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Impact of Durga Idol Immersion on Water Bodies with Early and Late Removal of Idols in Asansol, West Bengal, India

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Abstract: Indians celebrate a large number of cultural and religious festivals throughout the year. Idols represents the deity, which is worshiped. At the end the idols are mostly immersed in water bodies. Ancillary like flowers, papers, ashes are also disposed in the water. These activities are often ignored as the source of water pollution, as these activities have aesthetic and cultural value. In this study, impact of Durga idol immersion on the physico-chemical properties of the water of two ponds in Asansol (West Bengal, India) was assessed. One of the two pond is well managed, where the local authorities remove the idols and other puja associated materials very promptly, whereas in the other pond, these materials remain there for days. Water was collected from these ponds before and after the idol immersion and parameters like, pH, TDS, BOD, COD, heavy metal etc. were estimated. A significant deterioration of most of the water quality parameters in both the ponds was explored but condition is little better in the pond where early removal of immerged materials is practiced. These outcome helps to conclude that the idol immersion activities have negative impact on the water quality, but early removal of debris can lead to lesser pollution. Strict follow of 'Pollution Control Board' protocols regarding idol immersion may impose less impact on the water bodies. Apart from this, awareness for using eco-friendly objects for coloring idols, lesser use of non-biodegradable objects during idol making etc. might improve the situation of the local water bodies.

Keywords: Idol immersion, Water quality, Heavy metal, Water pollution, Physico-chemical parameters

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Introduction

Water quality issues are one of the greatest problems globally. Rapid urbanization, high population growth and untreated waste water discharge have a huge impact on water contamination along with declination of water quality (Tirkey *et al.*, 2013). But there are some sources that often remains unnoticed as the source of water pollution, may be due to having some aesthetic values. The widespread problem of water pollution is known to jeopardizing our health. According to a factsheet shared by World Health Organization, intake of contaminated water causes 4,85,000 diarrhoeal deaths each year (WHO, 2019).

India has a large number of cultural and religious festivals throughout the year. Idols represents the deity, which is worshiped or addressed or sometimes adored throughout the religious activities (also known as 'Puja'). After worshiping, the idols are immersed into water bodies. There are a large number of festivals in which the idols are worshipped, such as Durga puja, Ganesh puja, Jagadhatri puja, Vishwakarma Puja and many more. Thousands of Ganesh and Durga idols, size of those varies between 20 feet to 40 feet are immersed in the water bodies (Reddy and Kumar, 2001). The idols are mainly made up of mud, Plaster of Paris, paddy straw, bamboo sticks, small rods, clothes, metallic foils etc. and they are colored by water colors and varnish colors. The idols are often decorated by non-biodegradable plastics, thermocols etc. which are the source of environmental pollution. Apart from these, the main constituents of synthetic paints, that are used for the decoration and bright coloration of the idols, are heavy metals such as mercury, arsenic, cadmium, zinc etc. (Bhattacharya *et al.*, 2014). After the idol immersion, all the chemical compounds get mixed with the water and that ultimately causes deterioration of the water quality. The biodegradable components and flowers associated with puja, causes water pollution for very short period of time, but the heavy metals may impose long term adverse effects on the life dependent upon the water bodies. Bioaccumulation of these heavy metals is known to transfer toxic substances from producers to consumer levels and leads to health hazards to the consumers (Rakshit and Sarkar, 2017).

Asansol is the district head quarter of the Paschim Bardhaman district of West Bengal in India. A large number of festivals are celebrated in the city and the idols are immersed in the Damodar, Ajay, Barakar and Nunia rivers and several ponds within the city. Geographically the northern boundary of this district is marked by Ajay river, where as southern and western boundary is marked by Damodar river. Durga puja is one of the biggest festivals here, and it has been celebrated in every nook and corners of the city. Most of the immersions of idols organized in core of the city, mainly in the local water bodies like ponds. In this study, the two ponds within the heart of Asansol are selected to assess the impact of Durga idol immersion on the physico-chemical properties of the water.

