

## Assessment of Concentration and Variations Due to Seasonal Effect on the Presence of Heavy Metals in the Water of Upper Lake, Bhopal

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### ABSTRACT

Water is the most precious gift of nature and is a valued natural resource for the existence of living beings. Management of this natural resource is thus of utmost importance. The present study was carried out to determine the presence of a few heavy metals viz, lead, chromium, copper and mercury in the various samples of Upper Lake, Bhopal. The samples were analyzed during both the pre-monsoon and the post-monsoon season. From the observations it was concluded that a general increase in the concentration was observed in the post monsoon season due to surface runoff coming into the lake water in the rainy season.

**Key words:** Heavy metals, Management, Surface runoff, Post - monsoon.

### INTRODUCTION

Water supports life on earth and is an essential commodity for survival of mankind and other living organisms. The development and growth of a nation is closely related to its water resources. When effectively harnessed, the potential for water resources can be enormous. But today, ignoring all these facts, man is indiscriminately polluting water and unknowingly provoking the nature for complex situations.

Bhopal, the capital city of Madhya Pradesh and the city of lakes is situated in the heart of India. It is facilitated with large number of water bodies in and around it. Upper lake, the biggest lake of Bhopal is the chief source of potable water for the residents of the city. The lake was created by Raja Bhoj in 11<sup>th</sup> century by construction of an earthen dam across the Kolans river, a rain fed tributary of the Betwa river. The lake has a large catchment area of 361 sq.km and at present water spread area is 36 sq.km at full

tank level. Bhopal is fast developing in all directions and fringe areas are converting into a part of urban development at a faster pace rapidly. The increased anthropogenic activities and urbanization in the catchment have caused an increased inflow of the silt, untreated domestic sewage from the nearby areas, nutrients, pesticides and other agricultural wastes from the rural areas, industrial wastes from the urban areas and an overall deterioration of the water quality.

Heavy metals are the pillars of all major civilizations. They are natural components of the Earth's crust. They cannot be degraded or destroyed. Today, contamination of water by toxic heavy metals in the form of wastes effluents from industries is a worldwide environmental problem. To a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals (e.g. lead, chromium, copper, mercury, manganese, selenium, zinc etc) are essential to maintain the metabolism of the human body. However, at higher concentrations

they can lead to poisoning. Heavy metal poisoning could result, for instance, from drinking-water contamination (e.g. lead pipes), high ambient air concentrations near emission sources, from domestic sewage discharge, street dust, land runoff, fossil fuel burning or intake via the food chain. Large amounts of heavy metals may cause acute or chronic toxicity, upsetting the biological functions, causing deformity and even death in the end. Mukherjee A. (2005) stated that the biodegradable matter after decomposition recycles to the system while no biodegradable substances form sediments. The non bio-accumulation of heavy metal in biological system transfers the toxic element from producer to consumer level, which can be a future health hazard.

#### METHOD AND MATERIALS

The present study was conducted to evaluate the status of water quality of Upper Lake, Bhopal specifically in terms of determination of the concentration of a few selected heavy metals namely, Lead, Chromium, Copper and Mercury. For the study water samples were collected from various sampling sites of the Upper Lake in plastic cans. The heavy metals were preserved by adding 5 ml of 1 N HNO<sub>3</sub> in one litre of sample, maintaining the pH to below 4.0. The samples were then transported to the laboratory for analysis of selective heavy metals following the standard procedure given by APHA using Atomic Absorption spectrophotometer.

#### Description of Sampling Stations

The sampling stations selected for the study were as under:

##### S1 - Sampling station near Bairagrah Kalan

This station of the Upper Lake is near Bairagarh and Sehore nalla and it is more polluted due to substantial inflow of domestic sewage.

##### S2 - Sampling station near Kohefiza

There are more than 6,000 accommodations in Koh-e-Fiza. All waste from these residences goes to the upper lake.

##### S3 - Sampling station near Gandhi Medical College

GMC is located in Fatehgarh area on

Sultania Road in Bhopal, Madhya Pradesh. The college stands tall on the ground where once Fatehgarh Fort stood. It is adjacent to VIP Road, which is a major tourist attraction due to a beautiful scene of the Upper Lake. Under Bhoj Wetland project due to diversion of Nalla the entry of silt load and hospital wastes into the lake has been prevented.

