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The Study of Heavy Metals in Sediments Sampled From Dal Lake

Faizanul Mukhtar*, Hamida Chisti

Department of Chemistry, National Institute of Technology, Srinagar, J&K, India, 190006

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Abstract

Water quality monitoring has been high priority to determine the current conditions of the water system. The fast-growing population, unmanageable urbanization, steep industrialization and improper utilization of water resources have led to the unmatched destruction of water quality throughout the globe. The present study evaluates some of the heavy metals sampled from Dal Lake on temporal basis. These sediments were sampled and analyzed for heavy metals by atomic absorption spectrophotometery. However, the observed heavy metal concentration in these sediments was below the recommended limits. Thus, monitoring of man-made pollution which may lead to ecosystem and food chain contamination is necessary.

Keywords: Water quality, Dal Lake, Sediments, Heavy metals, Temporal basis

Introduction

Water, a prime natural resource and precious national asset, forms the chief constituent of the ecosystem. Water is a universal solvent and the most plentiful substance on earth. The natural aquatic environments are characterized by a complexity seldom encountered in the laboratory. Natural waters indeed are open and dynamic systems with variable inputs of mass and energy. The flow of energy (solar radiations) from a higher to lower potential drives the hydrological and geochemical cycles. Lakes are subjected to various natural processes taking place in the environment, such as the hydrological cycle, silting etc. Storm water runoff and discharge of sewage into the lakes are two common ways that various nutrients enter the aquatic ecosystems resulting in the death of those systems [1]. Water quality characteristics of aquatic environment arise from a multitude of physical, chemical and biological interactions. A regular monitoring of water bodies with required number of parameters in relation to water quality not only prevents the outbreak of diseases but also help to mitigate occurrence of hazards. Fresh water systems are critical for the sustainability of all life [2]. However, the declining qualities of the waters in these systems threaten their sustainability. Lakes and surface water reservoirs are the planet's most important fresh water resources and provide innumerable benefits. They are used for domestic and irrigation purposes, and provide ecosystems for aquatic life especially fish, thereby functioning as a source of essential protein, and for significant elements of the world's biological diversity [3]. Heavy metals are important environmental pollutants and their toxicity is a problem of increasing significance for ecological, evolutionary, and environmental reasons [4]. This problem is not only currently acute but it is also becoming regressive day by day. In the long run, the effect of water quality destruction alters the delicate balance of the nature. Basically, the contaminants of water are classified as organic and inorganic pollutants. The inorganic pollutants consists mainly the heavy metals. According to environmentalists and researchers, the term "heavy metal" is often used in their research articles as a combined name for metals and semi-metals (metalloids) that have been associated with contamination and potential threat in terms of toxicity. However, as per the literature survey, the term heavy metal has never been appropriately defined by any established authoritative bodies such as IUPAC and reveals that the term "heavy metals" has been used inconsistently. Some authors define it in relation to density or specific gravity [5] others define it in terms of atomic mass or atomic number while some definitions have no clear cut explanation except toxicity. This term is misnomer because they are not all "heavy" in terms of atomic weight, density, or atomic number and some are not even entirely metallic in character e.g. arsenic (metalloid). Metals and metalloids due to their extensive use represent an important fraction of the pollutants. Several unforgettable historical episodes due to heavy metal contamination in aquatic environment have increased the awareness towards the menace of heavy metal toxicity. Metals can be distinguished from other toxic pollutants, since they are non-biodegradable and can accumulate in living tissues, thus becoming concentrated throughout the food chain. A variety of anthropogenic sources and industries are responsible for the release of heavy metals into the aquatic environment [6, 7]. Metal ions are natural components in the earth's crust and hence

Corresponding author: Faizanul Mukhtar, Department of Chemistry, National Institute of Technology, Srinagar, J&K, India, 190006, E-mail: kufaizan78614@gmail.com.

cannot be destroyed or degraded, so they are ubiquitous in the environments. Metal ions can be dispersed into the earth's elements: soil, water and air. Human use of metals has remarkably affected the environment after the industrial revolution, by the various industrial setups. There are numerous sources of metal ion pollution of the aquatic environments. However, mainly two sources natural and anthropogenic are responsible for pollution. Due to high mobility, solubility, persistency, toxicity and bio-accumulation tendency of the metal ions in aquatic ecosystems creates adverse effects on human health and environmental degradation [8-10]. One of the most famous and beautiful lakes of world, Dal lake, is a Himalayan urban lake surrounded by mountains on its three sides. Dal lake is situated at an altitude of 1,886m above sea level between $34^{o}6'$-$34^{o}10'$ N latitude and $74^{o}8'$ -$74^{o}9'$ E longitude, in the heart of the Kashmir valley on the north east of the state summer capital Srinagar. The lake is multi-basined comprising of four basins. Temporal study was carried to know the effect on the concentration of various heavy metal ions.

