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RESEARCH ARTICLE

ASSESSMENT OF HEAVY METAL CONCENTRATION IN SEDIMENTS FROM UPPANAR ESTUARY (SIPCOT), CUDDALORE COAST, BAY OF BENGAL, INDIA

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ABSTRACT

The Uppanar estuary runs behind the SIPCOT complex which is located at Cuddalore. The present study was conceded out to conclude the heavy metals in sediments samples Uppanar Estuary, Cuddalore, Southeast coast of India. The data obtained during period January to December 2012 reveled that six heavy metals of two stations. The minimum and maximum values of heavy metal ranges in sediment Iron, Copper Zinc, Cadmium, Chromium and Nickel were 1.88 to 6.48 and 1.24 to 6.32; 0.35 to 1.37 and 0.25 to 1.32; 0.35 to 1.25 and 0.31 to 1.12; 0.13 to 0.52 and 0.12 to 0.36; 0.13 to 0.68 and 0.12 to 0.53 and 0.11 to 0.69 and 0.09 to 0.53 at the two stations with minimum and maximum mean values of 4.60±1.78 (S1) and 4.31±1.87 (S2); 0.95±0.38 (S1) and 0.81±0.37 (S2); 0.74±0.28 (S1) and 0.66±0.25 (S2); 0.32±0.12 (S1) and 0.27±0.09 (S2); 0.35±0.20 (S1) and 0.28±0.18 (S2); 0.33±0.20 (S1) and 0.26±0.14 (S2) values was respectively. The results indicate that industrial growth has affected the aquatic environments and normal monitoring will help to adopt severe pollution control measures for better managing of the aquatic area.

INTRODUCTION

Heavy metals are initiated to the marine environment by domestic and industrial actions as pollutants. A lot of this input eventually accumulates in the estuarine zone and continental shelf, which are important sinks for suspended matter and associated land-derived contaminants. The pollution of aquatic and terrestrial ecosystems with heavy metals is a major environmental trouble. Some of these metals are potentially toxic or carcinogenic at enough concentrations and can cause serious human health hazards if they enter the food chain. Heavy metals in the sediment are essential to assess the extent of metal pollution. The distribution of heavy metals in solution has widely been recognized as a major factor in the geochemical behavior, transport and biological effects of these elements in natural waters (Ananthan *et al.*, 1992, 2005, 2006; Karthikeyan *et al*., 2004, 2007). Moreover, sediment has aptly been called as 'Trace element trap' (Eugenia *et al.*, 2004) because they eventually receive almost all the heavy metals, which enter the aquatic environment (Karthikeyan *et al*., 2007).

Such accumulation takes place by biological and geochemical mechanisms (Karbassi and Amirnezhad, 2004). Evaluation of heavy metal concentration in the coastal waters can be made by using indicator organisms (Chernova *et al.,* 2002; Thangaradjou *et al.,* 2010) which accumulate pollutants proportionally to their environmental condition (Lyngby and Brix, 1987). Estuaries are geochemical reactors and their varied reaction determines the destiny of metals of continental source to the ocean this aspect has been studied extensively during the last two decades (Klinkhammer and Bender 1981; Apte *et al*. 1990). Heavy metal pollution in the marine environment including esturine, back waters and coastal waters were investigated by several workers (Ramesh *et al.,* 2006; Thangaradjou *et al.,* 2010). However, literature on the concentration of heavy metals in seawater and sediments is scanty (Palanichamy and Rajendran, 2000).

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Fish is significant for a healthy diet, since it is low in fat, high in protein and wealthy in essential nutrients. However, after fish tissues accrue metals in various concentrations, and when that exceeds the safety levels, the toxic metals reach the human body and cause different unidentified carcinogenic diseases. For this reason, fish consumption could become a main way to metal revelation and following risk for human health (Ulozlu *et al.,* 2007). Fishes of the aquatic ecosystems accumulate the microelements in their organs through their life span, which may reflect the hydro chemical conditions of the water bodies (Alliot 1990).

Accumulation of these elements in fish tissue depends on many factors like properties of microelements, species of fish, age, physiological state and the season (Catski 1999). However, the effective dose of microelements was determined by their absorption in the ambient environment (Moiseenko *et al.,* 2004). As part of a complete study in the aquatic regions of industrial zones of Tamil Nadu State, a study was undertaken from 2001, which expose enhancement of trace metals in sediments all along the Uppanar River located south of Cuddalore town (Ayyamperumal *et al*., 2006). The present study focus on the level of dissolved trace metals in both the environments off Cuddalore, southeast coast of India. The results will also be useful for pollution monitoring program along the river, coastal region and also to check the rank of dissolved trace metals.