##### S4 - Sampling station near Lake View

This station of the Upper Lake is a site of recreational importance. The tourists get attracted to its scenic beauty.

##### S5 - Sampling station near Prempura

This sampling station of Upper lake is majorly affected by bathing and religious activities such as that of idol immersion.

##### S6 - Sampling station near Kotra Nallah

This station receives main untreated drainage from Kotra. It is the confluence point of drainage nalla from charimli area behind Kotra.

##### S7 - Sampling station near Kaliasote

This sampling station is situated near the Kaliasote dam and also has agricultural practices going on in the catchment area.

#### RESULT AND DISCUSSION

The observations of the current study can be summarized as follows:

#### Lead

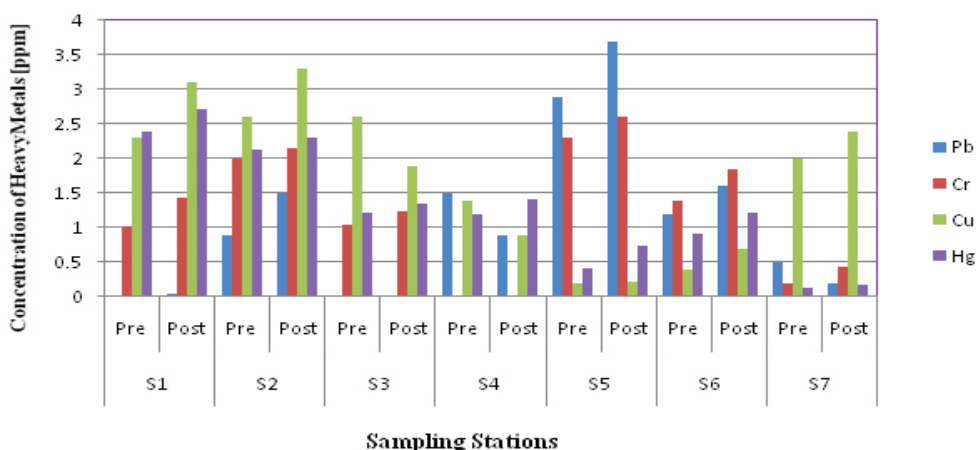
Lead occurs naturally in the environment. However, most lead concentrations that are found in the environment are a result of human activities. Lead is used in leaded pipes, car batteries, ceramic glazes, screen of computers, in paints, enamels etc. Idol immersion is a common religious practice in India during Ganesh Visarjan and Durga Pooja. These idols are decorated with paints which consist of a considerable quantity of lead. The results have also supported the fact that the concentration of lead in the water samples increases after idol immersions ie during the post – monsoon period. The highest concentration of lead ie of 3.70 ppm was observed at S5 station during the post monsoon period. Anju Vyas *et. al.* (2007) have also observed that lead concentration has increased many folds in the

waters of Upper Lake, Bhopal due to idol immersion. *Jaswant Singh et. al.* (2012) Studied seasonal variations of heavy metal concentrations in water of Ramgarh lake, Gorakhpur and found that in all the seasons only the concentration of lead was found to be beyond limits (0.1mg/ltr). He also reported higher concentration of heavy metals in the pre – monsoon season and a lower concentration in the post – monsoon season due to the dilution factor.

**Copper**

Copper is a widely used metal employed in many fields like transportation, manufacturing currency, electricity, construction and agricultural fields. It normally occurs in drinking water from copper pipes, as well as from additives designed to control algal growth. It is an essential component of key metalloenzyme that maintains the vascular and nervous system, but its high doses can cause

anemia, liver and kidney damage, and stomach and intestinal irritation. During the present investigation, highest concentration of copper of 3.30 ppm was observed at **S2** station during the post monsoon period while the minimum concentration was observed at **S5** station during the pre monsoon period. *Anilava Kaviraj et. al.* (1999) during his investigation discovered that the concentration of Cadmium, Zinc and Copper in water, sediment and fish of four perennial ponds of an industrial town showed an increased concentration during the summer and diluted concentration during monsoon. These metals were found to concentrate in sediment at much higher rate. *Namdev et. al.* (2011b) studied accumulation of micronutrients especially Zn, Cu, Mn and Mo and concluded that higher concentrations of these heavy metals were found higher near the station where chemical fertilizers are being used in the catchment area.