2 Materials and Methods

2-1 Sample collection and pre-treatment

The sampling network was designed to cover a wide range of determinates of key sites, which reasonably represent the water quality of the lake system. The sampling stations were selected based on ecological settings and human activities in the area. The samplings were done in year 2015. The top 20 cm of the bottom sediment samples were collected from each sampling station using the Eckman bottom sampler and kept in glass bottles (1 kg). The sediment samples (1 kg) were wet digested; then 25mL of the samples was prepared using 0.1N HCl. The concentrations of zinc (Zn), copper (Cu), Nickel (Ni), Iron (Fe) and Manganese (Mn) were determined using Atomic Absorption Spectrophotometer (AAS).

2-2 Chemicals and reagents

Triple distilled water was used throughout the work. All chemicals and reagents were analytical grade, Merck (Darmstadt, Germany). Standard solutions of these elements were prepared by dilution of 1000 ppm certified standard solutions.

3 Results and Discussion

Seasonal variation in different heavy metal concentration in the sediments of Dal Lake is presented in Table 1. Graphical representation of seasonal variation in different heavy metal concentration in sediments of Dal Lake is presented in Fig 1. The concentrations of variables displayed great seasonality. A remarkable high concentration of (Fe) iron, ranged from 8.91ppm to 11.92 ppm was present. The Fe content indicated that this metal was abundant in soil and rocks of catchment area from where the water reaches to the lake. As regards the effect of season on heavy metals concentration in sediments of Dal, concentration of metals like Fe, Zn, Cu, Ni and Mn were maximum during summer and rainy season while minimum concentrations were observed during winter season. This trend could be attributed to the evaporation of water from lakes during summer and subsequent dilution due to precipitation and run off from catchment area during rainy season. The variations in the concentration level of heavy metals are due to the variation of the solubility of the existing forms of metal in water as well as their availability in the immediate environment. Among metals the level of Zinc ranged from 0.654 to 0.845 ppm.

Table1: Heavy metal content in sediments during different seasons.

Season	Heavy Metals (ppm)				
	Fe	Zn	Cu	Ni	Mn
Summer	11.92	0.845	0.109	0.277	0.228
Rainy	11.82	0.819	0.100	0.001	0.141
Winter/Autumn	8.91	0.654	0.010	0.001	0.061

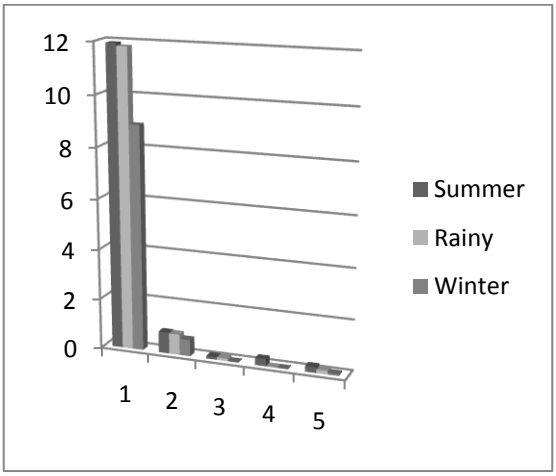

Fig 1: Heavy metal content in sediments during different seasons

A certain degree of variation was observed in zinc concentration. In natural water system Zn remains as either hydroxide or carbonate form with having almost same solubility which is higher than solubility of majority of the existing forms of other metals. This could be the reason for comparatively higher values of Zn in studied lake water. The concentration of Cu ranged from 0.010 to 0.109 ppm and was well within the permissible of WHO (2 ppm). The Ni concentration ranges from 0.001 to 0.277 ppm. Sources of Ni may include electronic components, utensils and their washings. Mn concentration varies from 0.061 to 0.228 ppm.

4 Conclusion

The heavy metal concentration in studied lake showed distinct temporal variations. There was significant seasonal variation in metal concentration within the study period. The dry season registered elevated levels of metals as compared to wet season. Dilution effect of rainy season due to storm run-off into receiving lakes and excessive evaporation of surface water with its attendant pre-concentration of most of metals may be responsible for

observed trend. The results of study have indicated gross pollution of lakes especially regards heavy metals. The average level of metals followed the order Fe > Zn > Mn > Ni > Cu. Through some of detected heavy metals are beneficial for human and plants up to a certain limit; it may be harmful beyond that. The findings of this study could serve as water quality data base for the study area for future water project developments and further research.

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