Water Quality at an Idol Immersion Site: A Case Study of Boat Club, Yamuna Bazar 3, Yamuna River, Delhi, India

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ABSTRACT

India is a country where sacred practices have been associated to water bodies such as immersion of idols of god and goddess into the water bodies during the festivals of Vinayaka Chathurthi, Durga Puja and Saraswati Puja. These religious practices are responsible for the contamination of water bodies. The present investigation has been carried out to assess the quality of water at an idol immersion site i.e. Boat Club, Yamuna Bazar 3, Yamuna River, Delhi during the year 2009 at three different time periods i.e. during pre-idol immersion (one month before the idol immersion at the site), immersion and post- idol immersion (one month after the idol immersion at the site). The parameters being analyzed include total hardness (TH), dissolved oxygen (DO), biological oxygen demand (BOD) and chemical oxygen demand (COD). During these investigations, it has been observed that there is an increase in the values of TH, BOD and COD during immersion and post immersion that carries a negative impact on the water quality of the River Yamuna.

Key Words: Water analysis, DO, BOD, COD, Total Hardness, Idol immersion, River water quality, Yamuna River

I. INTRODUCTION

India possesses a diverse and rich cultural heritage and is renowned as a 'land of festivals' (Avvannavar *et al*., 2009). Idol worship has been in practice in India since ages (Reddy and Kumar, 2001). During the festivals of Vinayaka Chathurthi, Durga Puja, Saraswati Puja, the idols of the respective god/goddess of various sizes are immersed in water bodies such as rivers, lakes, ponds, estuaries, wells, etc. Idols are usually made up of materials like wood, bamboo, straw, jute ropes, iron rods, clay and plaster of Paris. Also during the idol

immersion process, worships of the idol are made and for this purpose, materials like flowers, oil, germinated grains, ornaments, garlands, cosmetics, earthen lamps, food items etc. are used. Idol immersion also plays an important role as the plaster of paris used for making the idols, clothes, small iron rods, chemical colours, varnish and paints deteriorate water quality of ponds. All these materials, collectively, cause contamination and sedimentation in the water bodies. Onset of monsoon helps in diluting these pollutants. The present study investigates into the extent of pollution caused by immersion of idols into one of the idol immersion site of River Yamuna in the capital city of Delhi, India - Boat Club, Yamuna Bazar 3. Although similar type of studies have been done by various scientists for various water bodies, but no literature is available on investigated site of river Yamuna - Boat Club, Yamuna Bazar 3, Delhi.

II. MATERIAL AND METHODS

A. Sampling

Sampling was done from Boat Club, Yamuna Bazar 3, the idol immersion site, of the River Yamuna, Delhi. The water sample was collected at three different time periods: Pre-idol immersion (one month before the idol immersion at the site), during immersion and post-idol immersion (one month after the idol immersion at the site) during the year 2010.

Sampling precautions

Sample should be handed in such a way that if does not deteriorate or become contaminated before it reaches the laboratory and hence every attempt was made in accordance with WHO guidelines for sample collections. All the containers were made airtight using polythene sheet to avoid any leakage.While filling sample, it was made sure that we bottle out two or three times with the water being collected, unless the bottle contains a preservative or de-chlorinating agent. Sampling points were fixed using map of the sites and marked accordingly so that it could be well recognized by any for future testing of the same.

B. METHODOLOGY

Physiochemical and biological parameters were analyzed by using techniques given by APHA, 2000.

Total Hardness (TH): TH was estimated by EDTA titration method using the following chemicals: standard calcium solution, NH_3 buffer solution (added 16.9 g of NH_4Cl to 143 ml of NH_4OH, made the final volume to 250 ml using distilled water), 0.01 M EDTA solution

(Dissolved 3.723 g of EDTA disodium salt to distilled water, made the volume to 1 litre), Erichrome Black T (EBT) indicator (Dissolved 0.5 g of EBT in 100 ml of 80% ethyl alcohol). Standardization of EDTA solution with standard $CaCO_3$ solution: To 10.0 ml of standard calcium solution, added 2.0 ml of ammonia buffer solution. Added 4-5 drops of EBT indicator, wine red color appeared. Titrated it against EDTA solution till wine red color changed to blue. Recorded the volume of EDTA used to be taken as equivalent to $CaCO_3$.

Titration of test samples: To 10.0 ml of water sample taken in a titration flask, added 2.0 ml of buffer solution. Added 4-5 drops of EBT indicator, wine red color appeared. Titrated it against EDTA solution till wine red color changed to blue. Recorded the volume of EDTA solution used.

