

# Sediment Quality of Sewri Mudflats, Mumbai, West Coast of India

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**Abstract-** The sediment is the ultimate sink of contaminants in the aquatic systems. The study was conducted to assess the sediment physico-chemical parameters of Sewri mudflats. Sediment samples were collected for a periods of 13 months from November 2008 to November 2009 at low, mid and high tides area from 9 different stations near Sewri jetty. Samples were analysed for temperature, pH, moisture content, sediment texture (sand, silt and clay), total phosphorus and organic carbon of sediment. Pearson correlation coefficient was used to analyse the data. Sediment average values of temperature, pH, moisture content, sand, silt, clay, total phosphorus and organic carbon were respectively 26.3 °C, 7.4, 76.6 %, 5.6 %, 48.5 %, 45.9 %, 3288 µg g<sup>-1</sup> and 3.1 %. The Moisture content was slightly higher attributed to silty clay to clayey silt nature of sediment. Total phosphorus and organic carbon showed marginally higher values which can be attributed to organic load. Throughout the study benthic phytoplankton and 3 groups of macrobenthose were observed.

**Index Terms-** physico-chemical parameters, pollution, sediment, Sewri mudflats.

## I. INTRODUCTION

The mudflats area in Maharashtra is 471.44 km<sup>2</sup> (Jagtap *et al.*, 2001). The mud surface plays an important role in nutrient chemistry. They receive nutrients from the tidal flow and the nearby marsh, particularly as its decays. However, mudflats worldwide are under threat from predicted sea level rises, land claims for housing and development, digging and dredging for navigation and chemical pollution. The physico-chemical properties of muddy substratum directly influence the infaunal community that lives in the soft sediment (Wilson, 1981). Moreover, Hopkison *et al.* (1999) contented that sediments play an important role in organic matter degradation and nutrient recycling in aquatic ecosystems.

Sedimentological parameters have been studied in association with ecological aspects. The pioneering work was done by Sander (1956, 58) in U.S.A. and Jones (1951, 52, 55-56) in U.K. In India, sediment have been reported from Mandovi and Zuari estuaries (Jagtap, 1987; Ansari, 1988; Nasnolkar *et al.*, 1996), Asthamudi estuary (Nair *et al.*, 1984), Rushikuly estuary (Gouda & Panigrahy, 1996), Cochin backwaters (Murty & Veerayya, 1972; Reddy & Sankaranarayanan, 1972; Sankaranarayanan & Punampunnayil, 1979; Sunil kumar, 2001), marine environment of Bombay (Kotimere & Bhosale, 1976; Mohapatra, 1985; Sahoo & Khopkar, 1985).

## II. AREA OF STUDY

The open mudflats of Sewri are located along the Arabian Sea (west coast of India), covering an area of 10 km long and 3 km wide, dominated by mangroves all along the coast. There are many migratory birds including flamingos, which visit this area. Their migration to Sewri creek is likely to get affected in future due to ongoing and proposed developmental work in the area. There are many petrochemical and refinery industries located along the coast. Considering the importance of flora and fauna and constant threat from the industrial discharge, sewage disposal and developmental activities, regular monitoring of this ecosystem is required to assess its health. There is no information on sediment quality of Sewri creek, as it is major intertidal area of Arabian Sea adjoining Mumbai harbour. The present study, in addition to rendering information on ecological characteristics of mudflats will also help in providing baseline information for future ecological comparisons.

## III. MATERIALS AND METHODS

Nine stations (L1, M1, H1 - L2, M2, H2 - L3, M3, H3) for sediments sample were selected, covering low tide, mid tide and high tide areas. These stations were divided into three zones as zone 1 towards the left of jetty (L1, M1, H1), zone 2 in front of jetty (L2, M2, H2) and zone 3 towards right of jetty (L3, M3, H3). The stations located between 19° 01' 00" N and 72° 52' 60" E.

Sediment samples were collected with help of scoop once in a month for 13 months (November 2008 – November 2009) during the low tides. Sediments were collected at each sampling station and stored in a labeled polythene bags. The collected sediments were air dried and oven dried at room temperature in the laboratory for the estimation of temperature, pH, moisture content of the sediment, sediment texture, total phosphorus, organic carbon and benthic organisms for qualitative analysis. The sediment physico-chemical parameters were determined following standard methods (APHA, 1992).

