

SHORT TERM VARIATIONS IN PARTICULATE MATTER IN MAHI RIVER ESTUARY

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ABSTRACT

The particulate matter (PM) collected from Mahi River estuary was analysed for organic carbon (POC), nitrogen (PON), and chlorophyll *a* (Chl *a*). The concentration of PM, POC, PON and Chl *a* showed short term variations. Average surface concentration of PM, POC, PON, and Chl *a* varied from 56-1976 mg l⁻¹, 0.6-4.19 mg l⁻¹, 0.10-0.21 mg l⁻¹ and 3.11-26.80 µg l⁻¹ respectively. POC/PON, POC/Chl *a* and PON/Chl *a* varied from 3.7-23.31, 25.64-1112 and 9.24-65 respectively in the surface waters. POC/PON ratios of bottom samples ranged from 4-31.50. Regression analyses showed that PM was significantly correlated with POC ($r = 0.853$, $p = < 0.001$). Significant correlation ($r = 0.744$, $p = < 0.001$) between POC and PON was also observed. Low POC/PON, POC/Chl *a* and PON/Chl *a* ratios at Dabka and Mahammadpura indicated that autochthonous production formed a major source of PM at these two stations. High values of POC/PON, POC/Chl *a* and PON/Chl *a* suggested that detritus formed a major part of the PM in the middle and near the mouth of the estuary.

Key words : Particulate matter, Mahi River estuary.

INTRODUCTION

The standing biomass of planktonic organisms and organic detritus derived from them in the water column form food for filter feeding pelagic animals (Happ, Gosselink, and Day, 1977). In the estuarine environment, organic detritus often represents a major component of the food chain. Studies on the distribution and composition of PM are therefore important to understand the decomposition or mineralization of organic matter derived from autochthonous and allochthonous sources (Tanoue and Handa, 1979).

Mahi river estuary extends inland upto Mahammadpura for about 50 km (Fig. 1). The presence of a rocky sill at Mahammadpura effectively prevents

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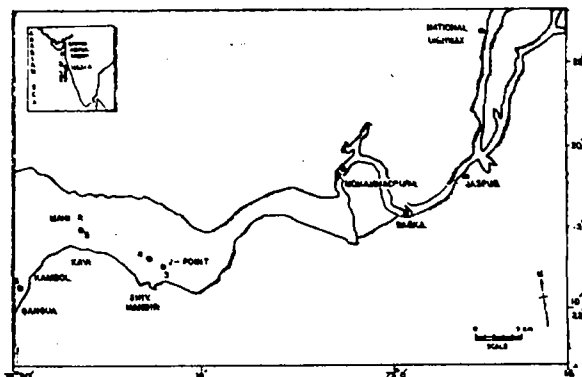


Fig. 1 Station locations in Mahi River estuary.

intrusion of saline water beyond Mahammadpura except during spring tides when some seawater flows over the sill. The mouth of the estuary is a wide stretch of shallow tidal flats and shoals. During low tide the estuary is almost dry except for a few narrow and shallow meandering channels. There is a pronounced fresh water discharge during July to September in the river. During this period the river banks become highly unstable due to submergence and erosion. Due to its proximity to the Gulf of Cambay tidal influence is considerable with a tidal prism of 2.5m sweeping the estuary. Near total drainage of tidal water during the ebb tide subjects the channel to complete physical flushing out. A rivulet which joins the Mahi river at Jaspur brings industrial waste water containing high levels of ammonium compounds. Due to poor flushing during dry season (December-June) this gets accumulated in the riverine stretch between Jaspur and Mahammadpura. This communication deals with the short term variations in particulate matter and its composition in Mahi river estuary.

MATERIALS AND METHODS

Water samples were collected from six stations i.e. Mahi National High Way, Gangua, Kavi, Dabka, Mahammadpura, 'J' point and Shiv mandir on 6, 7, 9, 13, 15, 18 & 19th October, 1981 (Fig. 1). Each station was occupied for a period of 5-11 hrs. and the samples were collected with a interval of two to three hours. Niskin sampler (5 l) was used for collecting subsurface water samples and a clean polyethylene bucket for surface samples. The samples were transported to the field laboratory as early as possible and filtered. In order to estimate the PM a known volume of water was filtered through previously weighed Whatman GF/C filter paper, dried to constant weight at 70°C and the difference in the weight was taken as the amount of particulate matter. For the analysis of POC, PON and Chl *a*, aliquots of samples were filtered through preignited Whatman GF/C filters. POC and Chl *a* were analysed following the methods of Strickland and Parsons (1972). For PON analysis,

filters were digested with low nitrogen containing potassium persulphate (0.001%N). Using this method nitrogen was converted to nitrate. Nitrate was then reduced to nitrite by passing through amalgamated cadmium column and the nitrite was estimated following the method of Bendschneider and Robinson (1952). Standards used were EDTA and glycine. Blanks and standards were also analysed in the same way using ignited filter papers (Whatman, GF/C).