Materials and Methods

Water samples were collected from two ponds in Asansol city, namely, Masir Pukur (23.40N, 86.58E) (hereafter referred as Site 1) (Fig. 1) and B.C. College Pond (also known as B.C. College Talaw or Dudhiya Talaw; 23.67N, 86.95E) (hereafter referred as Site 2) (Fig. 2). More than 100 idols are immersed in these two ponds every year. Both of the sites share similar topography, and climatic conditions. But there is difference in the management of the two ponds. Among these two sites, in site 2 the idols and other materials related to puja are removed immediately after immersion but in site 1 these are leftover for a few days (Figs. 3A-D). Therefore, a parallel study was conducted in these two ponds to evaluate the impact of idol immersion on the water quality in two different scenarios.

The samples were collected in the month of October, 2021, before and after the Durga idols immersion. The samples were collected on 4^{th} of October, 2021 as pre-immersion sample and on 18^{th} of October, 2021 as post-immersion sample. Physico-chemical parameters like pH, TDS, EC etc. were measured on spot while other parameters were analyzed in the laboratory using APHA (2005) protocols. Heavy metal analysis was performed using atomic absorption spectrophotometry (AAS).

Results and Discussion

Critical analysis of the water quality data depicted a declination in the water quality of both the water bodies in post-immersion time (Tables 1, 2).

pH:

The value of pH can be changed by the increased proportion of carbon dioxide in the water, which

Fig. 1: Satellite image of Site1 retrieved from Google Earth.

Fig. 2: Satellite image of Site-2 retrieved from Google Earth.

Table 1: Variation in water quality parameters before and after idol immersion at site 1

Sl. No.	Water Quality Parameters	Site 1		Units
		Before Idol Immersion	After Idol Immersion	
1	pH	7.03	6.63	-
2	Total Dissolved Solutes (TDS)	142.66	174.00	ppm
3	Electrical Conductivity (EC)	287.66	317.00	µS/m
4	Dissolved Oxygen (O_2)	5.83	4.33	mg/l
5	Carbon dioxide (CO_2)	5.66	9.33	mg/l
6	Hardness	112.00	114.24	mg/l
7	Calcium	43.00	42.11	mg/l
8	Chemical Oxygen Demand (COD)	18.5	27.60	mg/l
9	Biological Oxygen Demand (BOD)	7.00	12.00	mg/l
10	Arsenic (As)	0.09	0.62	µg/l
11	Mercury (Hg)	2.56	3.20	µg/l
12	Lead (Pb)	BDL	2.09	µg/l
13	Cadmium (Cd)	BDL	BDL	µg/l
14	Zinc (Zn)	BDL	BDL	mg/l

BDL= below detectable level

Table 2: Variation in water quality parameters before and after idol immersion at site 2

Sl. No.	Water Quality Parameters	Site 2		Units
		Before Idol Immersion	After Idol Immersion	
1	pH	7.06	6.96	-
2	Total Dissolved Solutes (TDS)	120.60	129.66	ppm
3	Electrical Conductivity (EC)	257.66	258.66	µS/m
4	Dissolved Oxygen (O_2)	5.33	4.00	mg/l
5	Carbon dioxide (CO_2)	6.66	10.66	mg/l
6	Hardness	78.00	103.04	mg/l
7	Calcium	25.98	32.26	mg/l
8	Chemical Oxygen Demand (COD)	9.20	11.88	mg/l
9	Biological Oxygen Demand (BOD)	4.00	4.00	mg/l
10	Arsenic (As)	0.59	0.84	µg/l
11	Mercury (Hg)	2.14	2.73	µg/l
12	Lead (Pb)	BDL	2.09	µg/l
13	Cadmium (Cd)	BDL	BDL	µg/l
14	Zinc (Zn)	BDL	0.003	mg/l

BDL= below detectable level

Fig. 3 (A-D): Photographs of Ponds of Asansol soon after idol immersion.

may be due to the dissolving of idols in the water bodies and degradation of flowers and other puja accessories (Bhattacharya *et al.*, 2014). The range of pH in the pre-immersion water samples was nearly neutral in both of the pond, the values were 7.03 and 7.06, in site 1 and site 2, respectively. In post-immersion water samples (Fig. 4) the pH was decreased in both the sites, in site 1 it was 6.63 and while in site 2 it was 6.96. The percentage of decrease in pH in site 1 was about 5.69% whereas the percentage of decrease of the same in site 2 was 1.41%. However, the values of pH in both ponds remained within the permissible limits (BIS, 2012).

