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Trace Metal Concentration in Water of the Karnaphuli River Estuary of the Bay of Bengal

Biplob Das, Yusuf Sharif Ahmed Khan and Mohammad Abdul Karim Sarker
Institute of Marine Sciences, University of Chittagong, Chittagong-4331, Bangladesh

Abstract: A study was conducted for the determination of some trace metal (Cr, Mn, Zn, Ni, Cu, Pb, Cd and Fe) concentrations in water of the Karnaphuli River estuary analyzing seasonally viz., pre-monsoon, monsoon and post-monsoon by employing air acetylene flame in combination with single element hollow cathode lamps and atomic absorption spectrophotometer. Sub-surface water samples were collected from 4 stations namely Mouth, Naval base, Sadarghat and Kalurghat regions of the Karnaphuli River estuary. The concentrations ($\mu g\ g^{-1}$ dry weight) of Cr, Mn, Zn, Ni, Cu, Pb, Cd and Fe were found to range from 0.421 to 0.925, 0.498 to 1.372, 0.472 to 1.186, 0.356 to 0.865, 0.372 to 0.973, 0.405 to 1.195, 0.090 to 0.217 and 20.025 to 42.203 respectively. The concentrations of Pb, Cu, Fe, Ni and Cr were observed higher and concentrations of Mn and Cd were found lower than that of the recommended values. It is assumed from the analytical findings that the estuary has been polluted from domestic sewage, land washout, river run-off and shipping activities.

Key words: Trace metals, Karnaphuli river estuary, bay of Bengal, pollution, sewage

Introduction

Bangladesh has a large coast line of about 720 km offering a good potential for exploitation of coastal and estuarine water for fishery resources, production of salt, navigation, etc. but the water body of River, estuary and sea is impacted much due to accumulation of wastes from agricultural land, urban areas and industries. ESCAP (1987) and DOE (1990), etc. reported on environmental condition of some rivers and water bodies of Bangladesh. Metal concentration on aquatic environment is of serious concern due to the toxicity of metal and their accumulation in aquatic habitats. The natural concentrations of metal lie in an order of magnitude between about 10^{-5} and 10^{-8} gm/l. Generally Rivers contain higher concentration of dissolved metals than seawater.

The Chittagong city is expanding and developing with the addition of population, industrial activities, agricultural practices and other infrastructures, as a result a large amount of industrial effluents, municipal wastes and oil and grease are discharged into the Karnaphuli River without any treatment through different drainage systems. These large volumes of organic and inorganic substances change the chemical characteristics of the water body by producing toxic substances and ultimately pollute the Karnaphuli River estuary.

However, information on the distribution of trace metals in the Karnaphuli river water is very limited. The present study has been carried out seasonally to determine the concentrations of Cr, Mn, Zn, Ni, Cu, Pb, Cd and Fe in the water of the Karnaphuli River estuary, Bangladesh.

Materials and Methods

Description of the investigated area: The study was carried out in the Karnaphuli River estuary during the period of July '97, November '97 and March '98, which were considered as the representative of monsoon, post-monsoon and pre-monsoon respectively. The samples were collected from four stations namely Mouth, Naval Base, Sadarghat and Kalurghat.

Collection of water sample: Sub-surface seawater samples were collected seasonally by using a Rutner sampler of fibreglass made.

Preservation of sample: The water samples were kept in acid-washed glass bottles, acidified immediately after collection with the addition of 2 ml ultra pure HNO_3 per liter of seawater (Morley *et al.*, 1993) and then carefully preserved in a refrigerator at 40°C for laboratory analysis.

Digestion of samples: Two hundred and fifty ml of well mixed acidified water samples were kept in Pyrex backer and evaporated the samples on water bath (temperature above 100 ° C) placing watch glass on each beaker to about dryness. Five ml concentrated HNO_3 was added in each beaker and digested on water bath and filtered by a filter paper (Quantitative Whatman 541) and was made the filtrate to 25 ml with de-ionized water in a 25ml volumetric flask. Blank digestion was carried out for each sample.

Atomic absorption spectrophotometric measurement: The digested samples were analyzed by using air acetylene flame in combination with single element hollow cathode lamps into an atomic absorption spectrophotometer (Hitachi, A-1800). Finally sample was injected by an automatic sampler and the absorbance and concentration data were automatically printed out and displayed.

