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HEAVY METAL FLUX IN SEA WATER (ARABIAN SEA) OF COASTAL KANYAKUMARI DISTRICT, INDIA

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ABSTRACT

The study deals with metal concentrations such as lead, cadmium, zinc, copper and iron in the coastal water of Kanyakumari district. The distribution of heavy metals in the seawater of Kanyakumari region has been monitored during the month of July 2001. The concentrations of different heavy metals have shown seasonal as well as station – wise variations. The results obtained from the analysis of seawater samples from various locations along the Kanyakumari coast were compared. Various pollution sources such as domestic sewage, urban discharge and industrial effluents along the coastal region have been identified. This work aimed at the assessment of heavy metal pollution in the coastal region and may help to determine or identify certain metal oriented pockets. Enrichment of heavy metal contaminations was less in this coast, when compared to other marine environments of Indian coast and natural sea water level.

Key words : Heavy metal, Sea water, Kanyakumari.

INTRODUCTION

Kanyakumari district is situated at the southern tip of peninsular India. Surrounded by three oceans, it is a centre of ecological treasures and attracts tourists from all over the world. It receives maximum rainfall when compared to other districts of Tamil Nadu. Since the water resources are rich, very little effort is made to make it available throughout the year. Unlike other districts in Tamil Nadu, Kanyakumari District has the unique advantage of rainfall during the southwest and northeast monsoons. The period of southwest monsoon is from June to September while that of northeast monsoon is from October to December. During rainy season, all wastes including municipal garbage, industrial effluents etc. reach the sea along with pesticides and fungicides containing heavy metals originating from agricultural fields. All these pollute sea water to a larger extent. Heavy metal pollution causes serious environmental health hazards as they magnify in the food chain[1].

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MATERIALS AND METHODS

Description of study area

Seawater samples collected from six stations viz Manakkudy, Kadiapattanam, Manavalakkurichi, Mondaikkadu, Colachel and Thengapattanam, were analysed. From each station, three samples were collected with a gap of 0.5 Km. Water samples were collected about 400 to 500 meters from the shore. Totally eighteen sea water samples were taken and analysed using standard methods[2]. The aim of this study is to find out the concentration of heavy metals like copper, lead, zinc, cadmium and iron in the seawater samples of the Kanyakumari coast. The study was carried out in July 2001.

Sampling and analytical methodology

Standard procedures were adopted for the determination of heavy metals[3]. Samples were collected from eighteen different areas of six stations in polythene bottles to ensure that they might not get contaminated with heavy metals from the sampling and storage equipments.

Some samples were analysed as such and some water samples were analysed after dilution. Trace metals were analysed using voltammetric Trace Analyzer (Metrohm VA 746, Switzerland) using hanging mercury drop electrode (HMDE) and against Ag/AgCl as reference and platinum as auxiliary electrodes