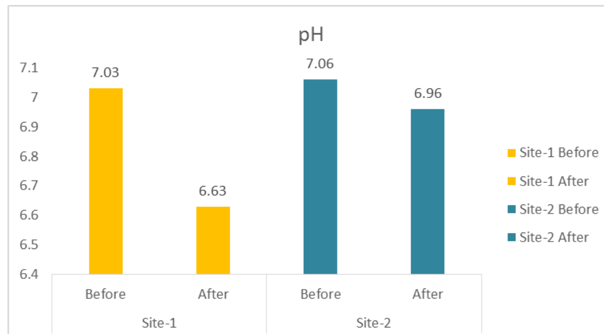

Fig 4: Variation in pH in the two sites before and after idol immersion.

Total Dissolved Solutes (TDS):

The value of TDS represents the total amount of inorganic and organic minerals present in any water sample in dissolved condition (Mitra *et al.*, 2018). The ions include Mg^{2+}, Ca^{2+}, SO_4^{2-}, K^+, Na^+ etc. (Mondal and Sinha, 2020). The value of TDS in site 1 was recorded as 142.66 ppm in pre-immersion water sampling and the value got increased to 174 ppm in post-immersion sample. In case of site 2, the pre- and post-immersion TDS values were recorded as 120.60 ppm and 129.66 ppm, respectively (Fig. 5). Though both

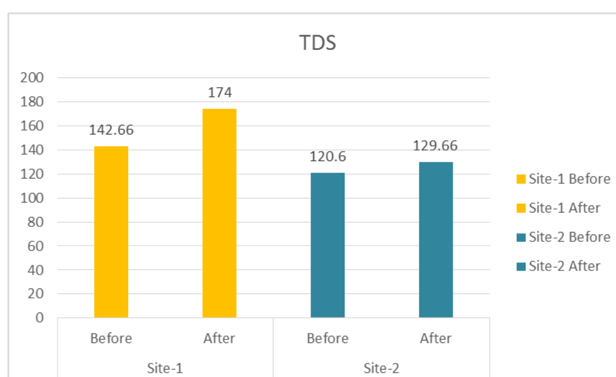

Fig. 5: Variation in Total Dissolved Solutes (TDS) in the two sites before and after idol immersion.

the values of TDS were much below than the permissible values for drinking water (BIS, 2012), but there was 21.96% and 7.50% total increase in TDS values in site 1 and site 2, respectively.

Electrical Conductivity (EC):

Electrical conductivity is an indirectly significant factor for the analysis of water quality (Mondal and Sinha, 2020). EC measures the total concentration of salts in the water sample. The value of EC has been changed in this study in both the sites, during pre-immersion and post-immersion sampling. In site 1, the value of EC was 287.66 µS/m and after idol immersion the value increased to 317 µS/m with 10.19% increase in the value. In case of site 2, the values were 257.66 µS/m and 258.66 µS/m in pre- and post-immersion samples, respectively with only 0.38% increase (Fig. 6).

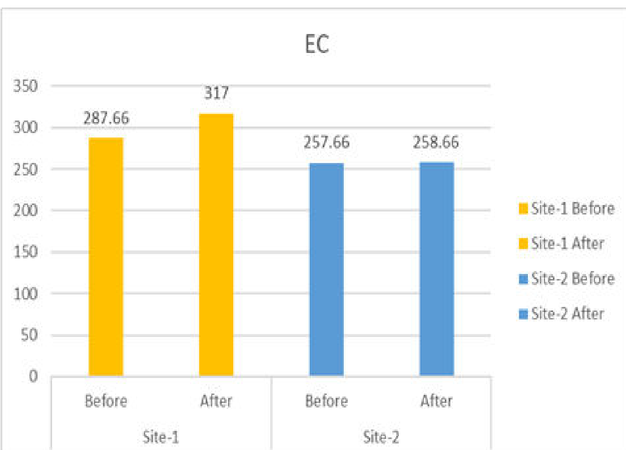

Fig. 6: Variation in Electrical Conductivity (EC) in the two sites before and after idol immersion.