RESULTS AND DISCUSSION

The PM collected from Mahi River estuary, on analysis for POC, PON, Chl *a* showed short term variations which was less pronounced in PON (Fig. 2,

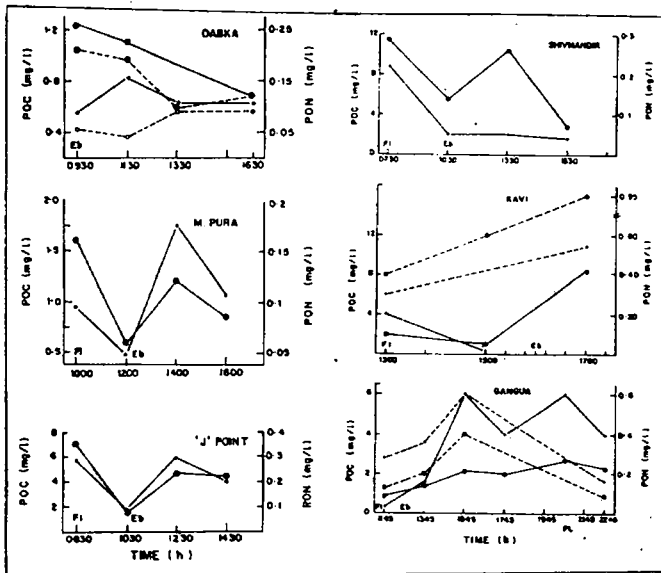


Fig. 2 Tidal variation in surface (—) and bottom (---) POC and surface (—) and bottom (---) PON at different stations in Mahi River estuary

Table I). The average concentration of PM varied from 56-1976 mg l⁻¹ in the surface waters. Large variations in PM concentration were observed in the middle and near the mouth of the estuary (Table I). POC followed the same trend of distribution as observed for PM. Pooled values of POC over the entire sampling period varied from 0.6 to 4.19 mg. l⁻¹ and from 0.21 to 11.99 mg l⁻¹ in the surface and bottom water respectively. The average surface POC concen-

Table — I Summary of the Ranges and Mean of Particulate Matter (PM), Chlorophyll *a* (Chl *a*) Particulate Organic Carbon (POC) and Particulate Organic Nitrogen (PON) in Mahi River Estuary. (n. represents the number of samples)

Station	PM	Chl <i>a</i>	POC (mg l^{-1})		PON (mg l^{-1})	
	mg l^{-1}	$\mu\text{g l}^{-1}$	Surface	Bottom	Surface	Bottom
Dabka	35-125 n=5 (56)	24-30 n=2 (27)	0.56-0.82 n=4 (0.60)	0.36-0.56 n=4 (0.33)	0.11-0.26 n=3 (0.20)	0.09-0.21 n=4 (0.15)
Mahammadpura	139-658 n=4 (414)	7.93-14.46 n=4 (10.53)	0.480-1.76 n=4 (1.70)	—	0.06-00.16 n=4 (0.10)	—
J-Point	503-3713 n=4 (1976)	3.58-8.28 n=3 (5.84)	1.99-6.00 n=4 (4.19)	7.99-15.99 n=4 (11.99)	0.08-0.34 n=4 (0.21)	0.27-0.4: n=4 (0.36)
Shivmandir	—	—	1.66-8.80 n=4 (3.60)	—	0.06-0.29 n=4 (0.18)	—
Kzvi	46-1024 n=3 (577)	13-21.08 n=4 (16.98)	0.20-6.00 n=2 (3.10)	6.00-10.80 n=2 (8.40)	0.04-0.42 n=3 (0.18)	0.40-0.4: n=3 (0.60)
Gangua	35-2000 n=6 (1164)	1.47-5.37 n=6 (3.11)	0.26-6.00 n=6 (3.64)	0.09-0.39 n=4 (0.20)	0.08-0.27 n=6 (0.19)	0.09-0. n= (0.2)

tration was minimum in the riverine stations (Dabka and Mahammadpura) (Table I) but it increased in the middle and near the mouth of the estuary. A maximum value of 4.19 mg l^{-1} POC was observed at J-point. However, large variations in POC concentration compared to other stations were recorded at Gangua. Such large variation in POC are also reported for Vellar, Ems-Dollart and Louisiana estuaries (Happ, Gosselink and Day, 1977; Laane, 1982; Subramanian and Venugopalan, 1980).

The PM of Mahi estuary is characterised by its low organic content (Table II). The highest mean concentration of POC was 1.07% of PM. This is comparatively less than those reported for coastal waters. For example, Biggs (1970) reported POC values of 7.8% of PM, whereas, Hobson and Menzel (1969) observed 5-7% POC in coastal waters. However, values observed in the present study are similar to those reported by Loder and Hood (1972) for Alaskan estuary.

Table — II Mean values of salinity, particulate Matter (PM), POC, PON and Chlorophyll *a* (Chl *a*) as percent of PM.

