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TRACE METALS IN COASTAL WATER ALONG THE SHIP BREAKING AREA, CHITTAGONG, BANGLADESH

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Abstract: The levels of trace metals in surface water from the intertidal zone of ship breaking (Fouzdarhat, Madambibirhat and Kumira) and Halishahar (controlled zone) area, Chittagong were analyzed seasonally. The maximum concentration of Fe was found at Kumira varying from 65.710 to 67.900 $\mu\text{g ml}^{-1}$ while the minimum was observed in Station-4 (0.119 to 0.122 $\mu\text{g ml}^{-1}$). In case of Cu concentration, Fouzdarhat indicated the highest value ranging between 0.037 and 0.041 $\mu\text{g. ml}^{-1}$. The lowest concentration of Cu was found in Halishahar (0.018 $\mu\text{g. ml}^{-1}$) during pre-monsoon period. The level of Zn concentrations found in Fouzdarhat was twice the value observed in Halishahar. Cd concentrations were higher in Madambibirhat and Kumira in comparison with those at Halishahar. The concentration of different trace metals measured was found to be higher than the certified limit indicating deleterious effect on aquatic biota. However, concentrations of Pb were within the certified limit. The concentrations of trace metals in Halishahar (Controlled zone) were lower compared with those at ship breaking area. Besides, there were minimal seasonal fluctuations of trace elements observed in the studied four Stations. As per analysis and subsequent determinations the ship breaking area has been indicated as polluted zone.

Key words: Trace metal, Ship breaking, Coastal water, Pollution

Introduction

In natural aquatic systems, metal occurs in low concentration. However, the occurrence of metal contaminants in excess of natural loads has become a problem of increasing concern. This situation has arisen as a result of the rapid growth of population, increased urbanization, expansion of industrial activities, exploitation of natural resources, extension of irrigation and lack of environmental regulations. The problems associated with trace metal contamination were first highlighted in Sweden and Japan (Kurland *et al.*, 1960; Nitta, 1972; Goldberg, 1976). Potential toxic trace elements in seawaters are introduced to the marine environment by natural sources and as byproducts of various human activities.

In the offshore of the Bay of Bengal, Chittagong, the business of dismantling old, damaged and abandoned sea going ship, cargo and oil tanker has been practiced since 1980 (Islam and Hossain, 1986). The ship breaking industry covering 14km coastal area from Fouzdarhat to Kumira, Chittagong is now considered a booming industry. It is causing worries to the environmentalists as many pollutants such as oil and oil residue, lubricants and assorted junks and metals are thrown

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into the water, contributing to pollution. Metal contamination of the aquatic environment thus leads to deleterious effect from localized input, which may be acutely or chronically toxic to aquatic life within the affected area. Most published data on the effects of metals on aquatic organisms however provides the report of adverse effects at concentrations higher than acceptable limit (GESAMP, 1985, 1988).

Scanty information is available on the marine pollution of coastal area of the Bay of Bengal. The aim of the present investigation was to evaluate the concentration of trace metals (Fe, Cu, Zn, Cd and Pb) in the ship breaking area, Chittagong and to evaluate the environmental condition and level of pollution in that area.

Materials and Methods

About 14 km area along the ship breaking zone from Fouzdarhat to Kumira was divided into three Stations namely Fouzdarhat (Station-1), Madambibirhat (Station-2) and Kumira (Station-3). Another Station outside the ship breaking area near Halishahar Sea Coast was treated as Station-4 (Controlled Zone). Surface water samples from the intertidal zone were collected seasonally from the four Stations in pre-washed (20 ml HNO₃ and 0.5 ml H₂O₂) and pre-dried (65°C overnight) bottles (1 litre). To avoid bacterial degradation, the collected samples were mixed with concentrated HNO₃ and preserved in refrigerator (4°C) until analyzed. Samples were then brought to Chemistry Division, Atomic Energy Centre, Dhaka for spectrophotometric measurement of trace metals.