Dissolved Oxygen (DO):

Dissolved oxygen (DO) implies the total amount of free oxygen dissolved within the water. Oxygen gets mixed with the water due to photosynthesis of aquatic plants and also by the aerating action (by simple diffusion) of winds. The threshold value of DO for wildlife is 5 ppm (Das, 2020). Decreased DO level causes stress in aquatic life. The values of dissolved oxygen in pre-immersion sample were 5.83 mg/l and 5.33 mg/l, in site 1 and site 2 respectively. But in post-immersion sample the values decreased to 4.33mg/l and 4 mg/l, with 25.72% and 24.95% decrease in site 1 and site 2, respectively (Fig. 7).

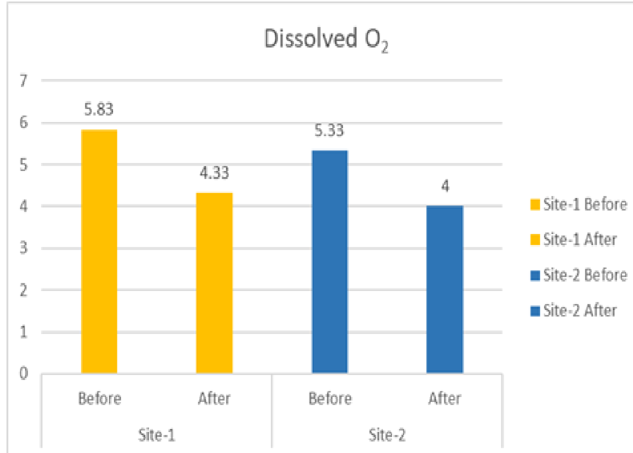

Fig. 7: Variation in Dissolved oxygen in the two sites before and after idol immersion.

Carbon dioxide (CO_2):

Concentration of free carbon dioxide may be indicative of the water quality of an aquatic system. Increased carbon dioxide decreases the pH of water that brings harmful effect in fishes (Ishimatsu *et al.*, 2004). The concentration of carbon dioxide showed an increase in post-immersion sampling. The values of CO_2 in two ponds were 5.66 mg/l (site 1) and 6.66 mg/l (site 2). After idol immersion the values of CO_2 increased and reached to 9.33 mg/l and 10.66 mg/l in site 1 and site 2, respectively (Fig. 8). There was 64.84% increase in the CO_2 value in site 1, whereas the increase in case of site 2 was around 60.06%.

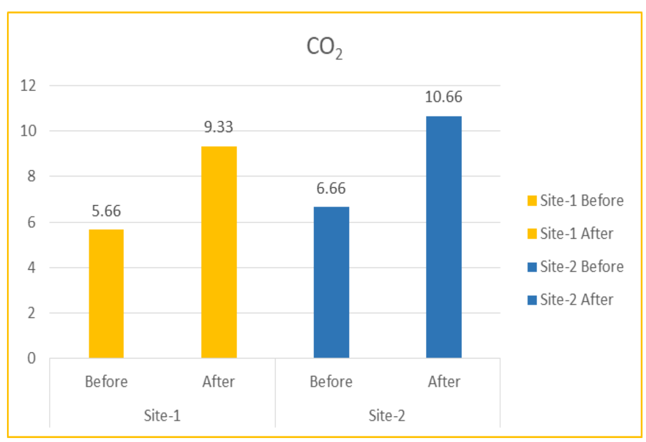

Fig. 8: Variation in Carbon dioxide in the two sites before and after idol immersion.

Hardness:

The hardness of water is dependent on the dissolved calcium and magnesium ions in the water sample. The hardness of the water before idol immersion was 112 mg/l and 78 mg/l in site 1 and site 2, respectively. But after idol immersion the hardness has been increased to 114.24 mg/l (site 1) and 103.04 mg/l (site 2) (Fig. 9). According to US Geological Survey, the water with 61-120 mg/l hardness is referred to as moderate hardness (USGS, 2018).