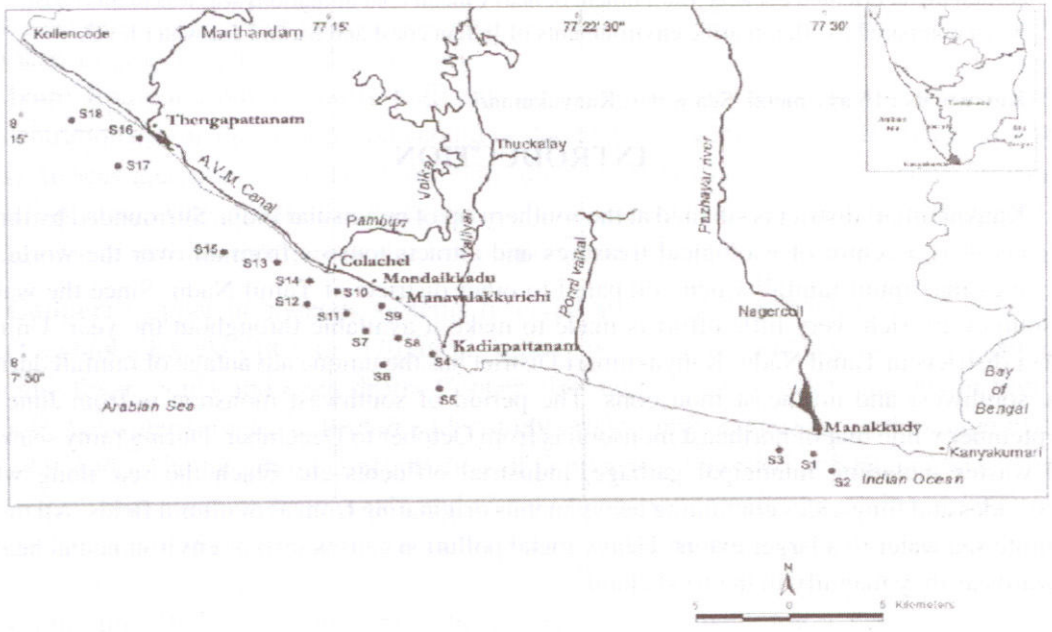

Fig. 1: Map of the Kanyakumari coast indicating the study sites

RESULTS AND DISCUSSION

During the last decades, heavy metal pollution has considerably increased in the environment. Automobile exhaust emission is regarded as one of the major sources of lead contamination in urbanised areas. This is due to the combustion of leaded gasoline and the consequent release of lead particles. Other metals such as zinc, copper, nickel, chromium and cadmium, which are associated with vehicles, are released in the environment due to wear and tear. Due to their presence in the atmosphere, the metals reach the water by precipitation. The presence of many automobile service garages, welding and lathe workshops resulted in high metal concentrations in surface soil samples.

The heavy metals are the most harmful and insidious pollutants because of their non – biodegradable nature and their potential to cause adverse effects on certain levels of exposure and absorption[4]. The study area comprises small–scale industries like engineering units, rubber processing units, stone crushers, dyes and glass industries etc. Hence, it is essential to assess the heavy metal contents. It is difficult to trace the exact source of metal contamination. Iron is the fourth most abundant element in the earth's crust and is mainly used in alloy industries, building constructions and also in pharmaceutical industry and machinery. Cadmium is used in industries like electroplating and nickel – cadmium batteries[4]. Organocadmium compounds act as catalysts. Cadmium is widely used as a pigment, stabilizer in paints and plastics and protective coating for metal parts and solders in fittings, water heater, water cooler, taps and PVC. Zinc is used mainly in alloy industries and also in galvanizing process. Zinc is also used as pesticides and white pigment. Extensive fibrosis of lungs ending in death due to higher exposure of zinc has been reported[5]. Copper is one of the most common metals, which is used extensively from domestic utensils to conducting wires, wood preservatives, alloys, batteries, paints etc[4]. The presence of copper may be due to spraying copper sulphate as a fungicide in the rubber plantation and agricultural fields. Zinc, copper and iron are derived from pigments and dyes as well as from corrosion of metals. Lead is used in the manufacture of metal products, solder fitting, rust inhibitors, lead acid batteries, pipes in plumbing, pigments etc. Anaemia, acute abdominal colic, peripheral neuropathy are some consequences of excess lead ingestion. The tendency of using modern equipments and fast foods probably contributes to the high levels of heavy metals. Lead acid batteries contribute 65% of lead in municipal solid wastes and consumer electronics like television set, radio, casette recorder, etc contribute 27%. 50% of cadmium in solid waste comes from house hold batteries and 28% from plastic. Motor vehicles form the main source of metals in road environments, from the combustion of fuel and by corrosion and wear of vehicle components such as brake linings

and tyres[6]. There is a wide variation in heavy metal contents. No specific trends could be observed in the amounts of heavy metals contributed by various samples.

Table 1. Heavy metals in sea water – July 2001

Station	Sample	Zn	Cd	Pb	Cu	Fe
Manakkudy	S1	68.15	1.770	94.17	35.90	ND
	S2	85.20	0.512	91.93	27.55	250.0
	S3	96.71	0.631	85.73	38.01	ND
Kadiapattanam	S4	76.72	0.502	66.00	31.90	ND
	S5	89.88	1.907	75.67	39.90	375.0
	S6	76.04	0.660	58.20	37.50	250.0
Manavalakkurichi	S7	74.24	4.590	57.46	35.95	225.0
	S8	135.00	0.670	78.75	21.97	250.0
	S9	118.00	2.118	70.10	38.40	125.0
Mondaikkadu	S10	ND	ND	ND	ND	570.0
	S11	03.82	4.750	4.62	ND	500.0
	S12	87.26	2.668	63.98	96.70	142.0
Colachel	S13	142.60	0.772	150.70	25.70	428.0
	S14	97.70	0.972	60.44	148.90	286.0
	S15	103.00	0.753	57.84	41.40	428.0
Thengapattanam	S16	109.50	0.627	55.99	37.20	428.0
	S17	115.90	0.472	71.00	45.10	428.0
	S18	73.72	0.708	58.50	39.00	414.0

All values are given in µg/L; ND: Not Detected.

Iron: Iron contributes a fairly high amount to the total metal contents[6]. The higher concentration of iron during monsoon could be due to the effluents coming from the mining sites[7]. In seawater, concentration of iron ranged between 0 to 570 µg/L. The values of iron were high at two sites of Mondaikkadu and at all the sites of Thengapattanam in July 2001. The source of iron content may be due to transportation of weathering products.

