

On physical and chemical characteristics of estuaries of Southern Gujarat

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Extensive surveys of ten estuaries of Southern Gujarat, all flowing through the coastal alluvial plains and opening in the Arabian Sea, were carried out during 1977-80 by the regional center of National Institute of Oceanography, Mumbai. The survey of these estuaries was undertaken for the preparation of a master plan for pollution control. Periodic observations at several stations along the entire estuarine stretch were carried out during different months and tidal cycles. These surveys are among the best carried out along the coast of India. The estuaries studied were Mahi, Narmada, Tapi, Mindhola, Purna, Ambika (including the tributaries Kaveri and Kareira), Auranga, Par, Kolak and Damanganga. These estuaries are under considerable tidal influence that generally increases northward. The spring tidal range in some is as high as 5.6 m in the mouth region of the estuary. High tidal influence generates strong tidal currents with current speeds exceeding 1 m s^{-1} during spring tides, which signify good mixing and flushing of estuaries.

Rapid industrialization of Gujarat State resulted in several industrial pockets in the vicinity of rivers and estuaries for the convenience of not only obtaining the freshwater, but also for dumping the civil and industrial waste. The industrial and sewage waste in several cases was released indiscriminately, without prior treatment onto the adjacent vacant land, where it either stagnated or flowed to the nearby river or the estuary. Some estuaries in Gujarat indicated rising pollution level and significant deterioration of water quality as a result of anthropogenic activities.

Tides were measured at different stages and periods (flood and ebb; spring and neap) at different stations to obtain the range, duration and type (diurnal/ semi-diurnal/ mixed). The information obtained on the extent of seawater (salinity) intrusion, saltwater influx, currents and tidal volumes was used to determine the mixing type and flushing characteristics of estuaries. Water quality parameters and nutrients were measured at different locations to understand (a) their diurnal variations and overall distribution within the estuary, (b) to ascertain the influence of wastewaters and (c) to work out the biogeochemical budgets of the estuary. Trace metals Fe, Mn, Ni, Cu, Zn, Pb and As in water, sediments and suspended particulate matter were measured to discern regular trends of variation and to identify their natural /industrial source.

Industrial and domestic wastewater discharges were quantified after gauging the streams to help evaluate their influence on the water quality of the estuary. In general, oxygen levels, pH and BOD loads were used to assess the extent of pollution in the estuary. With the knowledge of pollutant load into the estuary and the estuarine flushing characteristics, the tidal excursion within the estuary and flushing time in different segments of the estuary were evaluated to identify suitable locations for the purpose of release of wastewater.

Estuaries are a transition zone that act as a filter. Some dissolved elements in river water precipitate in the region where river water meets seawater while some elements are regenerated from the suspended particle/ sediments. During the surveys, it was opportune to study the behavioral trends of some elements (B, Ca, Mg, F, Al, Si, Fe, particulate organic matter, dissolved carbohydrates) using the concepts of theoretical dilution within the mixing zone of the estuary. Some of the findings are highlighted here.