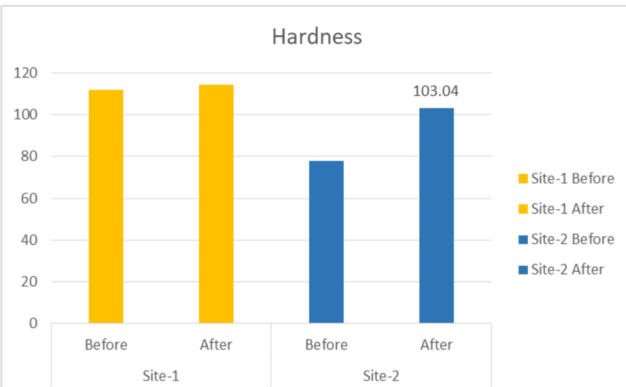

Fig. 9: Variation in Hardness in the two sites before and after idol immersion.

Calcium (Ca):

The calcium ion concentration in site 1 was 43 mg/l in pre-immersion time and after idol immersion the value was 42.11 mg/l. In case of site 2, the concentration of calcium ion was 25.98 mg/l in pre-immersion sample, while after idol immersion the value increased to 32.26 mg/l (Fig. 10).

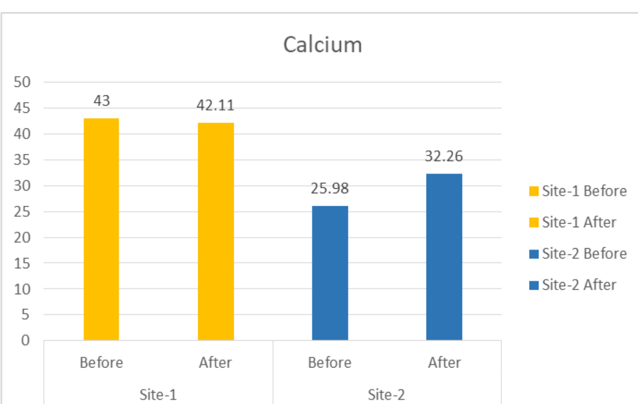

Fig. 10: Variation in Calcium Ion in the two sites before and after idol immersion.

Chemical Oxygen Demand (COD):

Chemical oxygen demand is an important indicator of water pollution. Before idol immersion the COD values in site 1 and site 2 were 18.5 mg/l and 9.2 mg/l, respectively. After idol immersion the values of COD increased in both the sites, and the increase was 49.19% and 29.13%, respectively (Fig. 11).

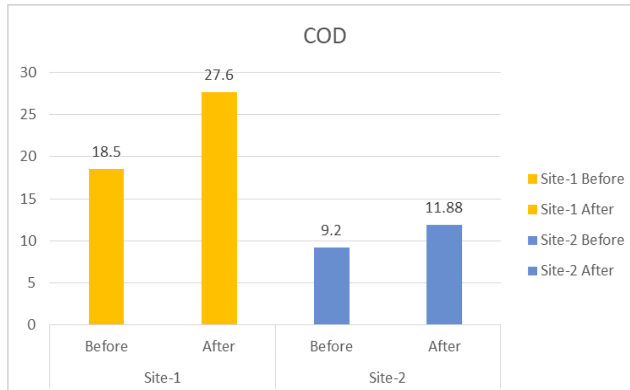

Fig. 11: Variation in Chemical oxygen demand in the two sites before and after idol immersion.

Biological Oxygen Demand (BOD):

Biological oxygen demand represents the total amount of oxygen consumed by the microorganisms to decompose organic matter under aerobic condition. So, BOD is indicative of organic pollution of any water bodies. The BOD values in site 1 and site 2 were 7 mg/l and 4 mg/l in pre-immersion sample. After idol immersion, the BOD in site 1 changed to 12 mg/l (41.67% increase), but in site 2 the BOD remained unchanged (Fig. 12).

