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Particulate Iron, Manganese, Copper & Zinc in Waters of the Cochin Backwater

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Particulate matter from the Cochin backwater was analysed at close network of stations for Fe, Mn, Cu and Zn. Significant concentrations of Fe, Mn and Cu were found at the river mouth. These concentrations were higher than the values reported for similar environments in other regions of the country, which might be partly due to the domestic and industrial pollution in the area.

THE backwaters of Kerala, in general, are highly productive and form nursery ground for a variety of fish and shell fish in addition to their rich brackish water fishery. Besides, the backwaters offer considerable potential for the development of aquaculture. Ecological conditions in the backwater ecosystem affect not only its own resources but also those of the adjacent sea and the rivers. Hazards arising from the discharge of pollutants by industries (containing high concentrations of heavy metals) in these environments necessitate a regular monitoring of the levels of the heavy metals in the waters, mud and organisms. The primary objective of the present investigation is to collect some data on the heavy metal concentrations in the particulate matter of the Cochin backwater from the marine zone to the fresh water zone, on which there is no information. As larger quantities of heavy metals are transported by the river as particulate¹ the particulate matter has been analysed for various metal concentrations and compared with data reported for the waters from other parts of the country²⁻⁸.

Water samples from the surface and bottom were collected at various stations from the Cochin backwaters, from the marine zone to the freshwater zone, in March 1977. The station positions are shown in Fig. 1. Surface samples were collected using a plastic bucket and bottom samples using a Vandom sampler. Water samples were stored in acid-cleaned plastic bottles and filtration was carried out as soon as the samples were brought to the laboratory. A suitable quantity of the sample was

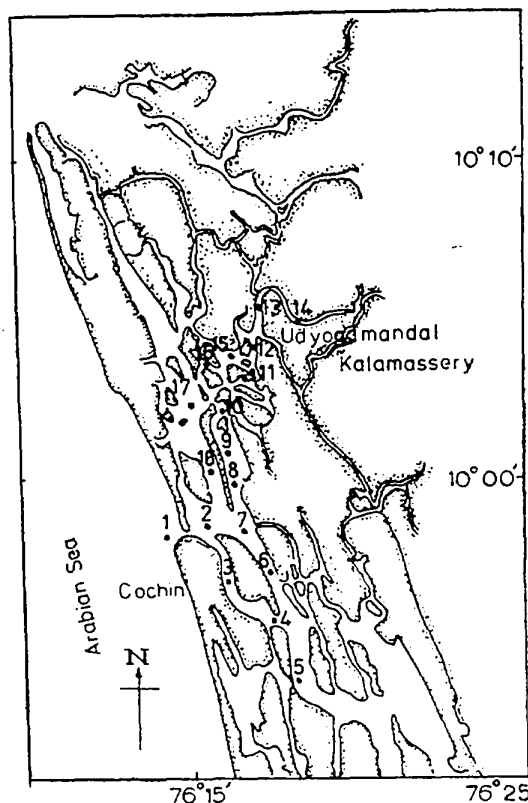


Fig. 1 — Station positions

filtered through 0.45 μ pore size membrane filter paper and the particulate matter retained on the filter paper was used for estimation of various metals. Wet digestion was carried out as described in the Manual of methods in aquatic environment research⁹. A blank determination was carried out in the same way with a blank filter paper. Metal concentrations were estimated in the digested sample using the Atomic absorption spectrophotometer (Hilger and Watts Atomspek H 1550). Metals estimated were iron, manganese, copper and zinc.

Sampling for the metal estimations in the Cochin backwater is made at closely spaced intervals from the estuarine mouth to 15 km upstream. The main source of freshwater in the Cochin backwater is from two large rivers: Periyar on the north and Pamba on the south. The backwater system is subjected to very wide ranges of physico-chemical conditions. During the south-west monsoon period (June-September), the estuary becomes dominant with freshwater, with brackish water or very nearly freshwater at the surface and with a tongue of saline water at the bottom. During the post-monsoon season there is a marked increase in the salinity and during the premonsoon period (March-May) the backwater becomes almost an extension of the adjoining sea with salinity values $>30\text{‰}$.

Concentrations of various metals are shown in Table 1. The data are compared with published information and interpreted (Table 2).

TABLE 1 — CONCENTRATION OF METALS AT VARIOUS STATIONS IN THE COCHIN BACKWATER

Station No.	Depth	Salinity ‰	Suspended matter, mg/litre	Conc., µg/litre			
				Fe	Mn	Cu	Zn
1	S	32.54	32.7	2913	5.7	2.1	11.4
	B	33.24	92.3	9771	40.2	10.5	25.8
2	S	32.1	42.2	4686	26.5	6.8	24.6
	B	32.94	35.1	3312	18.6	4.7	18.5
3	S	31.8	12.5	1257	7.5	3.8	5.7
	B	32.6	42.8	2328	17.7	3.8	16.2
4	S	23.66	17.4	219	10.8	2.6	2.4
	B	28.3	6.4	3177	36.9	13.7	20.1
5	S	20.3	12.3	1644	16.8	2.1	2.3
	B	26.4	28.5	1281	25.2	3.8	12.6
6	S	31.2	14.5	366	12.9	2.1	4.5
	B	32.4	12.5	354	4.8	2.6	3.1
7	S	32.34	18	744	14.1	5.9	13.5
	B	32.6	29.7	2286	16.3	2.6	6.9
8	S	27.75	16.2	219	11.6	2.6	6.9
	B	31.31	46.5	2516	21	7.1	21.4
9	S	24.92	18.3	310	18.7	0.8	15.8
	B	25.6	30.1	1260	32.5	3.4	29
10	S	22.77	12.6	868	19	1.97	9.9
	B	23.84	16	584	13.6	2.8	20
11	S	16.29	12	268	48	2.2	18.2
	B	19.54	10.9	204	39.2	0.8	13.2
12	S	12.86	10	172	50.4	3.1	36.6
	B	18.46	10.2	212	45.2	1.4	15.4
13	S	13.04	9.3	156	64	0.8	34.4
	B	18.46	11	330	59.8	2.8	23.8
14	S	7.57	6.3	288	12	2.8	88.8
	B	13.22	13.8	568	97	4.2	83.6
15	S	14.31	14.4	178	24.6	2.8	113.2
	B	16.47	12.2	352	56.2	3.8	38.1
16	S	17.38	13.4	220	20.4	3.6	35
	B	21.51	19.9	620	24	5.4	57.4
17	S	24.38	12.1	170	12.8	3.2	13.6
	B	24.56	11.5	192	8	2.3	9.4
18	S	24.38	19.8	548	24.4	5.4	23.3
	B	24.38	22	520	26.8	4.3	22.1

