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RESEARCH ARTICLE

SEASONAL VARIATIONS OF HEAVY METALS DISTRIBUTION IN THE SEDIMENTS OF KADUVAIYAR ESTUARY, NAGAPATTINAM COASTAL AREA, TAMILNADU, INDIA

[1]Saleshrani, K and [2]Prabhahar, C

[1]Department of Zoology, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India.
[2]Department of Zoology, Annamalai University, Chidambaram, Tamilnadu, India

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ABSTRACT

In the present investigation the levels of heavy metals were evaluated. In the sediments of Kaduvaiyar estuary, Nagapattinam Coastal area and South East Coast of India In this study, the heavy metals such as Zinc, Copper, lead, Cadmium, Chromium and Iron were analysed in the Sediment samples. The sample analysis was done by microwave assisted digestion and Atomic Absorption Spectro photometer (AAS).

INTRODUCTION

The hydrosphere accounts for a great areas of earth surface than the lithosphere and is divided into lakes, rivers, estuaries and oceans. Metals exist in the hydrosphere as dissolved materials and suspended particles and in areas of deposited sediments. Sediment in river and lakes accounts for the main sinks of heavy metal in the hydrosphere. Atmospheric deposition, soil leaching, runoff, erosion and breakdown of mineral deposits all contribute to the concentration of metals in natural water supplies. Metal accumulation is eagerly attributed differences in uptance and depuration period for various metals in difference fish species (Tawari – Fufeyin and Ekaye, 2007).

Another type of toxic pollution comes from heavy metals such as cadmium, mercury and lead. Recently, a highly toxic chemical called TriButylTin (TBT) is used in paints to protect boats from the ravaging effects of the oceans. The best known example of mercury metal pollution in the oceans took place in 1984, when a Japanese factory discharged a significant amount of this metal into Minamata Bay and after a decade the effect of mercury metal came to light. Minerals containing heavy metallic elements are of widespread occurrence in rocks and soils. When they are weathered, cations of the heavy metals are liberated and find their way into surface and soil water. Lead, copper and zinc have been extensively mined, and whose environmental levels have been strongly influenced by man. All are toxic to living animals and are considered as serious pollutants (Karadede – Akin and uniu, 2007). Malik *et al.* ,(2010) have reported that the trace amount of chromium is necessary for all the organism as it is needed for the proper utilization of iron and its conversion into haemoglobin excessive discharge of chromium into the aquatic environment can have an adverse effect both on animals and man who eat these animals as food. In animals, it reduces fertility.

Mohammed, (2009) have observed Copper is an essential trace element, which is widely distributed in nature and also widely used metal industries. Copper sulphate mixed with lime is used as a fungicide. Medicinally copper sulphate is used as an emetic, it is also used as an antiparasitic agent based on its astringent and caustic actions. Copper levels in human body vary with age. Copper levels in brain increase with age and Cu levels are high in new borns than in adults.

Dara, (2004) have reported Cadmium contamination of water may also come from use of metallic and plastic pipes, while super phosphate fertilizers, sewage sludge and automobile tyres also contain some amount of this toxic metal. The main problem with Cd in human nutrition is that the body does not completely excrete whatever Cd is absorbed. Cd in water at 10ppm level can kill fishes in one day while at 2ppm level they will be killed in 10 days. Hardness and salinity of water provides some degree of protection.

Human exposure to lead occurs primarily through drinking water, airborne lead-containing particles and lead based paints. Several industrial processes create lead dust and fumes. After lead is airborne for a period of 10 days it falls into the ground and becomes distributed in soils and water sources. Lead may cause fatigue, irritability, information processing difficulties, memory problems, a reduction in sensory and motor reaction (EPA, 1989).

Zinc is nutritionally an essential element and is required for the activity of a number of enzymes. Mining, processing and smelting of ores for the extraction of zinc constitutes the chief

* Corresponding author: + 91
E-mail address: mcprabhahar@gmail.com

source of zinc pollution in the environment. Zinc content in aquatic invertebrates in fresh unpolluted water ranges between 25-200mg per litre. Above 40ppm level this metal imparts a faint but definite metallic taste and milky appearance to fresh water (Asthana and Meera Asthana, 2005).

Increased loads of nutrients, heavy metals and other compounds like pesticides, fertilizers have resulted from changes in land use and anthropogenic development of the river basins. Since, rivers constitute the main inland water resources for domestic, industrial and irrigation purposes, it is imperative to prevent and control the river pollution and to have reliable information on the quality of water for effective management Farombi *et al.,* (2007).