## IV. RESULTS

**Sedimentology:** The range of sediment temperature for the entire study area was from 24 to 30 °C with an average of 26.3 °C. The highest temperature was recorded in the month of February from stations M1 and M2 and the lowest in the month of April from stations L1, M1, H2 and H3. Seasonal values for the area were 26.5, 25.7 and 26.6 °C respectively for

premonsoon, monsoon and postmonsoon periods. The pH is a parameter that plays an important role in the recycling of nutrients between water and sediments of an estuary (Nasrolkar *et al.*, 1996). The range of pH for the area varied from 6.23 to 8.36 (av. 7.42). The maximum pH was observed in the month of November '08 from station H3 and the minimum in the months of June and April from stations L1 and H3 respectively. Calculated values for premonsoon, monsoon and postmonsoon seasons were 7.18, 7.38 and 7.65 respectively. Presence of clay in the sediment increases the water holding capacity, where as sandy substrate holds less moisture. At Sewri mudflats it was from 58.01 to 92.37 % with an average of 76.57 %. The highest and the lowest moisture content were recorded in the month of June and November '08 respectively from station M3. Seasonal values for premonsoon, monsoon and postmonsoon periods were 75.64, 82.96 and 72.20 % respectively. The range of sand percentage for the area was from 4.10 to 7.30 % with an average of 5.57 %. The highest percentage of sand was observed in the month of January from station L1 and the lowest in December from station M2. Calculated values of sand content for premonsoon, monsoon and postmonsoon seasons were 5.45, 5.47 and 5.74 % respectively. The range of silt for Sewri mudflats varied between 35.70 and 66.20 % (av.48.57 %). The maximum silt was recorded in the month of March from station M3 and the minimum in the month of November'09 from station H1. Seasonal values of silt for premonsoon, monsoon and postmonsoon periods were 48.89, 49.38 and 47.60 % respectively. Clay content of the sediment ranged from 28.10 to 58.00 % with an average of 45.90 %. The maximum value was recorded in the month of December from station H1 and the minimum in February from station M3 and in March from stations M3 and H3. Calculated values of clay were 45.66, 45.16 and 46.68 % respectively for premonsoon, monsoon and postmonsoon periods. For the entire study area total phosphorous varied from 1050 to 4950  $\mu\text{g g}^{-1}$  with an average of 3288  $\mu\text{g g}^{-1}$ . The maximum value was observed in the month of January from station H3 and the minimum in February from stations M1 and H3. Calculated values of total phosphorous were 2609, 3536 and 3633  $\mu\text{g g}^{-1}$  respectively for premonsoon, monsoon and postmonsoon periods. The range of organic carbon varied between 1.61 and 5.32 % (av. 3.14 %). The highest percentage of organic carbon was observed in the month of December from station M2 and lowest in February from station L2. The calculated seasonal values were 2.88, 2.94 and 3.51 % respectively for premonsoon, monsoon and postmonsoon periods.

**Benthic phytoplankton:** 27 genera of phytoplankton were recorded from the sediments of Sewri mudflats. They are *Amphora*, *Amphiprora*, *Achanthes*, *Biddulphia*, *Coscinodiscus*, *Cyclotella*, *Cymbella*, *Diatoma*, *Eucampia*, *Gyrosigma*, *Hylodiscus*, *Lauderia*, *Licmophora*, *Melosira*, *Navicula*, *Nitzschia*, *Oscillatoria*, *Planktoniella*, *Pleurosigma*, *Rhizosolenia*, *Skeletonema*, *Surirella*, *Synedra*, *Thalassionema*, *Thalassiothrix*, *Triceratium* and *Spirulina*.

**Macrobenthos:** Throughout the study macrobenthos recorded from the sediment of Sewri mudflats belonged to 3 groups, polychaetes, gastropods and bivalves. Polychaetes were more in number as compared to gastropods and bivalves. They

belonged to families Eunicidae, Pilargidae, Spionidae, and Nereidae.