Results and Discussion

The maximum concentrations ($\mu g\ ml^{-1}$) of Cr, Mn, Zn, Ni, Cu, Pb, Cd and Fe were recorded as 0.925 (at station-3), 1.372 (at station-4), 1.186 (at station-3), 0.865 (at station-3), 0.973 (at station-1), 1.195 (at station-3), 0.217 (at station-1) and 42.203 (at station-3) respectively during monsoon (Table 1). The minimum concentrations ($\mu g\ ml^{-1}$) of Cr, Mn, Zn, Ni, Cu, Pb, Cd and Fe were found to be 0.421 at station-1 (during post- monsoon), 0.498 at station-2 (during post- monsoon), 0.541 at station-1 (during pre-monsoon), 0.356 at station-1 (during post-monsoon), 0.372 at station-2 (during pre-monsoon), 0.405 at station-1 (during post-monsoon), 0.090 at station-4 (during post-monsoon) and 20.025 at station-1 (during post-monsoon) respectively. Recommended values ($\mu g\ ml^{-1}$) of Cr, Mn, Zn, Ni, Cu, Pb, Cd and Fe from National Research Council, Canada (1995) for estuarine water (Code No. SLEW-2) are 0.169± 0.018, 17.1± 1.1, 1.10± 0.14, 0.709± 0.054, 1.62± 0.11, 0.027± 0.005, 0.019± 0.002 and 2.37± 0.37 respectively.

The results indicate that the concentrations of Cr, Ni (at station-3), Cu, Pd and Fe exceed the aforesaid recommended values while concentrations of Mn and Cd were lower than the recommended values and the concentration of Zn was found more or less the same in some stations (without few exceptions) with the aforesaid recommended value. Higher concentrations of trace metals might be due to discharge of untreated domestic sewage, agro-chemicals, industrial effluents, oil and grease and municipal wastes. Seasonal variation of Mn concentration was minimum, which worked in the north-eastern part of the Bay of Bengal and Pusser River estuary respectively. It is recorded maximum concentration of Zn as 0.887 ($\mu g\ ml^{-1}$) which less than the findings (1.86 $\mu g\ ml^{-1}$) of the present work at

Table 1: Seasonal variation of trace metal concentrations (μg Ml^{-1}) in water samples of the Karnaphuli River estuary

Station	Area	Season	Metal concentration (μg. ml^{-1})							
			Cr	Mn	Zn	Ni	Cu	Pb	Cd	Fe
1	Mouth	Pre-monsoon	0.573	1.174	0.541	0.493	0.390	0.563	0.139	26.316
		Monsoon	0.602	1.210	0.781	0.520	0.612	0.616	0.217	35.129
		Post-monsoon	0.421	0.686	0.625	0.356	0.391	0.405	0.119	20.025
2	Naval	Base	0.741	0.662	0.682	0.516	0.372	0.542	0.093	25.012
		Pre-monsoon	0.687	0.742	0.970	0.619	0.674	0.698	0.211	40.252
		Monsoon	0.429	0.498	0.472	0.510	0.449	0.437	0.129	23.168
3	Sadarghat	Pre-monsoon	0.572	0.121	0.932	0.697	0.543	0.916	0.192	31.021
		Monsoon	0.925	1.173	1.186	0.865	0.918	1.195	0.210	42.203
		Post-monsoon	0.721	0.972	0.852	0.811	0.903	0.876	0.185	22.193
4	Kalurghat	Pre-monsoon	0.809	1.071	0.731	0.685	0.711	0.772	0.159	35.325
		Monsoon	0.851	1.372	0.910	0.759	0.759	0.747	0.182	36.421
		Post-monsoon	0.512	0.983	1.112	0.891	0.891	0.675	0.090	28.120

station-3 (Sadarghat) of the Karnaphuli River estuary. This may be due to addition of Zn to the water body from industrial wastes and municipal run-off through 5 canals.

Seasonal variation of Cu concentration was minimum in all the stations except stations 3 and 4 (Table 1) but disagreed with the findings of Ouseph (1992), who worked on the dissolved and particulate trace metals in the Cochin estuary. Abdullah and Royle (1974), Zingede *et al.* (1976), Satyanarayana *et al.* (1985) and Shen *et al.* (1989) studied on the dissolved Pb and they reported that the main causes of its input to the river water might be due to industrial, municipal or surface discharges which is in well agreement with the present findings. The seasonal variation of Cd concentration was minimum, trace metal concentrations in the Karnaphuli River estuary and pollution status of the Fouzderhat coastal zone respectively.

The findings showed a little seasonal variation in the concentration of Fe, which is in well agreement with the findings of Ouseph (1992) who found the same variation in the concentrations of Fe in the Cochin estuary and Karnaphuli River estuary respectively.

The results of present analysis reveal that some trace metals (Cr, Fe, Ni, Pb, and Cu) exceeded the recommended values and gave little indication of metal pollution which did not reach the alarming condition, but if this trend of contamination continues, it may lead the quality of water of this area unfit for aquatic organisms in the long run. So, to prevent future adverse impact on this study area a restriction must be imposed on the discharge of trace metals through different sources.

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