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How Idol Immersion is Polluting The Ganga River in Kolkata, West Bengal: An Overview

KEYWORDS

Idol immersion, Paint, pH, Conductivity, Turbidity, Lead

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ABSTRACT Water pollution due to industrial activities is well known worldwide. In India, however, pollution load is added upon by a special activity, of idol immersions during the festive season. Traditionally the worshipped idols are immersed in the holy river of Ganga. The paints used for coloring the idols and also the Sindoor applied to female idols, add to the Lead load in the river, which might be a source of heavy metal poisoning, since Lead is bio-accumulative, thereby affecting the entire aquatic food chain including humans. The present study attempts to collect and provide information about the Lead levels in water and idol immersion as an activity for adding to Lead load to the Ganges. Lead level in Ganges was measured by Atomic Absorption Spectrophotometry, in samples of water from Pre-immersion, Immersion and Post-immersion phase. Along with that pH, turbidity and conductivity of water is also measured. All the parameters showed highly significant increase during the Immersion phase. Also the Lead level measured is way above the maximum permissible limit in fresh water, by WHO, BIS, ICMR and ISO 10500:1991 standards.

Introduction

Water is the strong hold of civilization since the origin of life. Also, it is an essential part of our life on which depends the life cycle and existence of our entire bio-diversity. Sea, rivers, lakes are natural resources of water. Water quality has become a serious issue due to increasing industrialization, urbanization and manmade problems. The constituents present in the water system depend on the location of the water body in nature and the discharge quality from various sources near that water body [1].

Though all industries in India function under the strict guidelines of both State and Central Pollution Control Board, still the environmental situation is far from satisfactory. In India, about 70% of the available water is polluted, out of which 8-16% is by industrial waste and 84-92% by sewage disposal & others [2].

Religious festivals like Durga Puja, Ganesh festival are traditionally celebrated in Kolkata, India, as a social and community activity. After the period of the festivals are over, the idols are immersed in the Ganga or any nearby water body. This too causes pollution to the water making it unfit for consumption. It has been roughly estimated that around the festival period almost 1600 idols are immersed in the Ganga from Babughat alone, in Kolkata, India [3].

At present, the chemical paints used to paint these idols contain heavy metals like Lead (Pb) which are potentially hazardous and bio-magnify along the food chain. These are oil paints of various colours, like, red, yellow, orange, white, black golden or skin color. This Pb, which is neurotoxic, nephrotoxic and even carcinogenic, is added to the water bodies through immersion of idols containing such paints and colours. Also the 'Sindoor' used on the idols as a tradition contains harmful level of Pb which can be toxic even in small quantity. When immersed, the colours and chemicals dissolve slowly leading to significant alteration in the water quality [4]. Also, contaminated sediments

do not always remain at the bottom of a water body. Anything that stirs the water, such as dredging, can suspend sediments. Resuspension affects all animals in the water and not just bottom dwellers with toxic contamination [5]; also it is observed that during immersion time the colour of Ganga water turns totally different due to high turbidity [6].

Pb has a relatively high density and is toxic or poisonous at low concentrations, being the natural component of earth's crust; they can neither be destroyed nor degraded. More than permissible limits act as general metabolic poison and enzyme inhibitor. It has the ability to replace calcium in bones to form long term replacement sites [7]. It is one of the commonest contaminant of drinking water and the known fatal effects from drinking water include damaged or reduced mental and CNS function and low energy level. They also cause anaemia and adversely affects organs like kidney and liver [8].

The present study is an endeavor to collect and provide information about the impact of levels of Pb in water and immersion of idols as an activity that is responsible for adding pollution load to the Ganges.

Materials & Methods

The important idol immersion site at Babughat (previously known as Baje kadamtala) in Kolkata, West Bengal, was selected for the present study. The position of the site is 22°35' N and 88°21' E. As almost 80% of discharge in the Ganga occurs in the months of monsoon, between July to October due to south-west Indian monsoon [4], water sample was collected from the surface layer during July 2015 to October 2015. The water was collected in sterile, acid-washed, polyethylene containers during the early morning hours for analysis. Pre-immersion samples were collected one month prior to immersion activities. During the immersion times Immersion samples were collected and Post-immersion samples were collected three weeks after the ac-

tivities were over. All samples were collected and analysed in triplicate.

The water samples collected were preserved by adding 5 ml of 1N HNO₃ and adjusting the pH to 4 and were analysed for Pb using a Flame Atomic Absorption Spectrophotometer (Perkin Elmar, 2130 AAS). The water samples were analysed according to the standard methods prescribed by American Public Health Association (APHA) [9]

The analytical quality control included analysis of standards and triplicate analysis of samples and blanks. The accuracy of the analytical technique was evaluated by analyzing a certified standard reference material SRM1634B, trace element in water (NIST, USA). All tests were done using inter laboratory quality control materials of Centre of Disease Control and Prevention (CDC, USA). The observed levels of Pb were compared with WHO, BIS, ICMR and ISO10500:1991 desirable limits for getting actual contamination level of immersion area [10].

pH was analysed using Systronics digital pH meter No 335.

Turbidity was estimated with the help of Turbidimeter and Electrical Conductivity by Conductivitymeter No. EC304.

Statistical significance was assayed with Student's T Test and results were deemed statistically significant when p<0.005 [11]. Also, statistical analysis was done using SAS software [12].