**Correlation:** Correlation of physicochemical parameters of sediment was significant with various parameters. Temperature of sediment showed 1 % level of significance with pH, silt and clay and 5% level of significance with sand of the sediment. Moisture contents and organic carbon of the sediments showed correlation with pH at 1 % level of significance. Correlation of moisture content with silt, clay and organic carbon of the sediment was at 1% level of significance. Sediment texture showed correlation with total phosphorous and organic carbon of the sediments at 1 % level of significance.

## V. DISCUSSION

At Sewri mudflats the variation in sediment temperature was marginal, influenced by atmospheric and water temperature. The acidic pH values observed at some station of study can be attributed to the release organic acid by mangrove into sediment (Ball, 1988). Comparatively narrow range of moisture content was reported by Matilal *et al.* (1986) from Sundarban mangroves (63.5 to 75.23 %) where coarse sand was also observed. Higher moisture content of sediment from Sewri mudflats can be attributed to dominance of silt and clay components that increases its water holding capacity. Seasonal variation of moisture content of Sewri mudflats was marginal with higher value in monsoon season. The sediment texture of Sewri mudflats showed highest percentage for clay and silt followed by sand. The percentage of sand, silt and clay for zone 1 was respectively 5.74, 41.71 and 52.56 where as for zone 2 their percentage was 5.32, 45.14 and 49.56 in that order. This indicates that the sediment texture is silty clay at zone 1 and 2. The percentage of sand silt and clay for zone 3 was respectively 5.64, 58.77 and 35.58 indicative of clayey silt texture. Considering the entire area of study i.e. zone 1, 2 and 3, the percentage of sand, silt and clay was 5.57, 48.54 and 45.90 respectively, indicative of clayey silt texture. The values of total phosphorous of sediment are higher than the values (770 – 1500  $\mu\text{g g}^{-1}$ ) observed by Ram & Zingde (2000) in Gorai creek. The higher value of phosphorous in the present study can be attributed to land drainage and regenerative activity in the sediment. Comparable values of organic carbon were observed by Joydas & Damodaran (2009) from Arabian Sea, west coast of India (av. 2.9%), Murty & Veerayya (1972) from Vembanad Lake (2.55 %), Thangaraj (1984) from Vellar estuary (2.32 %) and Reddy & Sankaranarayanan (1972) from tropical estuary (2.06 %). Vijayakumar *et al.* (1991) recorded 4.56 % of organic carbon from Kakinada Bay. Seasonal variation in the present study was marginal. Slightly higher value of organic carbon in the present study can be attributed to organic load due to land drainage, industrial discharge and mangroves. A concentration more than 4 % of organic carbon in the sediment can cause a decrease of benthic fauna.

## VI. CONCLUSION

Based on various aspect covered in the present study from Sewri mudflats following conclusions are made. Temperature

and pH were in the standard range. Moisture content was slightly higher attributed to silty clay to clayey silt nature of sediment. Organic carbon showed slightly higher values. Low population and diversity of benthic organisms was observed. Considering these findings, Sewri mudflats area can be termed as slightly to moderately polluted and under organic load. The deterioration can be attributed to huge quantity of domestic sewage and industrial effluent released in the creek. Reclamation and construction activities of ships also might be obstructing tidal flow affecting the flushing. The industries might be releasing effluents according to the pollution control board norms, but their concentration around an ecosystem accentuates the pollution effect. Continuous ecological assessment and monitoring is required to save this ecologically important ecosystem of Sewri mudflats.