MATERIALS AND METHODS

Heavy metals in the water samples were analyzed by adopting the procedure of Brooks *et al.*,(1967) Water samples were collected at monthly intervals (for a period of 12 months from July 2011 to June 2012) and were collected in precleaned and acid washed polypropylene and acid washed polypropylene bottles of one litre capacity and were immediately kept in an ice box and transported to the laboratory to avoid contamination. Water samples were then filtered through a Millipore filtering unit using a Millipore filter paper (pore size 0.45µm). The filtered water samples were reconcentrated with APDC-MIBK extraction by following the procedure of Brooks et al., (1967). The heavy metals in water were analysed in air-acetylenemic Absorption Spectrophotometer (AAS-Model 802), Undisturbed surface sediment samples were collected using a grab sampler placed in plastic containers for transport to the laboratory. Sample preparation for chemical analyses involved procedures for sub sampling during drying, sieving crushing and storage. All these steps were followed by adopting the methods Perkins and Altens Ga, (1979).

RESULTS

At Station 1 Minimum 19.36(mg/l) concentration of copper was recorded during summer season and the maximum 47.22(mg/l) during monsoon season. At Station 2, minimum Cu concentration 3.82mg/l was recorded during summer and the maximum 16.76(mg/l) during monsoon season. At Station 3, it was minimum 26.74(mg/l) during summer and the maximum 72.0(mg/)l during monsoon season.

Table 1 Mean values of heavy metal recorded in Kaduviyiar river sediment (station I) at Nagapattinam during the period from July 2011June2012.

METALS	PRE MONSOON	MONSOON	POST MONSOON	SUMMER
Copper. µg/g	27.18±1.08	3080.407±123.21	62.59±2.50	22.73±0.90
Zinc µg/g	16.42±0.65	18.39±0.91	16.09±0.67	9.71±0.90
Lead µg/g	0.85±0.03	1.46±0.07	0.75±0.03	0.48±0.01
Iron µg/g	0.72±0.02	0.9±0.04	0.69±0.03	0.46±0.01
Chromium µg/g	1.60±0.06	3.23±0.12	1.08±0.05	1.30±0.02
Cadmium µg/g	1.48±0.05	1.78±0.08	1.42±0.05	1.09±0.05

At Station 1, concentration of zinc in water ranged from 9.03(mg/l) to 19.33(mg/l) Minimum concentration (9.03 mg/l) was recorded during summer season and the maximum (19.33 mg/l) during the monsoon season. At Station 2, concentration of zinc in water ranged from (12.42mg/l) to (37.40 mg/l) with minimum concentration 12.42 mg/l during summer season and the maximum 37.40 mg/l during monsoon season. At Station 3, minimum concentration was recorded during summer season 21.03 mg/l and the maximum 35.02 mg/l during the monsoon – season. In general, minimum concentration of zinc in water was recorded during the summer and the maximum during the monsoon season at all the stations. Zinc was found to be high at Station 2. At Station 1, throughout the study period the lead in water was found to be Minimum 0.58 mg/l. At Station 2, lead in water was during Minimum 0.12 mg/l monsoon and maximum 0.73 mg/l during the pre - monsoon season. At Station 3, it was during post monsoon minimum 0.83(mg/l) and maximum 2.16 mg/l during the premonsoon season. Lead was found to be high at Station 3. At Station 1, concentration of Iron in water ranged from 0.3 mg/l to 0.73 mg/l. Minimum concentration 0.3(mg/l) was recorded during summer season and the maximum 0.73 mg/l during the monsoon season. At Station2, concentration of Iron in water ranged from 0.3 mg/l to 0.33 mg/l, with minimum concentration 0.3 mg/l during summer season and the maximum 0.33 mg/l during monsoon – season. At Station 3, minimum concentration 0.17 mg/l was recorded during summer season and the maximum 0.93 mg/l during the monsoon season. In general, minimum concentration of Iron in water was recorded during the summer and the maximum during the monsoon season at all the stations. Zinc was found to be high at Station 3. Station 1 registered minimum 0.99 mg/l and the maximum 3.97 mg/l values of chromium in water during summer and monsoon seasons respectively. Station 2 registered minimum 0.86 mg/l and maximum 4.3 mg/l values of Cr in water during post monsoon and monsoon seasons respectively. Station 3 respectively. Station 3 registered minimum 1.3 mg/l and maximum 5.2 mg/l values of Cr in water during post monsoon and monsoon seasons respectively.

In general, monsoon season recorded maximum values of Cr in water at all the stations. Chromium was found to be high at Station 3.At Station 1, cadmium was Minimum 0.14 mg/l during the premonsoon (September) season and the maximum 1.32 mg/l during monsoon season. At Station 2 minimum 2.87(mg/l) during the premonsoon season. At Station 3, it was Minimum 1.5 mg/l during post monsoon – and maximum 2.45 mg/l during the premonsoon seasons. Lead was found to be high at Station 3.