Water samples were then digested with nitric acid in a water bath at 55°C. Blank digestions were also performed with the result of a quantity for possible contamination. Prior to analysis of the digested samples of different trace metals, several dilutions were made. The digested samples were analyzed using Air Acetylene Flame with combination as well as single element Hollow Cathode Lamp and Atomic Absorption Spectrophotometer (Perkin Elmer560). The calculations were made with the help of calibration curve using standard solution of the elements (Fe, Cu, Zn, Cd and Pb) with known concentration.

Results and Discussion

Among the four Stations in the studied areas, highest concentrations of Fe were observed in Station -3. In this Station, there was not much variation in the concentration of Fe during different seasons which varied from 65.710 to 67.900 µg ml⁻¹ (Fig. 1). The higher concentration of Fe in this area was attributed to various types of refuse and disposable materials from the scrap ships. Ouseph (1992) observed highest concentration of Fe (0.001 µg ml⁻¹) in the Cochin estuary. However in the present investigation, the lowest concentration (0.119 µg ml⁻¹) of Fe in Station 3 was higher than the findings of Ouseph (1992). Results observed by Islam and Hossain (1986) were in agreement with the present investigation. The lowest concentration of Fe was observed in Station varying from 0.119 to 0.122 µg ml⁻¹ in different seasons. Lower values of Fe were due to no ship breaking activity in the controlled zone (Station- 4). The certified value of Fe for coastal water is 0.4 µg. ml⁻¹ (Martin and Whitfield, 1983). However, the present finding exceeded the certified value indicating harmful effect for the aquatic environment and the biota as well.

The maximum concentration of Cu was recorded as 0.141 at Station 3 and the lowest was 0.018 µg ml⁻¹ at Station- 4 (Fig. 2). It is also observed that the concentration of Cu in Station- 1 and Station- 2 were higher when compared with the connection at Station 4 (controlled zone). These higher concentrations were attributed to the ship breaking activities practiced along the sea beach (Station

1-3). Concentration of Cu at different Stations did not vary much during different seasons. These results did not correlate with the findings of Ouseph (1992) who observed higher fluctuations in Cu concentration during different seasons. The certified value of Cu for the coastal water in Bangladesh is $0.3 \mu\text{g ml}^{-1}$ (EQS, 1991) while the certified value recorded by Martin and Whitfield (1983) is 1 ng ml^{-1} . The present findings exceeded the certified value of Martin and Whitfield (1983) but was found to be lower than EQS (1991) certified value.

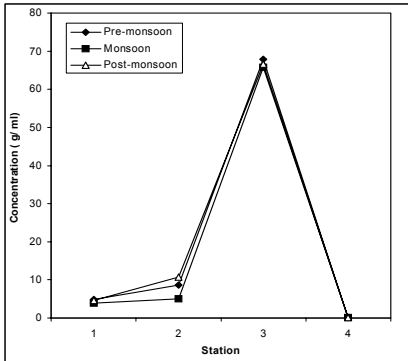


Fig. 1. Concentration ($\mu\text{g ml}^{-1}$) of Fe at different Stations.

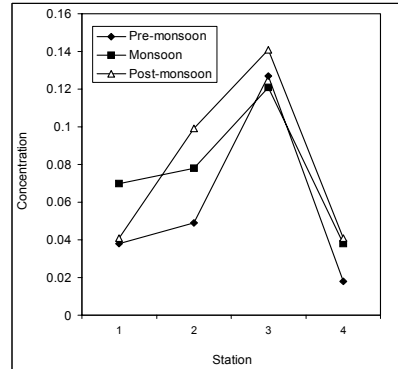


Fig. 2. Concentration ($\mu\text{g ml}^{-1}$) of Cu at different Stations.

The highest concentration of Zn was observed as $0.164 \mu\text{g ml}^{-1}$ during pre-monsoon and the lowest was $0.016 \mu\text{g ml}^{-1}$ in monsoon at Station-3 (Ship breaking Zone) and Station-4 (controlled zone) respectively (Fig. 3). In general, the concentration of Zn was always higher in the ship breaking area (Station 1-3) in comparison with that at controlled zone (Station-4). This higher concentration of Zn was due to ship breaking activities. Seasonal variation of Zn for the coastal water is $2.5 \mu\text{g ml}^{-1}$ (Martin and Whitfield, 1983) and $25.7 \mu\text{g ml}^{-1}$ (Quevauviller *et al.*, 1992) respectively. However the highest concentration of Zo in the present investigation was found to be very low ($0.104 \mu\text{g ml}^{-1}$).