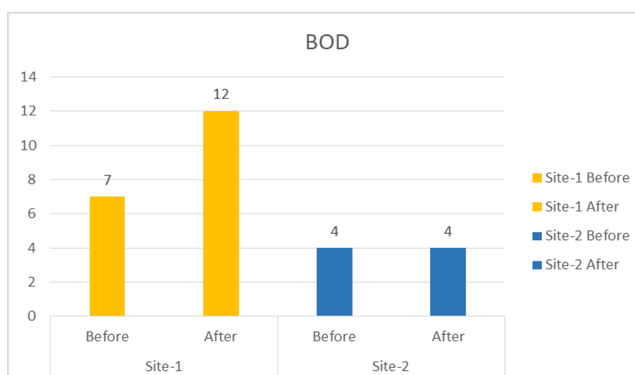

Fig. 12: Variation in Biological oxygen demand in the two sites before and after idol immersion.

Heavy Metals:

The heavy metals are not the natural component of water. Heavy metals mainly come into the water bodies from different anthropogenic activities like industrial waste water, idol immersion etc. Variation in the concentrations of Arsenic, Mercury, Lead, Cadmium and Zinc were estimated:

Arsenic: The Arsenic (As) concentration in site 1 was 0.09 µg/l in pre-immersion sample. After idol immersion there was increase in the As concentration (0.62 µg/l). There was almost 7-fold (588.89%) increase in the value in post-immersion sample. In case of site 2 the concentration of Arsenic (As) in pre-immersion sample was 0.59 µg/l and after immersion the value increased to 0.84 µg/l with overall 42.37% increase (Fig. 13).

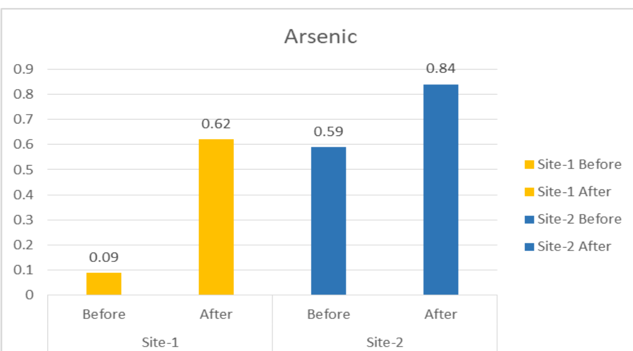

Fig. 13: Variation in Arsenic concentration in the two sites before and after idol immersion.

Cadmium: The concentration of Cadmium (Cd) ion in both of the site was below detectable level in both the sites in pre-immersion as well as post-immersion time.

Zinc: The Zinc (Zn) level was below detectable level in pre-immersion and post immersion time in site 1. In case of site 2, the level was initially below detectable level, but after idol immersion the level was 0.003 mg/l.

Mercury: The level of Mercury (Hg) in site 1, before the idol immersion was 2.56 µg/l and after idol immersion it was 3.2 µg/l. In case of site 2, the concentration of mercury was recorded as 2.14 µg/l(pre-immersion) and 2.73 µg/l (post immersion) (Fig. 14). There was about 25% and 27.57% increase in Mercury level in two sites (S 1 and S 2), respectively.

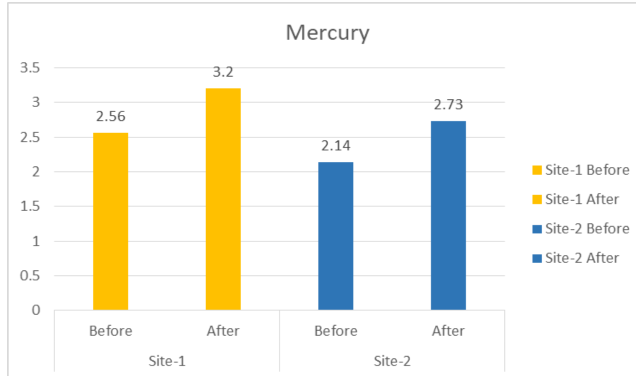

Fig. 14: Variation in Mercury concentration in the two sites before and after idol immersion.

Lead: The Lead (Pb) concentration in both the site was below detectable level before idol immersion but 2.09 µg/l lead was detected in the post-immersion water samples in both the sites (Fig. 15).