DISCUSSION

Mendil and Uluozlu, (2007) have reported that the concentration of heavy metals such as Copper, Zinc, Cadmium, Lead, Iron, Chromium and Manganese occur in marine seawater in different forms and in different concentrations. Heavy metals can enter a water supply by industrial and consumer waters or even from acidic rain, breaking down of soils and releasing heavy metals into streams, Lakes, Rivers and ground water (Nayag, 2006) who reported that the Heavy metals such as copper, zinc, cadmium, lead, iron, chromium and manganese occur in the marine water in different forms at different concentrations.

Pigments. Cadmium sulphide and selenide and are commonly used a pigments in plastics.

Rajappa *et al*. (2010) who reported that the Lead concentration was more during the monsoon in both stations due various sources of pollutions paints diesel fuel combustions pipes and solder discarded batteries and Natural deposits. Lead reduces

Table 8 Mean values of heavy metal recorded in Kaduvaiyar sediments (station II) at Nagapattinam During the period from July 2012June2012.

METALS	PRE MONSOON	MONSOON	POST MONSOON	SUMMER
Copper. µg/g	4.56±0.09	16.04±0.32	12.57±0.25	10.82±0.32
Zinc µg/g	13.24±0.04	36.37±1.8	36.38±0.09	16.81±0.67
Lead µg/g	0.38±0.01	0.63±0.01	0.14±0.00	0.24±0.01
Iron µg/g	8.20±0.32	0.23±0.01	4.98±0.09	2.91±0.05
Chromium µg/g	0.82±0.01	0.31±0.01	0.18±0.00	0.11±0.00
Cadmium µg/g	0.91±0.03	0.61±0.02	0.26±0.01	0.41±0.02

Dural *et al*. (2006) have reported that the Copper concentration was maximum during the monsoon seasons and minimum during the pre-monsoon. Such a seasonal variation of Cu concentration in sediments perhaps was due to the presence of major sources of metal pollution, intensive of human activity. All over the world discharge of domestic wastes and land run-off reaching the coastal area and also industrial effluents, sewage outlets and municipal wastes at Nagappattinam town. Phytoplankton activity might have also facilitated the seasonal variation in Cu as this metal is an essential one for phytoplankton. Fungicides and algalcides are used in the papers form mould developments, these Preparations contain copper compounds.

functions, hearing loss, blood disorders, hypertension and death may due to high level. Iron-concentration was more during the monsoon season in stations due to various sources of pollution leaching of cast iron pipes in water distribution system and by natural process. The effects of iron is to brackish colour, rusty sediment, better or metallic taste, brown green strains iron bacteria and discoloured beverages.

Rajappa *et al.* (2010) Who observed that the Chromium is highly toxic and responsible for several cases of poisoning through food. Small quantities of cadmium cause adverse changes in the arteries of human kidney. It replaces zinc biochemically and causes high blood pressures, kidney

Table 9 Mean values of heavy metal recorded in Coastal sediments (station III) at Nagapattinam During the period from July 2012June2012.

METALS	PRE MONSOON	MONSOON	POST MONSOON	SUMMER
Copper. µg/g	27.8±1.11	121.01±6.05	37.51±1.48	28.1±1.4
Zinc µg/g	27.30±1.09	33.80±1.69	24.66±0.72	21.59±0.64
Lead µg/g	1.36±0.06	2.07±0.08	1.35±0.02	0.95±0.03
Iron µg/g	0.11±0.01	0.93±0.03	0.38±0.01	0.65±0.02
Chromium µg/g	1.13±0.05	1.37±0.05	1.28±0.06	0.05±0.01
Cadmium µg/g	1.03±0.04	1.23±0.04	1.7±0.06	1.37±0.04

Rejomon *et al.* (2010) who reported that the Zinc concentration was high during the monsoon at both stations. High Zn concentration in water could have resulted due to the release of this metal from the sediments and abundant organic matter. Zn Concentration was low concentration during the summer season at both the stations. This would have resulted due to the utilization and uptake of Zn along with other nutrients by the biota including phytoplankton. (Gomez – Ariza *et al*., 2000) have also established that Zn could get strongly depleted from the surface waters as it has a nutrient type of distribution in seawater. Excessive intake of zinc may lead to vomiting, dehydration, abdominal pains, nausea, lethargy and dehydration.

Cadmium concentration was more during the monsoon at the both stations less during the summer season at both the stations. According to Eaton (2005) Cd is released into the atmosphere by fossil fuel and by the burning of agricultural and municipal wastes, including dried sewage sludge. It is used in nickel cadmium batteries PVC plastic and Paint

industrial discharge and Geological mining sites both stations show chromium concentrations high in monsoon season. A number of toxic elements are introduced into the aquatic environment from the effluents coming from the large industries resulting biodiversity and changes in water quality. For example effluents from textile mills and electroplating contained as much as 20-40ppm of chromium (Asthana and Meera Asthana, 2005).

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