Analysis of Heavy Metals Accumulation in Nagapattinam Coastal Waters, South East Coast of India

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Abstract

Heavy metals in ocean water which cause hazardous impact to the marine organisms. Effluent discharges from industries such as metal processing, paints and pigment production, and biocides production and through domestic sewage from nearby villages. Toxic metals such as cadmium (Cd), Cr, copper (Cu), mercury (Hg), and zinc (Zn) emanate from these industries polluting seawater and paving the way for the many serious problems we face today. The current study focuses on the distribution of heavy metals between October 2016 and March 2017 in coastal waters in Tranquebar, Poraiyar, Kottucherry, and Karaikal, off the southeast coast of India. Four metals including Cd, Cu, Hg, and Zn were analyzed by a microwave assisted digestion and the atomic absorption spectrophotometer. These comments and subsequent considerations of this study help to manage the impact of pollution from wild and industrial sources into aquatic environments. Hence, the coastal regions needed throughout impoundment.

Keywords: Heavy metals, Season, Southeast coast of India, Water quality

Introduction

Heavy metals in sea water cause hazardous impact on the marine flora and fauna. There are number of toxic metals such as cadmium (Cd), Cr, copper (Cu), mercury (Hg), and zinc (Zn) increasing levels in the sea water which are serious problem today. They are released in high doses through industrial waste removal, metal processing, paint and color production, biocides production, and domestic sewer pipes from nearby residents. Therefore, the current study focuses on the distribution of heavy metals (Cd, Cu, Hg, and Zn) in the waters of Tranquebar, Poraiyar, Kottucherry, and Karaikal in the coastal region. The refinement of heavy metals in the aquatic body can be greatly influenced by the temporary variation in metal levels within the natural system.[1] The depletion of warm pollutants in coastal waters by vegetation and tropical industries exerts a negative impact on coastal waters, subspecies, and affects planktons.[2] Marine algae are indicators to assess the concentration of heavy metal in coastal waters.[3] Current research has been conducted to understand the water quality and concentration of heavy metals in Tranquebar, Poraiyar, Kottucherry, and Karaikal in the coastal region an important marine ecosystem.

Materials and Methods

Heavy metals in water samples were analyzed by adopting the procedure Brooks *et al*.[4] Water samples are collected monthly (for a period of 6 months from October 2016 to March 2017) and are collected before purification and acid to wash polypropylene and bottles of acid washes 1 L of polypropylene and were immediately stored in an ice box and transferred to a laboratory to avoid contamination. Water samples were then filtered through a Millipore filter unit using Millipore filter paper (pore size 0.45 μm). Filtered water samples were reconstituted with the release of APDC-MIBK following the procedure of Brooks *et al*.[4] The heavy metals in the water were analyzed on an air-acetylenemic Absorption Spectrophotometer (AAS-Model 802), which undisturbed wild samples were collected using a holding sample placed in plastic containers for transport to the laboratory. Sample preparation for

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chemical analysis included sub-sample processes during drying, cutting, and storage. All of these steps were followed using the methods Perkins and Altens.[5]

Study area

The study area Tranquebar Station 1 and Poraiyar, Station 2 (Lat. 11° 0`N; Long. 79°8`E) is a small coastal town in Nagapattinam district of Tamil Nadu state (Figure 1). A sandy beach was discovered in the 17th century Danish castle and an ancient temple. Tranquebar is not only of historical significance but also one of the richest ozone layers in South India. Rapid growth of aquaculture in a short period of 10 years and a thermal power station – independent PPN projects are limited to a fishery.

The study area Kottucherry Station 3 and Karaikal, Station 4 (Lat. 10°55`N; Long. 79°49`E) is a small coastal village in Karaikal district of Puducherry state (Figure 1). The stations are the coastal area of southeast coast of Tamil Nadu, India. These stations are rich in marine resources and are stretch along 10 km distance in the coastal zone with its own fish landing centers.

Results and Discussion

The number of heavy metals in the water at all channels varies. Variation in the distribution of metals has been shown to be

closely related to hydrobiological conditions. The refinement of molten metal especially Cu and Zn was high in the summer. Cd and Hg filters were very high in summer and after rain. In general, the natural resources of heavy metal in coastal waters are inland and in flowing rivers, as well as in mechanical and chemical conditions. The elements are also washed into space by rain, wind, forest fires, and volcanic particles, which add to the distribution of heavy metals in the water.[6]

Monitoring of heavy metals from October 2016 to March 2017 at Tranquebar Station 1, Poraiyar Station 2, Kottucherry Station 3, and Karaikal Station 4. Heavy metals of copper, cadmium, zinc, and mercury were hired. The copper focus at all four channels was recorded for promotion in December and March. Copper's highest screening was recorded at Station 1 (17.95 µg/l) in March and (11.48 µg/l) in December followed by Station 2 (16.41 µg/l) in March and (10.37 µg/l) in December (Figure 2). A gradual increase in copper filtration was observed in October, November, and December and a sharp decline in all four channels and the increasing concentrations in February and March were recorded. Copper is an important trace element, widely distributed in nature, and used in the metal industry. Copper sulfate mixed with lime is used as a fungicide. In medicine, copper sulfate is used as an emetic; it is also used as an anti-parasitic agent based on its critical actions and causes.[7]

