the turbidity. Due to Ganesh Visarjan, metals were also introduced in the water since the paints used contain lead and other heavy metals. Water hyacinths can also reduce the metal contents from the

water. Water hyacinths are also economical in use. The finest part of it being that all of this can be achieved without having any adverse effects on the surroundings of the lake.

REFERENCES

[1]. Zhang, Jia-Zhong, George Berberian, and Rik Wanninkhof. "Long-term storage of natural water samples for dissolved oxygen determination." Water Research 36.16 (2002): 4165-4168.

[2]. Hu, Weiping, Jørgen Salomonsen, Fu-Liu Xu, and Peiming Pu. "A model for the effects of water hyacinths on water quality in an experiment of physico-biological engineering in Lake Taihu, China." Ecological Modelling 107.2 (1998): 171-188.

[3]. Jatin, Srivastava, Gupta Amit, and Chandra Harish. "Managing water quality with aquatic macrophytes." Reviews in Environmental Science and Bio/Technology 7.3 (2008): 255-266.

[4]. William, James, Best Elly, and Barko John. "Sediment resuspension and light attenuation in Peoria Lake: can macrophytes improve water quality in this shallow system?." Hydrobiologia 515.1 (2004): 193-201.

[5]. Sangeeta, Dhote, and Dixit Savita. "Water quality improvement through macrophytes—a review." Environmental Monitoring and Assessment 152.1 (2009): 149-153.

[6]. Rodríguez, Mariana, Jacques Brisson, Guillermo Rueda, and Manuel S Rodríguez. "Water Quality Improvement of a Reservoir Invaded by an Exotic Macrophyte." Invasive Plant Science and Management 5.2 (2012): 290-299.

[7]. Al-Nozaily, F., G. Alaerts, and S. Veenstra. "Performance of duckweed-covered sewage lagoons—I. Oxygen balance and COD removal." Water Research 34.10 (2000): 2727-2733.

[8]. Prepas, Ellie E., Bernadette Pinel-Alloul, Patricia A. Chambers, Tom P. Murphy, Sharon Reedyk, Greg Sandland, and Mark Serediak. "Lime treatment and its effects on the chemistry and biota of hardwater eutrophic lakes." Freshwater Biology 46.8 (2001).

[9]. Zhang, Y., and E.E. Prepas. "Short-term effects of $Ca(OH)_2$ additions on phytoplankton biomass: A comparison of laboratory and in situ experiments." Water Research 30.5 (1996): 1285-1294.

[10]. Reedyk, Sharon, Ellie E. Prepas, and Patricia A. Chambers. "Effects of single $Ca(OH)_2$ doses on phosphorus concentration and macrophyte biomass of two boreal eutrophic lakes over 2 years." Freshwater Biology 46.8 (2001).

[11]. Prepas, Ellie E., Jay Babin, Tom P. Murphy, Patricia A. Chambers, Greg J. Sandland, Anas Ghadouani, and Mark Serediak. "Long-term effects of successive $Ca(OH)_2$ and $CaCO_3$ treatments on the water quality of two eutrophic hardwater lakes." Freshwater Biology 46.8 (2001).

[12]. Borghi, CaterinaChiara, Yoko Akiyama, Massimo Fabbri, Shigehiro Nishijima, and Pier Luigi Ribani. "Magnetic separation of magnetic activated carbons for water treatment and reuse." COMPEL: The International Journal for Computation and Mathematics in Electrical and Electronic Engineering 33.1/2 (2014): 445-462.