S=surface; B=bottom.

TABLE 2 — COMPARISON OF PRESENT DATA WITH REPORTED DATA FOR WATERS FROM DIFFERENT AREAS

Ranges of conc. in present study (µg/litre)		Values (µg/litre) reported earlier	Remarks
Surface	Bottom		
		IRON	
1257-4586	2286-9771	10-80 0.65-180 mg/l	Porto Novo waters ⁴ . Higher particulate concentration at the bottom also reported Waters around Goa ⁵ . Higher iron concentration observed attributed to the mining operation in the area
		MANGANESE	
5.7-64	4.8-97	2.21 40-42 12.5-102.2	Waters of Bombay ² British coastal waters ¹⁵ and Porto Novo waters ⁴ Waters of Goa ⁷ . High content has been explained as a result of mining activity in the area
		COPPER	
0.8-5.9	0.9-13.7	24.78 1.45 0.1-4.8 — 0.5-12 1.7-7.9	Waters of English Channel ¹⁶ and high value has been attributed to land drainage San Juan Channel ¹⁷ Sargasso Sea water ¹⁸ Av. copper content for river and ocean water, 5 and 3 respectively ¹⁹ Porto Novo waters ⁴ Arabian Sea waters ⁸
		ZINC	
2.3-113.2	3.1-83.6	28.35 0.8-52.6 21-38 1.3-47.6 2.8-42.3 5.5-42.4	Bombay waters ⁴ Sargasso Sea ¹⁸ Oresund ²⁰ . High values due to the influence of sewage effluents British coastal waters ¹⁵ due to terrestrial contamination Goa waters ⁷ Arabian Sea ⁸

The present study shows that some of the metals in the Cochin backwater occur at higher levels in the particulate matter. High concentration of iron present could be partly due to the river water which flows through laterite bed and also to the harbour activity and the sewage effluent. Higher iron values present at the river mouth may be due to precipitation and flocculation in contact with saline waters and suspended particles¹⁰. It is also shown^{11,12} that soluble iron transported by rivers undergoes precipitation and flocculation in contact with saline water. Highest concentration of manganese (50-64 and 45-97 µg/litre at surface and bottom respectively) is observed 2 to 4 km downstream of the industrial complex area. Higher manganese values have also been reported in the eastern Irish Sea (0.22-14.6 µg/litre in filtered seawater) which receives drainage from large industrial areas and rivers¹³. In most of the areas reported approximately 75% of the total manganese is found in suspended particulate matter¹³. The present observation also indicates higher manganese content in the waters due to pollution. High values of copper, observed in the Cochin backwater during the period when the freshwater discharge through the river is minimum are attributed to pollution as well as to other external sources. Zinc concentration in the waters is very much higher than the average concentrations of zinc in the river water (10 µg/litre). Sankaranarayanan *et al.* have also reported high accumulation of zinc by the oyster *Crasostrea madrasensis* from this region¹⁴.

Present studies show that some of the metals in the Cochin backwater occur at higher levels in the particulate matter either because of industrial or domestic pollution or due to the activity in the harbour area. In the absence of any previous reports on the metal concentrations from these waters it is difficult to assess the nature and magnitude of changes that have taken place in the concentration of metals. A regular monitoring of the levels of various metals in the waters, sediment and biomaterials is therefore recommended.

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Chemical Characteristics of Some Indigenously Manufactured Oil Dispersants

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Four oil dispersing chemicals, indigenously manufactured, have been analysed for the active functional groups present in the main ingredient namely surfactant. To evaluate their toxicity, surfactant concentration in sea water, after its use in dispersing the oil, has also been determined.

TO fight oil spills in the sea several dispersants, which remove spilled oil by emulsifying it have been developed. However, the main objection to their use has been their toxicity. Modern dispersants are known to be far less toxic than those used earlier. Poisoning of marine life can occur even with non-toxic detergents because they disperse the toxic materials present in crude oil. Hence, these chemicals should be used only when all other means of removal of oil are failed. An advantage of their use is that they greatly enhance the biodegradation of oil by increasing its surface area.

The present study has been undertaken to determine the nature and chemical composition of 4 dispersants manufactured in India and made available by the firms for testing. IR, UV and chromatographic techniques have been used numbering the dispersants as 1, 2, 3 and 4. The concentration of the surfactant ingredient in sea water, left in the emulsified state after the removal of oil, has also been determined by colorimetric method.

All the 4 dispersants were found to be non-ionic as none of them gave either precipitate or turbidity with ionic tensides. Dispersants 1 and 3 showed very weak turbidity which may be attributed to the ionic impurities introduced during manufacture. The