Results

The results obtained by Pb analysis of water samples in Babughat immersion point of Ganga river in Kolkata, India, before, during and after idol immersion, during the months between August to October, 2015, are depicted in table 1.

Table 1: Change in concentration of Pb (in mg/L) in Babughat immersion Point of Ganga River in Kolkata, India

Parameter	Pre-immersion phase	Immersion phase	Post-immersion phase	ICMR and BIS standard for highest desirable limits/WHO permissible limits/ISO 10500:1991 permissible limits
Lead (Pb) (in mg/L)	0.41±0.11	1.14±0.27	0.76±0.16	0.05

A range of the variations in pH, turbidity and electrical conductivity were obtained from the surface water during pre-immersion, immersion and post-immersion times respectively. They are tabulated in tables 2, 3 and 4 respectively.

Table 2: Variation of pH in Pre-immersion, at Immersion and in Post-immersion water samples collected from site

Parameter	Pre-immersion	Immersion	Post-immersion	ICMR and BIS standard for highest desirable limits	WHO permissible limits
pH of water	8.04±0.12	8.69±0.15	8.21±0.17	6.5-8.5	7.0-8.5

Table 3: Variation of Turbidity in Pre-immersion, at Immersion and in Post-immersion water samples collected from site

Parameter	Pre-immersion	Immersion	Post-immersion	ICMR & BIS standard for highest desirable limits/WHO permissible limits/ISO 10500:1991 permissible limits
Turbidity (in NTU)	8.2±0.2	10.3±0.5	8.7±0.1	5-10 NTU

Table 4: Variation of Conductivity in Pre-immersion, at Immersion and in Post-immersion water samples collected from site

Parameter	Pre-immersion	Immersion	Post-immersion	ICMR and BIS standard for highest desirable limits	WHO permissible limits
EC Conductivity (in µS/cm at 25° C)	475.92 ± 7.69	586.61 ± 10.13	492.83 ± 32.61	250-750	≤ 750

The statistical significance between the various parameters during Pre-immersion, at Immersion and in Post-immersion activities are depicted in Table 5.

Table 5: The statistical significance between the various parameters during Pre-immersion, at Immersion and in Post-immersion activities

Parameters	Pre-immersion : Immersion	Immersion : Post-immersion	Pre-immersion: Post-immersion
Lead (Pb) (mg/L)	<0.0001	<0.0001	<0.0001
pH of water	<0.0001	<0.0001	0.0008
Turbidity (in NTU)	<0.0001	<0.0001	<0.0001
EC Conductivity (in µS/cm at 25° C)	<0.0001	<0.0001	0.0298

Discussion

These data reveal that the quality of water in the Ganga River is grossly diminished during the immersion of idols. Pb concentration also significantly increases in this period. The concentration of Pb, a potentially hazardous heavy metal is increased manifolds in the water due to idol immersion, compared to the permissible limits of ICMR, BIS, WHO and ISO 10500:1991 standards [10]. Such activities add more toxic products to an already polluted water body due to various industrial wastes. This practice, if continued over a long time, may lead to pollution of the reservoir. Pb is known to persist in aquatic environment, and gradually accumulate and magnify through the process of bioaccumulation and biomagnifications and move up across the food chain [13]. Thus, the level of Pb may magnify at different trophic levels, including fishes and birds inhabiting the river, which finally reach humans through the food [14].

In humans, exposure to Pb may result in wide range of biological effects, depending on the level 7 duration of exposure. Its resistance to removal from the environment & its subtle, subclinical effects, particularly on neuropsychological effects on children, makes it very harmful for continuous exposure.

In the water samples, pH varied from within permissible limits in Pre-immersion phase to significantly high during the immersion phase, making the water more alkaline. This change is carried forward in the post-immersion phase, where the pH again is a little on the higher side than that in the pre-immersion phase. The reason for this might lay in the composition of idols, which include plaster of Paris & other calcium compounds.

The turbidity ranged from within permissible limits in Pre-immersion phase to higher than permissible during the Immersion phase. The maximum value of turbidity was observed during the idol immersion on the surface water. The water column is disturbed completely during idol immersion causing such a severe disruption. This, however, gets cleared soon along with the flow of the river. Similar impacts have been seen on water quality of the Twin lakes of Bhopal during festivals [15]

The average conductivity values in water ranged within the maximum permissible limits, though it is significantly increased during the immersion phase, thereby causing disturbance, but not total destruction, of the aquatic life.

Conclusion

The Pb concentration was found to be higher than pre-immersion phase in the post idol immersion times, which may ultimately cause serious health hazards in humans. It is, at present, of utmost importance to create awareness about suitable methods of disposal of idols post the worships and festivals associated with them. Also, the paints and Sindoor associated with the idols need to be obtained from organic non-toxic sources. Otherwise, the polluted waters will seriously affect the people who consume them in various forms, even along with street food. This is more important because Ganga water is the main source of drinking water for the inhabitants of Kolkata and chronic exposure to Pb above permissible limits will cause adverse physiological effects on excretory, digestive, circulatory and nervous systems. It is expected that regular assessments and monitoring of water quality by a concerned regulatory body will help in understanding the water quality trends over a period of time and prioritize pollution control efforts.

Acknowledgements

The authors are grateful to the National Referral Centre for Lead Projects in India, West Bengal, (NRCLPI, WB), for providing laboratory facilities and providing financial support.

Conflict of Interest

The authors declare no conflict of interest in the present study.

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