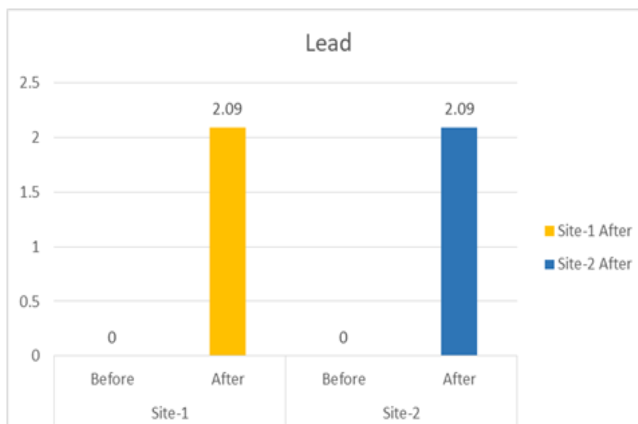

Fig. 15: Variation in Lead concentration in the two sites before and after idol immersion.

From the above data, it is evident that in case of site 1, most of the parameters showed an increase in post-immersion sample, but the increase in case of site 2 was not as higher, when compared to site 1. As stated earlier, the objects associated with idol immersions were removed very quickly in site 2, so the idols and other associated objects do not get enough time to mix with the water, that may be the reason behind lesser degree of contamination in site 2. But in site 1, the objects get enough time to mix with the water of that site and higher degree of contamination observed.

Though, a few heavy metals, like As, Hg, are not supposed to be in site water, even in pre-immersion sample, but as the sites are continuously used for idol immersion every year more than once, the heavy metals may be coming from previous idol immersion such as in 'Vishwakarma Puja', which are also observed in this industrial area. Lead is also detected in post-immersion water sample. Accumulation of these heavy metals may become a matter of concern in near future.

The absence of Cd and Zn in pond water even after idol immersion is very good status for both of the sites. This outcome may be due to local awareness to the idol makers, for using paints without Cadmium and Zinc. Even the lesser use of plaster of Paris, for idol making may be responsible for lesser Calcium in the pond water.

The findings of this study depicted that the dissolved oxygen concentration dropped even below the desirable limit for aquatic life (Das, 2020), which may be stressful for aquatic organisms. The Mercury level in the site is more than acceptable level which may cause serious problem to the nervous system. The post-immersion BOD and COD level indicated a moderate level of organic waste deposition and associated pollution in Site 1. This may be due to the dumping of flowers, fruits, and other things associated with pujas.

Conclusion

Polluted water can be a source of many direct or indirect health problems of humans as well as animals and can also act as breeding places of vector mosquitoes (Mitra *et al.*, 2018; WHO, 2019; Paramanik *et al.*, 2012).

The present investigation of the water quality, before and after idol immersion revealed that there was a negative impact of these activities in the water quality. It was evident that, water quality was very adversely affected with the increased amount of total dissolved solutes, low pH, low dissolved oxygen levels in the water bodies by the act of immersion of idols, and other accessory things used in 'Pujas'. The result of this study also supported the previous findings of Reddy and Kumar (2001), Ujjania and Mistry (2012), Billore and Dandawate (2015), Rakshit and Sarkar (2017), Mondal and Sinha (2020) and Gupta *et al.* (2020). The components used for the making of idols and other organic materials get settled in the water bodies, which makes the water unsuitable for use (Mondal and Sinha, 2020).

As the religious activities like idol immersion are associated with faith and belief, those activities cannot be stopped, but smart and eco-friendly techniques for making and coloring idols must be used. The eco-friendly paints without any heavy metals are suggested. Apart from all these, local authorities can maintain the site by regular monitoring. This study revealed that fast removal of the idols, with organic objects and puja objects, lead to lesser degree of water pollution. So, this strategy should be followed all-over sensibly under stringent observations to combat the water pollution with reference to idol immersion. Moreover, the protocols of Central Pollution Control Board and State pollution control board regarding idol immersion should be obeyed strictly.

Acknowledgements

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