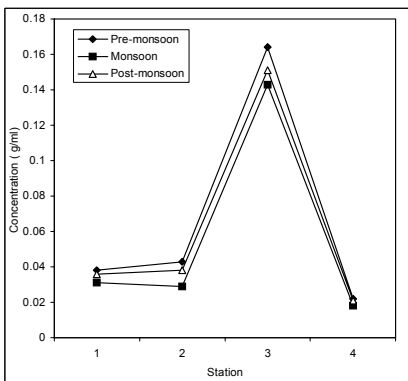


Fig. 3. Concentration ($\mu\text{g ml}^{-1}$) of Zn at different Stations.

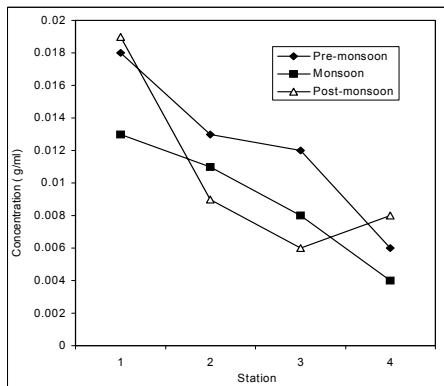


Fig. 4. Concentration ($\mu\text{g ml}^{-1}$) of Cd at different Stations.

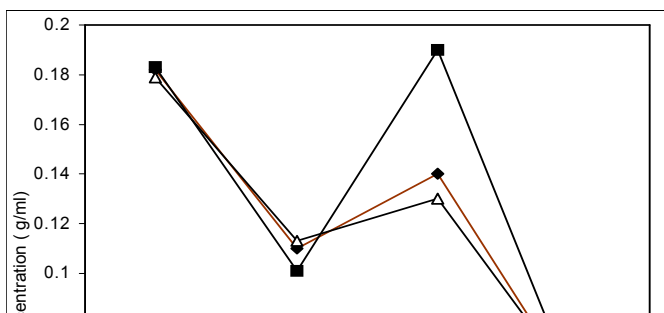


Fig. 5. Concentration ($\mu\text{g ml}^{-1}$) of Pb at different Stations.

It was observed that at Station 1, the concentration of Cd was found to be maximum ($0.019 \mu\text{g ml}^{-1}$) during post-monsoon period. While, the concentration of Cd was found to be minimum at Station 4 (controlled zone) during the monsoon period (Fig. 4). The concentrations of Cd in different seasons were minimum and the results did not coincide with the findings of Ouseph (1992). The certified value of Cd for the coastal water in Bangladesh is 0.3 (EQS, 1991) while according to Preston (1973), the certified value is 0.2-0.4 ng ml^{-1} . In the present investigation, the concentration of Cd was lower than the EQS value in all the Stations but higher than the value of Preston (1973).

The concentration of Pb was always higher in the ship breaking area (Station 1-3) compared with that at Station-4 (controlled zone) as shown in Fig. 5. The higher concentrations were due to the discharge of various types of refuse materials from the scrap ships. There was little seasonal variation in Pb concentration, which correlated with the findings of Ouseph (1992). The certified value of Pb for coastal water was $0.2 \mu\text{g ml}^{-1}$ (EQS, 1991) and 0.03ng ml^{-1} (Martin and Whitfield, 1993) respectively. The concentrations of Pb found in the present investigation were lower than both the certified values. It may therefore be assumed that the Pb concentrations in the studied area were not harmful for the aquatic biota.

Conclusion

It may be concluded that the trace metal concentrations of surfacial water were always higher in the ship braking area in comparison with those at controlled zone and sometimes exceeded the different certified values. It is therefore apprehended that ship breaking operation contaminates the water of the intertidal zone by its unregulated fast expansion and through the discharge of metal rust (Particularly Fe), refuse materials etc coming from the scrap ships.

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