TH was calculated using the following formulae:

$$TH = AXBX1000/V$$

Where, V= Volume of sample taken (ml)

A = Volume of EDTA used (ml) for titrating sample

B = mg of $CaCO_3$ equivalent to ml of 0.01 M EDTA titr ant used in standard calcium solution titration. (1ml of 0.01 M EDTA = 1 mg of $CaCO_3$)

Dissolved oxygen (DO): DO was measured by titration method taking into account the following chemicals: $MnSO_4$ solution (dissolved 100.0 grams of $MnSO_4$ in previously boiled distilled water, made the volume upto 200.0 ml), 0.025N sodium thiosulphate solution (dissolved 6.205 grams of $Na_2S_2O_3$ in distilled water, made the volume to 1.0L by adding distilled water), alkaline iodide solution (dissolved 100.0grams of KOH and 50.0 grams of KI in 200.0 ml of previously boiled water), starch indicator (dissolved 100.0 grams of starch in 100.0 ml of warm distilled water), potassium fluoride solution, concentrated sulphuric acid.

To the water sample filled BOD bottles, added 2.0ml of KF solution, 2.0 ml of $MnSO_4$ solution and 2.0 ml of alkaline KI. Shake the bottles and allow the precipitates to settle. Added 2.0ml of concentrated sulphuric acid, shake well to dissolve the precipitates. Transferred the contents of the bottles into titration flasks, added few drops of starch indicator to the flask till blue color appears. Titrated the solution against $Na_2S_2O_3$ solution until blue color disappears.

DO was calculated using the following formulae:

$$DO\ (mg/L) = 8X1000XNXV'/V$$

Where, V = Volume of the sample taken in ml

V'= Volume of titrant used in ml

N = Normality of the titrant

Biological Oxygen Demand (BOD): BOD involves the measuring differences in oxygen concentration in the water samples before and after incubating it, using the following chemicals: $MnSO_4$ solution (dissolved 100.0grams of $MnSO_4$ in previously boiled distilled water, made the volume up to 200.0 ml), 0.025N sodium thiosulphate solution (dissolved 6.205 grams of $Na_2S_2O_3$ in distilled water and made the volume to 1.0L by adding distilled water), alkaline iodide solution (dissolved 100.0grams of KOH and 50.0 grams of KI in 200.0 ml of previously boiled water), starch indicator (dissolved 100.0grams of starch in 100.0 ml of warm distilled water), potassium fluoride solution, concentrated sulphuric acid.

Water samples were collected in two different BOD bottles. From the first bottle, initial DO was determined. Incubated second bottle at 27^0C for 3 days, after which the DO was determined using the previously used procedure.

incubation BOD was calculated using the following formulae:

BOD (mg/L) = D1-D2

Where, D1= Initial DO (mg/L) of the first sample i.e. before incubation

D2= Initial DO (mg/L) of the second sample i.e. after 3 days of

Chemical Oxygen Demand (COD): COD gives the measure of oxygen consumed during the oxidation of the oxidizable organic matter present in a water sample. The following chemicals were used to determine the COD of a water sample:

0.1N $K_2Cr_2O_7$ solution (dissolved 3.67grams of $K_2Cr_2O_7$ to 1L of distilled water), 2M sulphuric acid (dissolved 10.8 concentrated sulphuric acid to 1L of distilled water), 0.1M sodium thiosulphate solution (dissolved 15.811grams of sodium thiosulphate to 2L of distilled water), KI solution (dissolved 20grams of KI in 100ml of distilled water), 1% starch solution (dissolved 1.0grams of starch to 100ml of distilled water). .

50.0ml of distilled water and 50.0 ml of water samples taken in two conical flasks, separately. To each flask, poured 5.0 ml of $K_2Cr_2O_7$ solution, incubated the flasks at 100^0C for an hour. After cooling for 10 minutes, added 5.0ml of KI solution and 10.0ml of sulphuric acid solution to each flask. Added 1.0ml of starch solution to each flask till blue color developed.Titrated the solutions in the flask against 0.01M sodium thiosulphate solution, till blue color disappears completely.

COD was calculated using the following formulae:

$$COD\ (mg/L) = 8 \times C \times (V_B - V_A)/ V_S$$

Where, C = Concentration of titrant (ml)

V_A = Volume of titrant used for control (ml)

V_B = Volume of titrant used for water samples (ml)

V_S= Volume of water samples taken (ml)

III. RESULTS & DISCUSSION

The water quality monitoring results obtained during 2010 indicated that high TH, BOD, COD and low DO continue to be the predominant source of pollution during idol-immersion and post-idol immersion in Yamuna river water at Boat Club, Yamuna Bazar 3, Delhi.

Figure 1-4 represent a comparative analysis of the water quality of the idol immersion site of river Yamuna at Boat Club, Yamuna Bazar 3, Delhi taking into account the parameters of TH, DO, BOD and COD during the time periods of pre- idol immersion, during idol immersion and post – idol immersion.