Station	Salinity ‰	Particulate Matter (PM) mg l ⁻¹	POC % PM	PON % PM	Chl <i>a</i> % PM
Dabka	0.144	56	1.07	0.35	0.047
Mahammadpura	6.07	414	0.410	0.02	0.002
J-Point	17.43	1976	0.212	0.01	0.0005
Kavi	11.76	577	0.363	0.03	0.0029
Gangua	15.83	1164	0.312	0.01	0.0002

PON also showed short term variations (Fig. 2, Table I). Very often PON of bottom samples was higher than that of the surface samples. Average PON varied from 0.10 to 0.21 mg l⁻¹ and 0.15 to 0.66 mg l⁻¹ in the surface and bottom samples respectively. These values are similar to those reported by Lodger and Hood (1972).

Phytoplankton biomass (as Chl *a*) varied from 3.11 to 26.80 μ g l⁻¹ and decreased near the mouth of the estuary. The highest concentration (28.80 μ g l⁻¹) of Chl *a* was observed at Dabka (Fig. 1, Table I). This riverine station (Fig. 1) receives industrial waste water containing a high level

Table — III Ranges and mean of ratios of POC/PON, POC/Chl *a*, and PON/Chl *a*. (n, represents number of samples)

Station	POC/PON		POC/Chl <i>a</i>	PON/Chl <i>a</i>
	Surface	Bottom		
Dabka	2.15-5.31 n=3 (3.70)	1.87-5.89 n=4 (4)	25.76-27.52 n=2 (26.64)	7.42-11.06 n=2 (9.24)
Mahammadpura	6-14.91 n=4 (10.30)	—	48-178 n=4 (107)	6.16-11.90 n=4 (9.97)
J-Point	13-26.55 n=4 (20.91)	28-35 n=4 (31.50)	161-1340 n=4 (643)	8.26-96.32 n=4 (36.57)
Shivmandir	7.51-30.14 n=4 (20.03)	—	—	—
Kavi	4-42.62 n=2 (23.31)	11-14.85 n=2 (12.5)	15-258 n=4 (136)	3.76-32.34 n=3 (14)
Gangua	3-28.44 n=6 (17.05)	15-21.87 n=4 (17.71)	181-2097 n=6 (1112)	44-95 n=6 (65.00)

of nutrient through a rivulet which might have triggered phytoplankton bloom resulting in high Chl *a* values. Chl *a* showed negative correlation with PM and POC. Due to large variations in PM and PON there was no significant correlation between Chl *a* and these parameters (Table I).

POC/PON of PM observed in the present study varied between 3.7 to 23.31 and 4 to 31.50 in the surface and bottom waters respectively (Table III). The POC/PON ratio varied from station to station suggesting differences in the composition of PM. Regression analysis of POC and PON yielded a significant positive correlation. The high POC/PON ratio indicate removal of nitrogen during recycling processes (Holligan, Harris, Newell, Harbour, Head, Linley, Lucas, Tranter, Weekly, 1984). Decrease in POC/PON ratio indicate less nitrogen depletion (Wassmann, 1983).

Average POC/Chl *a* and PON/Chl *a* of PM ranged from 25.64 to 1112 and 9.24 to 65.00 respectively (Table III). Low values of POC/PON, POC/Chl *a* and PON/Chl *a* ratios were observed at Dabka and Mahammadpura, while there was a large increase in POC/PON, POC/Chl *a*, and PON/Chl *a* ratios in the middle and near the mouth of the estuary (Table III). Parsons, Stephens and Strickland (1961) observed that POC/PON, POC/Chl *a* and PON/Chl *a* ratios of healthy phytoplankton varied from 2.5 to 10, 19 to 97 and 4 to 10 respectively. The values of POC/PON, POC/Chl *a* and PON/Chl *a* ratios observed for Dabka and Mahamadpura (Fig. 1, Table III) lie within this range. If we assume that such low ratios are indicative of living organisms, then the present results indicate that the PM consists of living material to a large extent at these two stations.

On the otherhand, there was an increase in POC/PON, POC/Chl *a* and PON/Chl *a* ratios in the middle and near the mouth of the estuary. These ratios are higher than those reported for living organisms by Parsons, Stephens and Strickland (1961), which mean detritus contribute significantly to the PM. This suggest that terrestrial detritus and resuspension of sediment forms an important source of PM and subsequently that of POC and PON. This was evident from the significant correlation observed between (i) PM and POC ($r = 0.853$, $p = < 0.001$) (ii) POC and PON ($r = 0.744$, $p = < 0.001$). Large influx of terrestrial organic matter masks any relationship between planktonic biomass and organic carbon and nitrogen.

These data suggest that PM of Dabka and Mahammadpura (Fig. 1, Table I) consists of living matter because it showed POC/PON, POC/Chl *a* and PON/Chl *a* ratios more or less similar to those observed for living phytoplankton. Whereas, high ratios of POC/PON, POC/Chl *a* and PON/Chl *a* of PM in the middle and near the mouth of the estuary suggest that PM is of detritus in nature in this part of the estuary.

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