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Heavy Metal Profiling Of Hussain Sagar Lake For Forensic Consideration

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Abstract:
Heavy metals are a group of toxic elements that have detrimental effects on human health and the environment. Their presence in water bodies is a major concern, as pollution caused by heavy metals can have severe consequences. Heavy metals such as lead, mercury, cadmium, and chromium are commonly found in industrial effluents, agricultural runoff, and domestic waste. Improper disposal and inadequate treatment of these pollutants result in their accumulation in water bodies. Hussain Sagar Lake over the years has faced the brunt of pollution, primarily due to untreated industrial effluents and domestic sewage discharged. This study focuses on analysis of heavy metals, encompassing the identification of the heavy metals present in the water outlet and water body of Hussain Sagar Lake. Subsequently, a comparative assessment of the heavy metal quantities in the collected sample is conducted for forensic purposes. In this study, samples were subjected to heavy metal analysis using Atomic Absorption Spectroscopy (AAS) for the detection of heavy metals.

Key Word*: Heavy metal, Pollutant, Hussain Sagar Lake, Forensic significance*

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I. Introduction

The protection and restoration of urban lakes and wetlands are in extremely poor condition in Hyderabad. Within the last 12 years, Hyderabad has lost 3245 hc. area of its water in the form of lakes and ponds. Almost all urban water bodies in India are suffering because of pollution due to disposing of untreated local sewage, industrial waste water and solid waste. In many cases the water bodies have been ultimately turned into landfills. Heavy metals, also known as trace metals, are one of the most persistent pollutants in wastewater **(Kumar *et al.*, 2015)[1].**

Heavy metals are a group of elements characterized by their high density and atomic weight. Although there is no strict definition for heavy metals, some commonly recognized ones include lead (Pb), mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), and nickel (Ni) **(Singh *et al.*, 2011)[2].** These metals are found naturally in the Earth's crust but can also be released into the environment through human activities such as industrial processes, mining, and the burning of fossil fuels. Heavy metals bio accumulates at a rate faster than they can be eliminated by an organism. When heavy metals enter an ecosystem, they can be taken up by plants through their roots or absorbed by aquatic organisms from water. This process continues as organisms at higher trophic levels consume those lower in the food chain, leading to the concentration of heavy metals in higher-level consumers.

Acute heavy metal intoxications may damage central nervous function, the cardiovascular and gastro intestinal (GI) systems, lungs, kidneys, liver, endocrine glands, and bones. It is not possible to completely avoid exposure to toxic metals. Even people who are not occupationally exposed carry certain metals in their body as a result of exposure from other sources, such as food, beverages, or air **(Nagar *et al.*, 2021)[3].**

Heavy metals have toxic effects even at low concentration, which may prove lethal to any living being. The toxic effects of heavy metals are long lasting, reason being the non-degradation properties of heavy metals. The known fatal effects of heavy metal toxicity in drinking water include damaged or reduced mental and central nervous function and lower energy level **(Mohod *et al.*, 2013)[4].**

II. Methdology

Collection of Water Sample: The samples were collected from five outlets of effluent discharge point

leading into Hussain Sagar Lake, as well as directly from the lake itself. 500ml of water sample were collected from each individual effluent outlet, along with five separate water samples obtained from the primary lake source. Subsequently these samples were digested and analytical analysis were done using Atomic Absorption Spectroscopy (Perkin Elmer Atomic Absorption Spectrophotometer AAnalyst 400).

Samples preparation: For digestion of samples, wet digestion method was performed. Firstly, 15ml of nitric acid is added to 15ml of water in 500ml beaker and was heated for up to 10 mins in hot plate at 90°C. Then the solution is cooled and 10ml of conc. Nitric acid is added and heated at 90°C for 25mins. The sample was cooled again and 2ml of deionized water and 5ml of 30% hydrogen peroxide were added. Then 10ml of concentrated hydrochloric acid and 15 ml of deionized water was added and the sample was heated for additional 10 min without boiling. The sample was cooled and filtered through a Whatman No. 42 filter paper and diluted to 40 ml with deionized water.

III. Results

The content of heavy metal in samples of effluent discharge as well as lake water was subjected to quantitative analysis using Atomic Absorption Spectroscopy (AAS) to determine the concentration of heavy metals. After performing AAS analysis the result revealed that the samples collected from effluent discharge point contained the following concentrations (in ppm) 0.00480 lead, 0.00706 cadmium, 0.00622 nickel and 0.00100 chromium. In contrast, the concentration of heavy metal in lake water was found to be 0.07880 lead, 0.01012 cadmium, 0.00906 nickel and 0.00100 chromium.

Fig: Heavy metal concentration (in ppm) of effluent discharge sample, water sample and WHO permissible limit.

Heavy metal	Effluent discharge point (in ppm)	Lake water (in ppm)	WHO permissible limit (in ppm)
Lead (Pb)	0.00480	0.07880	0.05
Cadmium (Cd)	0.00706	0.01012	0.005
Nickel (Ni)	0.00622	0.00906	0.01
Chromium (Cr)	0.00100	0.00100	0.05

In the analytical assessment it was found that the concentration of lead and cadmium in the lake water and the concentration of cadmium in effluent discharge point exceeded the permissible limit set by the World Health Organization (WHO), indicating a level of contamination that exceeds the safety threshold. The concentration of heavy metal nickel and chromium was detected at levels below the WHO's permissible limit.

It can be concluded that due to the bioaccumulation property of heavy metals (Pb, Cd), the concentration was found to be comparatively higher in the lake. Heavy metal analysis in water bodies holds significant forensic values by enabling, aiding in geolocation and facilitating compliance monitoring. It provides vital scientific evidence in environmental investigations, litigation and regulatory enforcement related to water pollution and its consequences.

Limnological studies on Hussain Sagar Lake have been conducted during 1998, 2004, 2008 **(Reddy *et al.*, 2013)**[5] and these studies have shown progressive deterioration in the sediment quality. The studies conducted on the lake revealed that there has been considerable increase of contamination level of lead and cadmium since past four decades and accumulation of pollutants in the lake bed in the form of sediments posing a potential threat of contributing pollution to the surrounding ground water.

IV. Discussion And Conclusion

After analysis of collected water samples from Hussain Sagar Lake it was found that the concentration of heavy metal (lead and cadmium) present was more than the permissible limit set by WHO, nickel and chromium was below the permissible limit. Heavy metals due to their persistent nature in the environment and its toxicity have substantial impact on forensic science and public health. These metals are known to bio accumulate in living organisms, which consequently leads to increased concentrations of these compounds at higher trophic levels. In forensic science heavy metals are vital markers for a number of investigations, by analyzing these metals crucial information can be obtained for locating contamination sources, identifying environmental crimes and even tracking bodies or objects. The detrimental effects of heavy metals on human health emphasize the necessity for strict control and monitoring.

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