MATERIALS AND METHODS

The Uppanar estuary is situated at Cuddalore (Lat.11/ 43'N, Long. 79/ 46' E) is at an average height of about 1 m above sea level. It is transient through the Industrial coastal town of Cuddalore on the southeast coast of India. The Uppanar River runs similar to the coast south of Cuddalore town and a number of small streams of domestic, treated and unprocessed effluents from industries join the coast through the river. The major industries along the western bank of Uppanar River contain chemicals, beverage industrialized, tanneries, oil, soap, paint production, paper, and metal processing plants; all industries are located along its western bank.

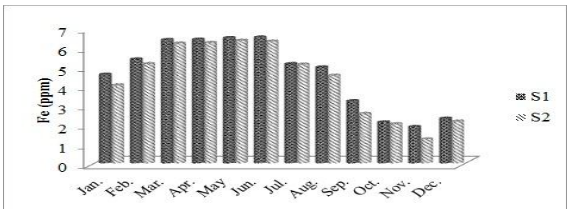

Fig.1. Monthly variations of Iron in two stations during the study period

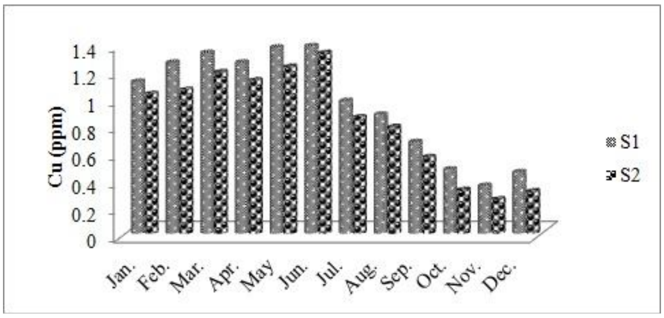

Fig.2. Monthly variations of Copper in two stations during the study period

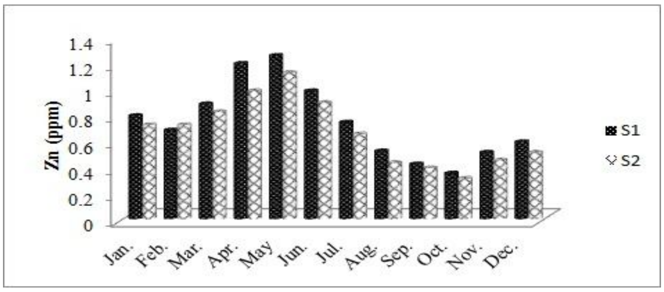

Fig.3. Monthly variations of Zinc in two stations during the study period

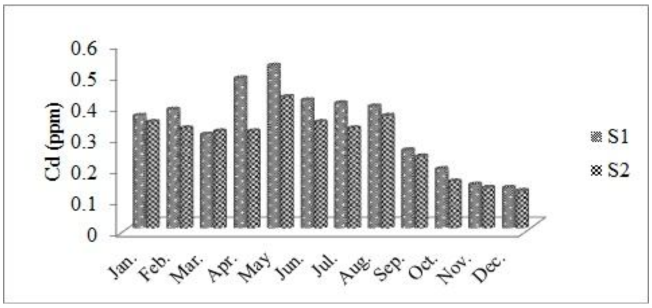

Fig.4. Monthly variations of Cadmium in two stations during the study period

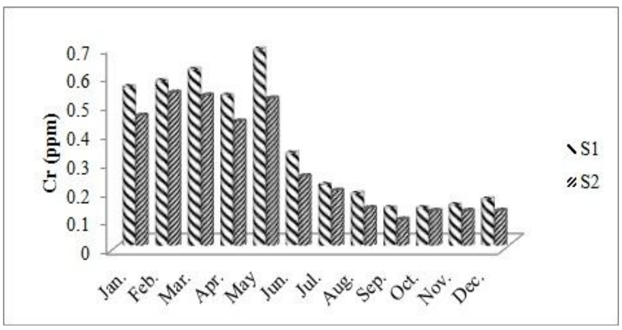

Fig.5. Monthly variations of Chromium in two stations during the study period

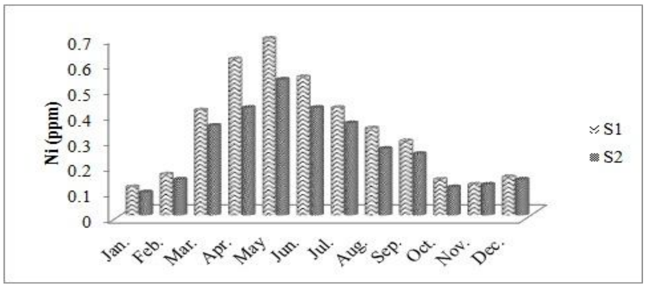

Fig.6. Monthly variations of Nickel in two stations during the study period

For the present study two sampling sites were chosen. Station 1 is 1 km away from the mouth of the Uppanar estuary SIPCOT (State Industrial promotion Corporation of Tamilnadu) industrial complex and the mouth of the estuary sets station 2. Monthly samplings were made during forenoon from January to December 2012 for four seasons viz. post-monsoon (January-March), summer (April-June), pre-monsoon (July-September) and monsoon (October-December). The dried sediment samples were ground well in a mortar and it weighed in 1.00 g samples were taken for heavy metal analysis. For the extraction of metals, acid digestion procedure was used following Walting (1981). Analysis for trace metals was continued by digesting the sample from which 1.00g was taken and digested with a mixture of 1 ml conc. H_2SO_4, 5 ml conc. HNO_3 and 2 ml of conc. $HClO_4$. The mixture was boiled, evaporated to near dryness. This was passed through a filter paper and made up to 25 ml with metal free double distilled water. The filtered sample was aspirated into the Atomic Absorption Spectrophotometer (AAS) and the reading was taken and the quantified metals are expressed in parts per million (ppm). The concentration of heavy metal such as Iron (Fe), copper (Cu), zinc (Zn), Cadmium (Cd), Chromium (Cr) and Nickel (Ni) was found out. The data are represented as mean ± standard deviation. All the data were analyzed statistically applying for all the studied parameters.

RESULTS

