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STUDIES ON THE MOBILITY OF THE HEAVY METALS IN THE RIVER GANGA AT MIRZAPUR

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ABSTRACT

Contaminated water sample were collected from five different sites of the river Ganga in Mirzapur District between Chunar and Adalpura. The quantitative estimation of Cu, Fe, Zn, Pb and Ni was carried out for a period of 12 months. The metal ion contribution were found higher in sediments (contaminated sample) than water samples. Pb and Ni were detected only in the sediment of midstream. The increased level of metals might be due to adsorption of cations by organize matter as a result of negative charge of colloids and sedimentation.

Key words : Mobility, Heavy metals, Water quality, Contamination.

INTRODUCTION

Environmental pollution with metal perhaps began with the discovery of fire and gradually aggrevated to its present alarming level with industrial development and advancement of the society. Domestic effluent contains huge amount of heavy metals and its ions. Industrial effluents and domestic drains form different colloids due to adsorption.

The reports on the incidence of Minamata and Itai-Itai diseases due to Hg and Cd pollution in Japan has attracted the attention of several scientists to take up studies on the dynamics of heavy metals in aquatic systems[1].

Commonly heavy metals are those metal, which have specific gravities of approximately 5 gm/cm^3 or more. Most of these heavy metals are required in trace level for biochemical reactions in living cells. If they exceed the permissible limits, then they become lethal to the cells. Reports are available on studies of heavy metals in water, plankton, sediment and in animal tissues.[2-4] Surprisingly, analysis of the river water shows that the heavy metals are present with in the permissible limit, where as the total heavy

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metal concentration of the sediment is in considerable amount.

The objective of the present work was to determine the heavy metals in Ganga river water and sediment in order to estimate the health implication and to maintain the aquatic biota.

EXPERIMENTAL

Materials and methods

Water samples were randomly collected from the sampling sites (upstream entry point of the river into the city Sikhar Ghat), Midstream, Adalpura Ghat and downstream Chunar Ghat at a distance of about 5 meter inside the river-from bank and at depth of about 0.25 meter in the third week of each month from June 2006 to July 2007 and brought to the laboratory for the analysis of various metals (viz. Cu, Fe, Zn, Pb and Ni) using methods as described in Standard Methods for the Examination of Water and Waste Water[5].

Table 1: Heavy metal contents of river water (Data presented are mean of three replicates with S. D.)

Sampling sites	Heavy metal concentration (mgg^{-1})				
	Cu	Fe	Zn	Pb	Ni
Upstream (Sikar Ghat)	0.240 ± 0.025	0.233 ± 0.008	0.482 ± 0.052	0.044 ± 0.005	0.105 ± 0.008
Midstream (Adalpura Ghat)	1.820 ± 0.051	1.447 ± 0.042	1.903 ± 0.035	0.091 ± 0.015	1.129 ± 0.025
Downstream (Chunar Ghat)	1.461 ± 0.050	1.713 ± 0.112	0.970 ± 0.022	0.674 ± 0.005	0.454 ± 0.012

All laboratory glasswares were precleaned by soaking in 10 % HNO_3 and reagents used were of AR grade. Colleted water samples were filtered through 0.45μ membrane to remove suspended particles and the samples were stored in prewashed polythene bottles.

Sediment samples were collected by inserting a fiberglass core to upper 2-3 cm. layer and filled in polythene bags. Samples were carried out to laboratory and pretreated by drying and sieving methods before analysis. Heavy metals in sediment were analyzed by following the procedure described by Rao[6].

Table 2: Total metal analysis of river sediment (Data presented are mean of three replicates with S. D.)

Sampling sites	Heavy metal concentration (mgg^{-1})				
	Cu	Fe	Zn	Pb	Ni
Upstream (Sikar Ghat)	0.417 ± 0.120	0.679 ± 0.085	0.894 ± 0.165	ND	ND
Midstream (Adalpura Ghat)	2.872 ± 0.115	1.865 ± 0.176	2.906 ± 0.185	0.250 ± 0.143	0.925 ± 0.150
Downstream (Chunar Ghat)	2.020 ± 0.425	2.220 ± 0.321	1.940 ± 0.225	ND	ND

ND = Not detected

RESULTS AND DISCUSSION

Annual average concentrations of metals in the Ganga river water and sediment at different sampling stations for 2006 to 2007 are given in Tables 1 and 2, respectively.

An average annual dissolved copper level in the river Ganga water was 0.240 + 0.025 mg L^{-1}, 1.820 + 0.05 mg L^{-1} and 1.460 + 0.050 mg L^{-1} in upstream midstream and downstream, respectively. Copper content was found more in sediments when compared to its corresponding water samples. Copper in sediment was found 0.4170 + 0.120 mgg^{-1}, 2.872 + 0.115 mgg^{-1} and 2.02 + 0.425 mgg^{-1} in upstream midstream and downstream, respectively. Highest concentration of copper was observed during May and June and minimum during January and February.

Average concentration of iron (Fe) in river water was recorded highest in midstream followed by downstream and upstream. The average mean concentration was 0.233 + 0.08 mg L^{-1}, 1.447 + 0.042 mg L^{-1} and 1.713 + 0.112 mg L^{-1} in up, mid and down stream, respectively. The highest concentration was recorded in May and June and lowest in August and September. Low contents, of iron in rainy season might be associated with dilution of the river water. Sediments showed the highest value 1.865 + 0.176 mgg^{-1} at midstream in May. Higher concentration of iron may be associated with metallic ashes filtration activities and iron bacteria during decomposition.

The lead (Pb) concentration was 0.044 + 0.005 mg L^{-1} (upsteam) 0.091 + 0.015 mg L^{-1} (midstream) and 0.091 + 0.005 mg L^{-1} (downstream). The highest value of lead was recorded in midstream and in summer months (May and June). It was not detected in sediment of any sampling sites except midstream (0.250 + 0.143 mg L^{-1}) in month of May.

Zinc followed the cyclic trend like other studied metals. Zine concentration in river water and sediment was highest in midstream followed by downstream and upstream. High level of zinc was noticed during February and March in river water and May in sediment samples. The increased level in sediment may be due to settlement through absorption and accumulation.

The average mean concentration of nickel in the river water ranged from 0.105 + 0.008 mg L^{-1} to 1.129 + 0.025 mg L^{-1} with highest value in midstream. Nickel was detected in sediment sample of midstream (0.925 + 0.150 mg L^{-1}) in the month of May.

The highest level of metals in summar months may be due to slow flow and reduced water level, while reduction in metal concentration in rainy season might be due to dilution as a result of rain. The concentration of heavy metals depends on its organic matter content and pH as most of the heavy metals depends on its organic matter content and pH as most of the heavy metals are precipitated at pH above seven[7]. Adsorption of cations by organic matter is due to negative charge of colloids and settling to bottom in the form of sediment[8]. The low concentration of metal in river water compared to relatively more contaminated states of underlying sediment, has been observed in this study, which show that river sediment serves as an important storage compartment for heavy metals released into the aquatic environment either by adsorption, precipitation or chelating mechanism and thus, reflects the water quality.

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