Copper: Copper in aqueous systems received attention mostly because of its toxic effect on biota. Excess of Cu (> 470 mg) in human body is toxic and causes hypertension, sporadic fever, coma and even death. Copper also causes pathological changes in brain tissues[8]. Seawater samples collected under study programme had copper in the range of 0 to 148.9 µg/L. The minimum concentration of copper was recorded at S10 and S11. The municipal solid waste or residential solid waste (domestic) contains excessive amount of heavy metals and these can be taken up by plants and ultimately passed on to man and animals causing several physiological disorders.

Cadmium: The concentration of cadmium was comparatively lower than other heavy metals. Highest recorded value was 4.75 µg/L at S11. The values of the metal ions varied

according to the inflow of waste. As the pH of the water increases, the solubility of the metals decreases[8]. No specific trends could be observed in the amounts of cadmium recorded in various stations. The agricultural application of phosphate fertilizers represents a direct input of cadmium to arable soils[10, 11]. Cadmium content was high at S11 (4.75 µg/L) and at S7 (4.59 µg/L) in July 2001.

Lead: Lead, another important toxic metal, was found to be very high at S13 (150.7 µg/L). The highest values of lead were observed at stations, Colachel and Manakkudy during the study period.

Zinc: Zinc concentration ranged between 0 and 142.6µg/L and it was high during monsoon season, i.e., at S3 (142.6 µg/L), perhaps due to the monsoonal discharges, from land runoff in the washings of polluted coast. Such a seasonal variation of zinc in the water might be perhaps due to the presence of major sources of metal pollution, intensive human activities, discharge of domestic wastes and land runoff reaching the coastal area.

Kottar in Nagercoil has also been associated with the manufacture of domestic vessels made from vellode or bell metal. Kottar is popular especially in the manufacture of brass vessels, temple bells and lamps. The heavy metals come with wastes emanating from operations like metal polishing, metal cleaning and electroplating. The concentration of metals in various wastewaters may also vary considerably both in quality and quantity.

In addition, lime shell is available in the coastal lagoons near Thamaraikulam, Manakkudy and Rajakkamangalam. Industries involving stone quarrying, stone polishing, brick making, electroplating, coir making etc. exist in different parts of this district. Everything that is carried away by rivers ultimately goes to the sea. Under natural conditions, rivers appear to be the most important source of heavy metals in the sea. It seems probable that continental weathering plays a major part in determining the heavy metal composition of large rivers but the relative contributions of weathering and aerosols in the atmosphere are uncertain.

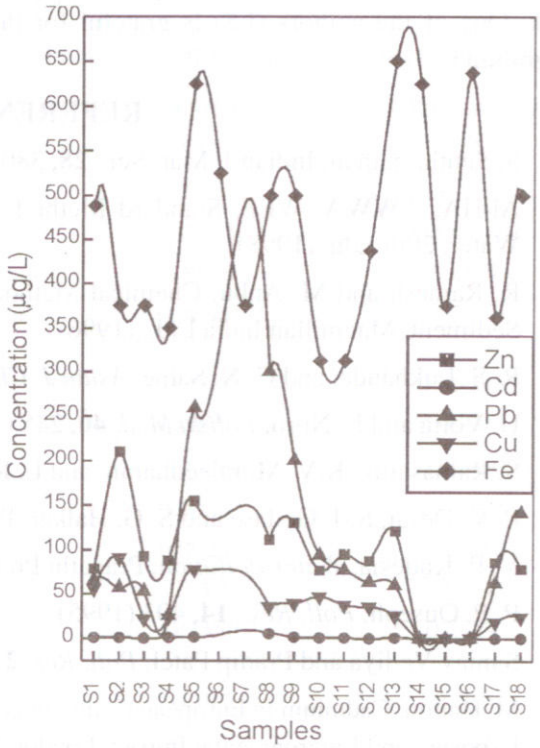

Fig. 2 Heavy metal distribution in seawater of Kanyakumari district coast during July 2001

Coastal environment is a very dynamic system of complex nature. It is controlled by a variety of physical, chemical and biological processes.

Human activities in the form of tourism commerce etc. should be streamlined in order to minimise pollution. Another source of marine based pollution is shipping or harbour activities at Colachel. Coastal villages like Manakkudy east and Manakkudy west have virtually become a desert due to coir industry and salinity intrusion. The disposal of electroplating effluent is not always carried out with care. Presence of heavy metals in wastewater has stimulating and detrimental effects on biological treatment system.

The data also suggested that the contamination problem is not alarming at present but the seawater quality will deteriorate with time, so proper care must be taken to avoid any seawater contamination.

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