**Fig. 1: Variation of lead, copper, chromium and mercury at different sampling stations of upper lake, bhopal**

**Table 1: Variation of Pb, Cu, Cr & Hg at different sampling stations of Upper Lake, Bhopal**

Sampling stations	Pb		Cr		Cu		Hg	
	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
S1	0.02	0.05	1.02	1.44	2.30	3.10	2.40	2.71
S2	0.90	1.50	2.01	2.15	2.60	3.30	2.13	2.31
S3	0.02	0.02	1.04	1.23	2.60	1.90	1.22	1.34
S4	1.50	0.90	0.02	0.03	1.40	0.90	1.20	1.41
S5	2.90	3.70	2.30	2.61	0.20	0.22	0.41	0.74
S6	1.20	1.60	1.40	1.84	0.40	0.70	0.92	1.21
S7	0.50	0.20	0.20	0.44	2.00	2.40	0.13	0.17

### Chromium

Chromium is mainly used in preparation of alloys such as stainless steel, in chrome plating and in metal ceramics. It is used in metallurgy to impart corrosion resistance and a shiny finish; and also as dyes and paints. For decorating the idols paints are used which is the main source of Cr during idol immersion. Usually Cr is negligible in the lake but after immersion it increases little bit although not significantly. During the present investigation, highest concentration of copper was observed at **S5** station during the post monsoon period while the minimum concentration was observed at **S4** station during the pre monsoon period. It can be concluded from the above observations that although chromium is used in paints but its concentration does not increase significantly even after idol immersion. The **S4** sampling station which is free from such activities showed minimum concentration of chromium in its samples. **Dixit *et.al.* (2008)** studied heavy metal pollution in Shahpura Lake Bhopal and concluded that Cu, Cr, Pb, Cd and Mn were present in higher concentration as compared to their permissible limits. As an essential nutrient, chromium is bio accumulated by a variety of aquatic organisms (**Moore *et. al.*, 1984**). Water hardness, temperature and to some extent pH affect the bioaccumulation of chromium by aquatic organisms (**Faust *et.al.*, 1981**).

### Mercury

Mercury is a liquid metal that is used in cell batteries, fluorescent lights, switches and other control equipments. It has been well known as an environmental pollutant. It can enter water supply by industrial and consumer waste or even from acidic rain, breaking down soils and releasing heavy metals

into streams, lakes, rivers and groundwater. Excess mercury in water can lead to loss of muscle control, kidney disease and brain damage. The observations of the present study indicate that maximum concentration of mercury is present at **S1** sampling station during the post monsoon season whereas minimum concentration was present at **S5** sampling station during the pre monsoon season. Organic compounds of mercury, for example methyl mercury when it enters the human body, concentrates in the brain and destroys the brain cells, damaging the central nervous system, and also causes corrosion and ulceration of the digestive tracts, **Bowen H.J.M., 1996**. Among the heavy metals, mercury is considered as the most dangerous pollutant to natural environment because of the ability of plants and animals to accumulate it (**Porvari and Verta, 2003**) and because of its detrimental effects even at very low concentrations (**Nriagu, 1979**).

### CONCLUSION

Studies carried out in the present investigation revealed that the concentration of a few heavy metals, specifically increases in the post monsoon season that is actually the period after idol immersion. The concentration of lead, which is a chief constituent of paints used for decoration of idols showed a significant increase in the post monsoon period specifically at Prempura Ghat which is chiefly used for the purpose whereas other sampling sites were generally not much affected. An increase in the concentration of copper might be attributed to runoff water from the catchment areas nearby where use of chemical fertilizers is prevalent. Besides, the water quality in terms of heavy metal concentration is not worst although it is alarming and by adopting proper measurements it can be controlled.

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