Fig.1

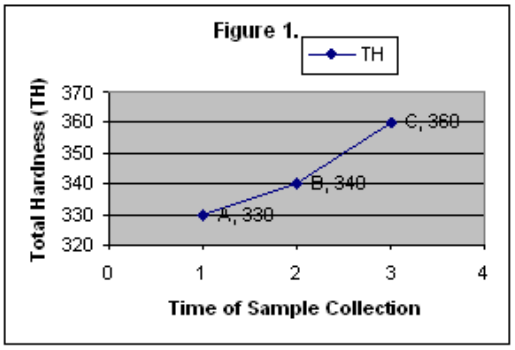

Fig. 2

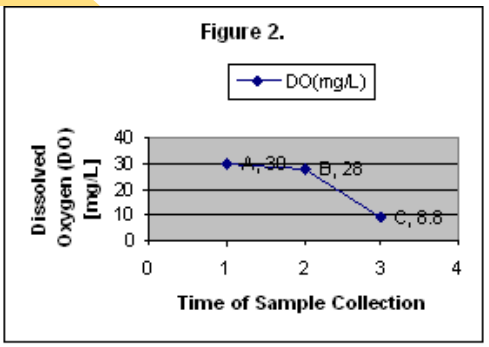

Fig.3

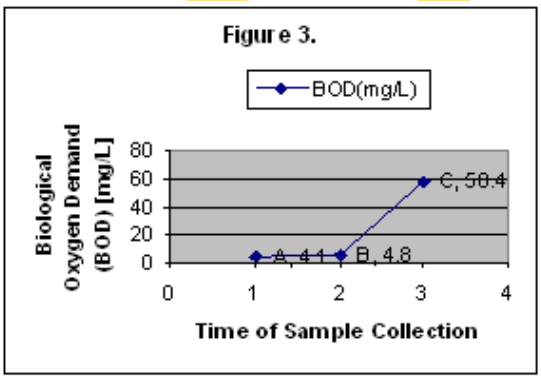

Fig. 4

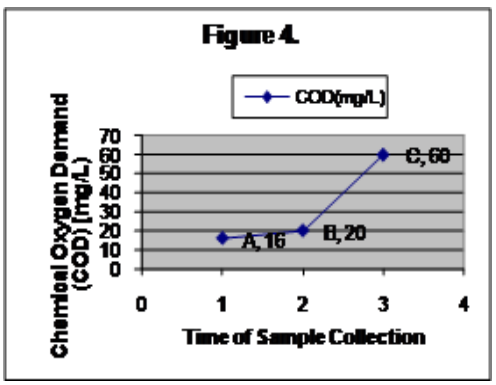

Figure 1-4 showing a comparative analysis of the water quality of the idol immersion site of river Yamuna at Boat Club, Yamuna Bazar 3, Delhi taking into account the parameters of TH, DO, BOD and COD during the time periods of pre-idol immersion, during idol immersion and post-idol immersion.

It has noticed that total hardness (TH) and BOD & COD were at its maximum after post-idol immersion (Fig. 1, 3 & 4) while DO has decreased significantly after post-idol immersion (Fig. 2). Hard water usually leads to scaling of pipes and boilers and hence presents the challenges to the engineers. The value of COD in conjugation with BOD are helpful in knowing the toxic conditions and presence of biologically resistant organic substances as also reported by Rajkumar *et al.* (2003). Dissolved oxygen plays a key role in the survival of aquatic life. Decrease in DO level after idol-immersion is worrisome. Similar type of study have also been conducted by Vyas *et al.* 2006, where they have assessed the environmental impact of idol immersion activity at Upper and Lower lakes of Bhopal and concluded that the parameters like DO, BOD and COD become higher on idol immersions. Jadhav and Dongare, 2009, during their *ex situ* study for Ganesh idol immersion upon investigation for DO and BOD have concluded that there is an adverse impact on the water quality of the micro-environment of the idol immersion. Also Unnisa and Rao, 2007, conducted a detailed study on the Hussain Sagar Lake before, during and after idol immersion in September- 2007. During their study they concluded that the water quality of lake declined after the idol immersion along with other anthropogenic activities.

Similar to our findings, Dhote *et al.*, 2001 & Patil and Dongare, 2006, have also shown that the values of DO, BOD, COD increase during and after immersion of idols in the Twin Lakes of Bhopal.

IV. CONCLUSION

Though human beings religious sentiments can not be ignored but idol immersion is posing a serious environmental threat as found during these investigations. In order to maintain the water quality, (CPCB), Ministry of Environment and Forests (MoEF), have prepared guidelines on idol immersion (www.cpcb.nic.in/upload/.../NewItem_159_Guideline). In addition, it was planned to guide the idol makers by the NGO, Development Alternative, regarding the usage of non-toxic colors to paint the idols (Vyas *et al.*, 2007). Although Government is taking strong steps in this regards, there is a need for further initiatives. At the time of festivals, artificial ponds should be created near the rivers. Public awareness through media should be created about

the pollution being created in the rivers through idol immersion. Non toxic natural colors should be used to paint the idols, instead of chemicals and dyes.

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