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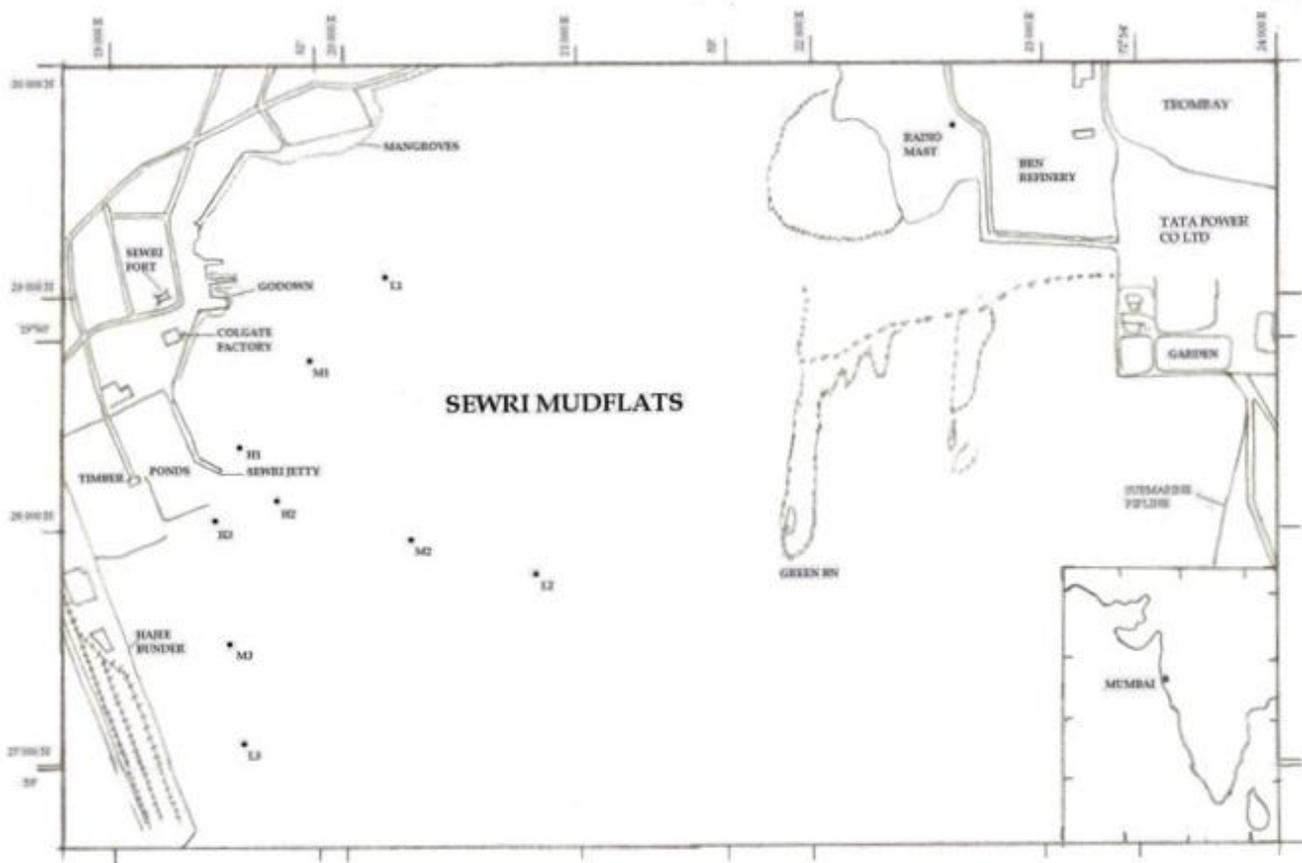
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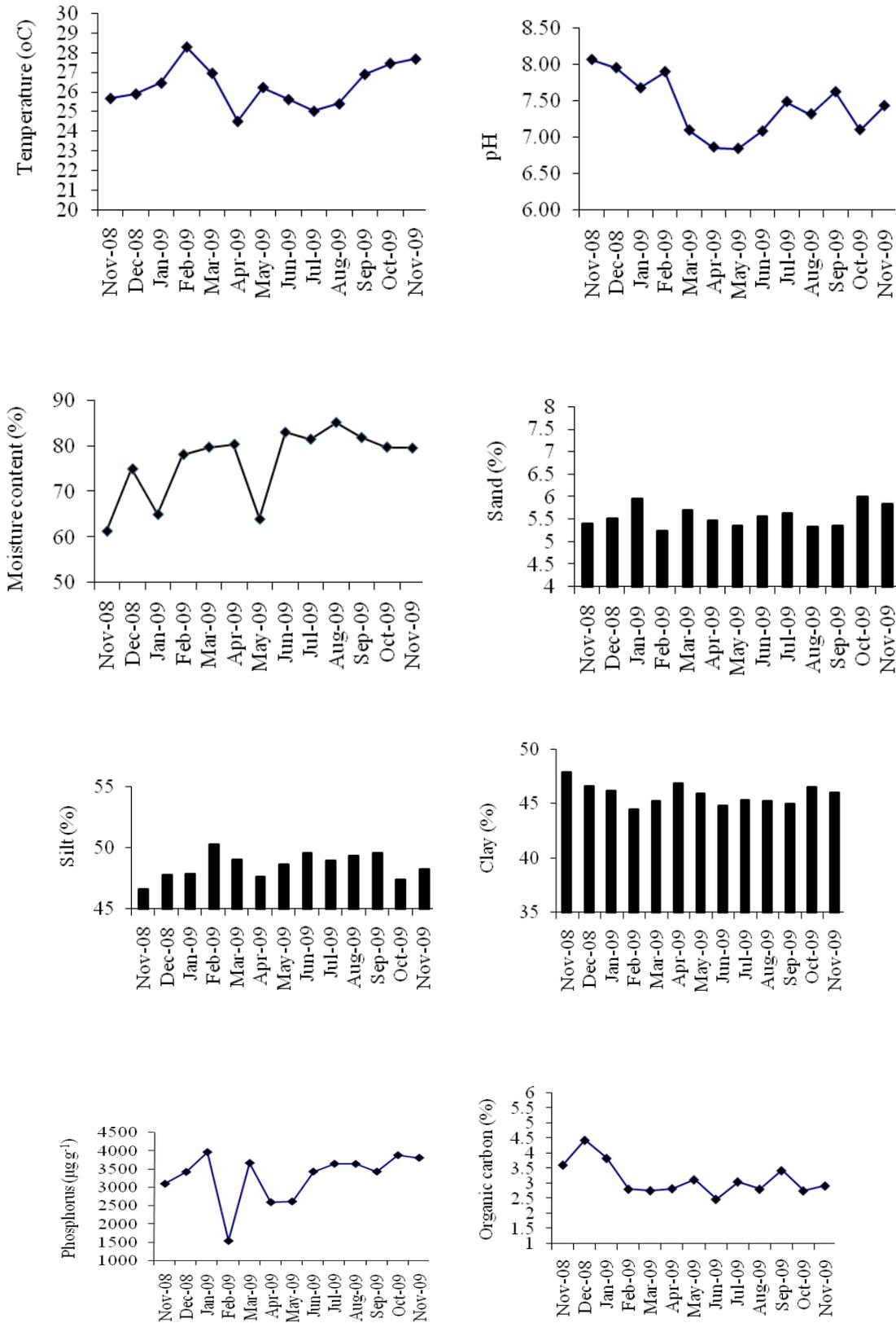
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**Table. 1.** Variations in different physico-chemical parameters of sediment (Values in parentheses are mean values).