Low Hg levels in water can cause high levels of organic ingestion and absorption of particles during rainfall. In all study channels, the quantity of iron has been observed: The precious metal (Zn) was of the highest quality and the essential iron (Hg) in the low concentration in the Bay of Bengal off the coast of Tamil Nadu.[8]

Zinc was elevated at station 1 (79.42 µg/l) and (78.21 µg/l) in December and March (Figure 3). In January, low levels of zinc were observed in all four channels. High concentrations of Zn in water would have an effect due to the removal of this metal from fields and many living organisms. Zn concentration was a small focus during the summer on both channels. This would have had an effect due to the use and absorption of Zn and other nutrients by biota including phytoplankton. Gomez-Ariza *et al*.[9] have also established that Zn can be significantly reduced in surface water as it has a type of nutrient distribution in seawater. Zinc is an important ingredient in a healthy diet. Mining, processing, and smelting of zinc extracts form a major source of zinc pollution in the environment. Zn 40 ppm level conveys the depletion, taste of iron, and the appearance of milk in fresh water.[10] High concentrations of nutrients, heavy metals, and other compounds such as pesticides and fertilizers have led to changes in land use and anthropogenic development in river dams. As rivers form inland water resources for domestic, industrial, and irrigation purposes, it is important to prevent and control river pollution and to have reliable data on water quality for effective management.

In Figure 4, high concentrations of cadmium were recorded at Station 2 (24.35 µg/l) and Station 4 (23.42 µg/l) in March. According to Eaton,[11] the CD is emitted into the atmosphere by fossil fuels and the burning of agricultural and municipal waste, including dry sewage. Used in nickel cadmium batteries polyvinyl chloride (PVC) plastic and Paint Pigments. Cadmium sulfide and selenide
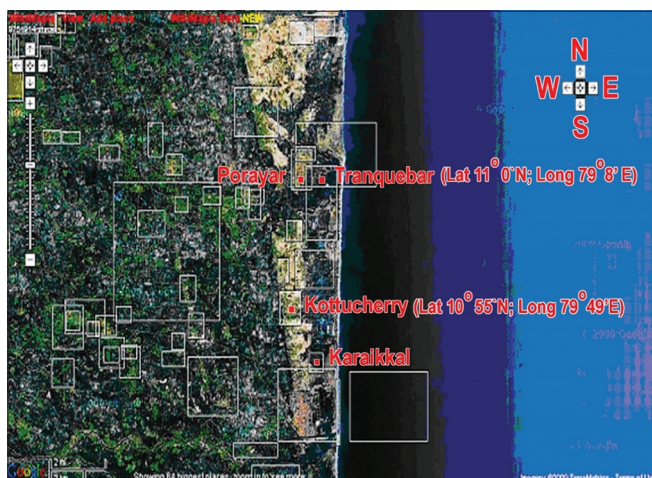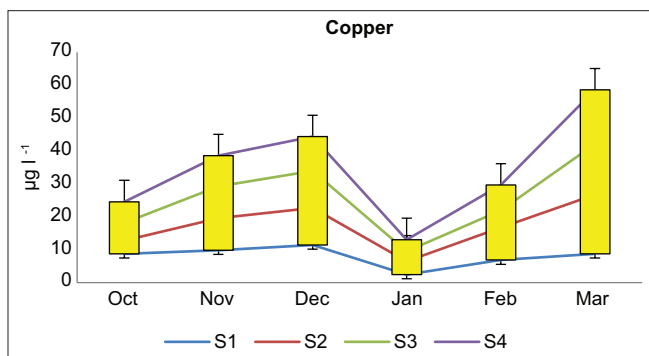

Figure 1: Map showing the study area

Figure 2: Seasonal variations in heavy metals (Cu) in water (µg/l) of the study areas during October 2016–March 2017
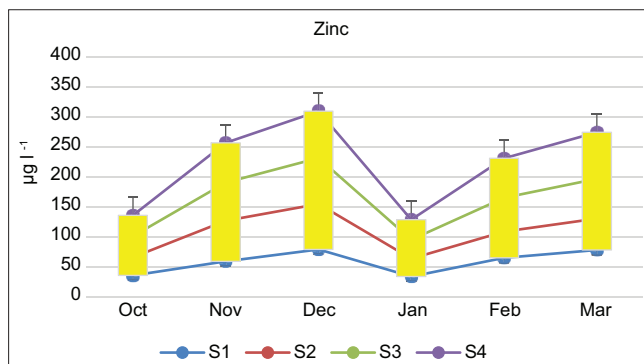