Iron in sediment sample values varied from 1.88 to 6.48 and 1.24 to 6.32 (Fig.1) at the two stations minimum and maximum mean values of 4.60±1.78 (S1) and 4.31±1.87 (S2). Copper in sediment values ranged between 0.35 to 1.37 and 0.25 to 1.32 (Fig.2) with minimum and maximum mean values ranged between 0.95±0.38 (S1) and 0.81±0.37 (S2). Zinc in sediment concentration varied from 0.35 to 1.25 and 0.31 to 1.12 (Fig.3) with minimum and maximum mean values ranges 0.74±0.28 (S1) and 0.66±0.25 (S2). Cadmium in sediment concentration varied from 0.13 to 0.52 and 0.12 to 0.36 (Fig.4) with minimum and maximum mean values ranges between 0.32±0.12 (S1) and 0.27±0.09 (S2). Chromium in sediment ranges between 0.13 to 0.68 and 0.12 to 0.53 (Fig.5) with minimum and maximum mean values ranges from 0.35±0.20 (S1) and 0.28±0.18 (S2). Nickel sediment values ranges from 0.11 to 0.69 and 0.09 to 0.53 (Fig.6) with minimum and maximum mean values ranges between 0.33±0.20 (S1) and 0.26±0.14 (S2). Sediments are vital sinks for land derived contaminants particularly heavy metals, and have been widely used to identify sources of pollution to estimate its extent and to diagnose the environmental quality of aquatic ecosystem (Tam, 1995). Concentrations of dissolved metals especially Fe, Cu and Zn were high concentration during summer and post monsoon season. Cd, Cr and Ni are higher concentration of summer season.

DISCUSSION

Usually, the normal sources of heavy metals in coastal waters are through earth and river runoff, and the mechanical and chemical weathering of rocks. The components also were washed from the atmosphere through rainfall, windblown dust, forest fire, and volcanic particles, adding to the distribution of heavy metals in water (Bryan, 1984). Low levels of Cu in the surface water during the monsoon could be due to the adsorption of Cu on to the particulate matter and consequent settlement to the bottom.

In sequence on heavy metal gathering in marine sediments is important for ecological studies (Lambshead *et al.,* 2000; Duineveld *et al.,* 2001). Heavy metals form an important abiotic component of marine ecosystem. These metals may connect with the sediment particles also by adsorption or complication and gradually go down with sediment or they may get released when mixed with marine water due to altered physico-chemical environment (Athalye and Gokhale, 1989). Zn and Cu always have a leaning to couple with organic carbon. Putrefaction of the organic matter remain are found to release heavy metals back to sediments and accumulated and this process might be responsible for the strong connection of Zn and Cu with organic carbon (Bardarudeen *et al*., 1996). Higher organic carbon values recorded in the summer season coincided with the elevated level of Zn and Cu in sediments. Besides the release of biologically bound heavy metals through influx from land runoff might have also contributed elevated level of Zn and Cu, despite they are meager in amount. Zn and Cu are generally good indicators of anthropogenic inputs (Forstuer and Wittman, 1979).

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