Parameters	Zone 1	Zone 2	Zone 3
Temperature ( $^{\circ}\text{C}$ )	24 – 30 (26.3)	24 – 30 (26.3)	24 – 28.5 (26.3)
pH	6.23 – 8.28 (7.39)	6.31 – 8.30 (7.46)	6.23 – 8.36 (7.40)
Moisture content (%)	58.77 – 90.46 (76.90)	59.86 – 90.53 (76.98)	58.01 – 92.37 (75.84)
Sand (%)	4.60 – 7.30 (5.74)	4.10 – 6.20 (5.32)	4.70 – 6.70 (5.64)
Silt (%)	35.70 – 45.10 (41.71)	39.80 – 49.30 (45.14)	46.80 – 66.20 (58.77)
Clay (%)	46.20 – 58 (52.56)	44.80 – 55.40 (49.56)	28.10 – 47 (35.58)
Phosphorus ( $\mu\text{g g}^{-1}$ )	1050 – 4510 (3165)	1200 – 4620 (3272)	1200 – 4950 (3426)
Organic carbon (%)	2.17 – 4.40 (3.21)	1.61 – 5.32 (3.12)	2.13 – 4.96 (3.09)



**Fig. 1.** Location of station



**Fig.2. Mean monthly values of sediment a) temperature b) pH c) moisture content d) sand e) silt f) clay g) total phosphorus h) organic carbon**