Figure 3: Seasonal variations in heavy metals (Zn) in water (µg/l) of the study areas during October 2016–March 2017
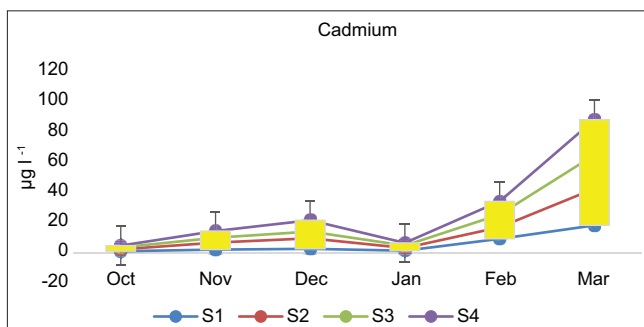

Figure 4: Seasonal variations in heavy metals (Cd) in water (µg/l) of the study areas during October 2016–March 2017

and commonly used for plastic pigs, steel pipes, fertilizer industries, sewage, and car tires also have a certain amount of this toxic metal. It is dangerous to fish and to humans.[12] Several toxic substances are introduced into the aquatic environment from wastewater from major industries creating biodiversity and changes in water quality.

In Figure 5 the elevated level of Mercury content was noticed in Station-2 (0.189 µg l-1) and station 4 (0.183 µg l-1) in the month of February 2017. The metal levels observed in this study are very high or similar to the reported levels from coastal and coastal waters in and around India. It is, therefore, concluded that the coastal area of Tranquebar is polluted by these metals, thus confirming the view of Ramachandran[8] who reported that the sea waters of Tamil Nadu state may be polluted by heavy metals. The concentration of heavy metals in coastal waters at all channels varies by nature. Variation in the distribution of metals has been shown to be closely related to hydrobiological conditions. The concentration of molten metal, especially Cu and Zn, was high during the summer. The concentration of Cd and Hg was higher during the summer. In general, the natural resources of heavy metal in coastal waters are inland and in flowing rivers, as well as in mechanical and chemical climates. The elements are also washed away from the atmosphere by rain, wind, forest fires, and volcanic particles, which add to the distribution of heavy metals in the water.[6]

Low Cu levels in the face can be caused by Cu's exposure to the particulate matter and subsequent settlement below. The metal levels seen in the present study are very high or similar to the reported levels from the coast and near the Indian Ocean and surrounding areas, especially from the Bay of Bengal. It is, therefore, concluded that the coastal area of Tranquebar is polluted by these metals, thus proving the view that the sea waters of the Tamil Nadu state may be polluted by heavy metals.[8,13]

The high concentration of metals detected during the rainy season can be attributed to heavy rainfall and subsequent river flow, bringing with it many industrial and terrestrial resources as well as domestic, municipal, and agricultural waste, including heavy metal residues containing pesticides.[14-16] Biological damage releases heavy metals back and forth which shows the strong interaction of Zn and Cu with organic carbon.[17] Zn and Cu are generally good indicators of anthropogenic implants.[18] Extensive use of antiseptic paints during the high post-fishing season would result in cuprous oxide also enriching Cu content in water.[19] In the summer, these metals can slightly raise the content because low salt and high pH water are likely to cause the release of these metals, which has led to their removal from the water column. Our present research findings are also consistent with previously published Shankar *et al*.[13]
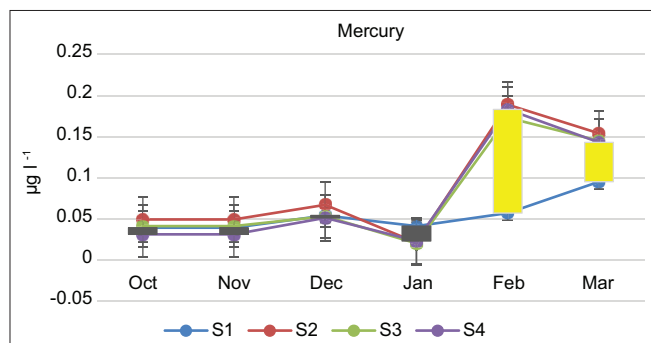

Figure 5: Seasonal variations in heavy metals (Hg) in water (µg/l) of the study areas during October 2016–March 2017

CONCLUSION

The present investigation shows the health of Tranquebar, Poraiyar, Kottucherry, and Karaikal coastal waters, east coast of India. The four areas selected for study, were highly polluted with Cd, Cu, Hg, and Zn. This may be due to the industrial effluents and anthropogenic activities. Our study has enlightened the persistent of heavy metal pollutants which should be regularly monitored to maintain coastal health. Safety measures and guidelines to be followed to monitor the heavy metal discharge from the industries to protect marine plants and animals. The study has provided baseline information of the heavy metals in ocean water would be an indicator for further ecological assessment and monitoring coastal environments.

ACKNOWLEDGMENTS

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