Hydrography of the Cochin Harbour

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The hydrography of the Cochin harbour is studied with reference to air temperature, dissolved oxygen, salinity and pH. The analysis of the data shows unique hydrographical characteristics which are influenced by the monsoon rains. The uniqueness lies mainly in the fluctuations of salinity which registers as low as 0.6 ‰ during monsoon period to near sea conditions (29.4 ‰) during the summer period. The dissolved oxygen, temperature and pH also showed fluctuations corresponding to seasons.

Sea water is a complex electrolyte containing almost every known element atleast in trace amounts. In spite of this the ratios of the major constituents of sea water are constant irrespective of the geographical location and the same ratios are maintained even when the salinity goes down to five parts per thousand (Dexter, 1980); but as regards temperature, dissolved oxygen, salinity and pH, sea water especially in the coastal region shows variation. A detailed study of the environment and its variability merits consideration while attempting effective control measures and fouling prevention practices. The Cochin harbour (Lat. 9°58' N, Long. 76°16' E) is one of the finest natural harbours on the south-west coast of India and is connected to the Arabian sea through a narrow passage of about 450 m wide.

The hydrography of the Cochin harbour had been the subject of investigation from the early time (Erlanson, 1936). Ramamirtham and Jayaraman (1963) studied some aspects of hydrographical conditions of the backwater of the Cochin harbour. The works of Wallershaus (1972) on the stratification of salinity, Shynamma and Balakrishnan (1973) on the diurnal variation of some physico-chemical factors, and Haridas *et al.* (1973) on salinity, temperature and oxygen are also reported. Pillai (1977) noted that during the south-west monsoon period, salinity decreased to a very low value and the estuarine water turned almost fresh with the onset of monsoon. Salinity stratification has also been reported by Lakshmanan *et al.* (1982). Detailed investigations on the hydrographical features of the Cochin harbour water has been carried out and the results reported in this communication.

Materials and Methods

Water samples for determination of temperature, dissolved oxygen, salinity, pH and hydrogen sulphide were collected from station A (Ernakulam channel) and station B (Mattancherry channel), shown in Fig. 1, daily between 10.00 and 11.00 hours for a period of one year. The temperature of the air and surface water was read correct to 0.1°C using a thermometer. Dissolved oxygen was estimated by the method of Winkler and salinity by Mohr titration method. The pH of the sample was measured by a glass-calomel combination electrode using Phillips digital pH meter with an accuracy of ± 0.01. Hydrogen sulphide was determined by using p. phenylenediamine hydrochloride and measuring the extinction at a

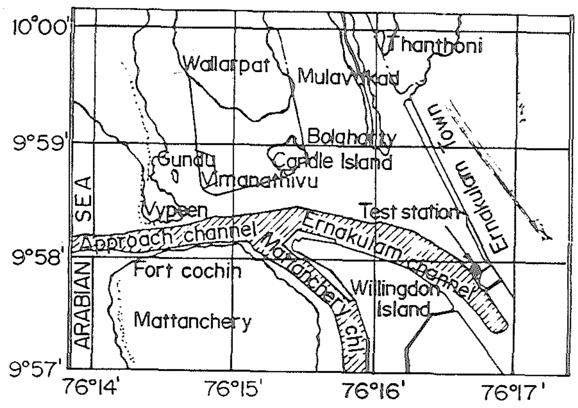

Fig. 1. Cochin harbour showing the test stations

wave length of 60000° A using Spectronic 20. Experimental procedures given in Strickland and Parson (1968) were followed for the determinations. Data on rainfall were gathered from the Indian Daily Weather Report published by the Indian Meteorological Department, Pune.

Results and Discussion

The monthly average of air temperature, surface water temperature, dissolved oxygen, salinity, pH and rainfall are given in Figs. 2 to 7. Hydrogen sulphide was not present in the samples analysed at station A.

The hydrographic features of Cochin backwaters are greatly influenced by the three characteristic seasons prevailing in Kerala, namely, pre-monsoon (December to May), monsoon (June to September) and post-monsoon (October to November). The rainfall during monsoon depends upon the south-west monsoon, and north-east monsoon.

The onset and the duration vary slightly from year to year. The changing pattern in the climatic conditions resulting from the seasonal variations is well reflected in the atmospheric temperature which recorded a sharp decline from a maximum value in April, reaching a minimum in June and gradually increasing during the post-monsoon period. The pattern of variation was similar at both test sites (Fig. 2). Same trends were noticed in the surface water

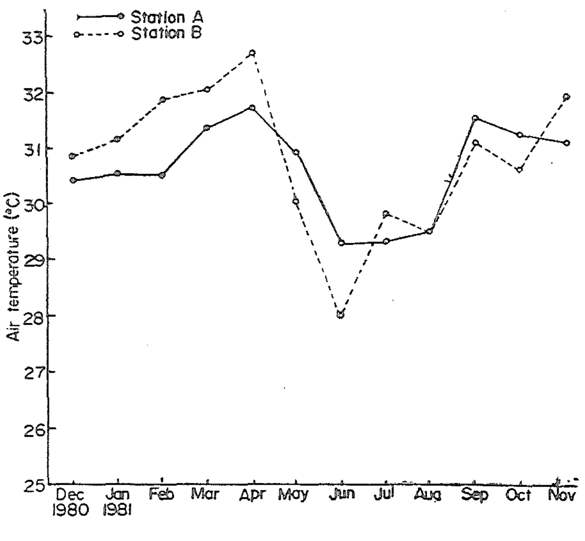

Fig. 2. Variation of air temperature during pre-monsoon, monsoon and post-monsoon periods

temperature as well (Fig. 3). Sharp variation in surface water temperature (Lakshmanan *et al.*, 1982) and vertical distribution of temperature (Ramamirtham & Jayaraman, 1960) corresponding to seasons are already reported.

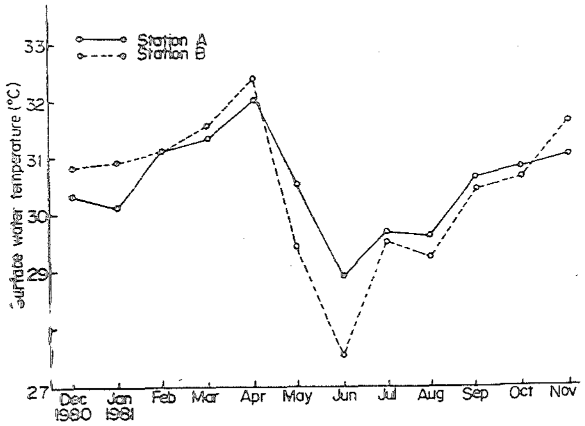

Fig. 3. Variation of surface water temperature during pre-monsoon, monsoon and post-monsoon periods

The distribution of dissolved oxygen in the surface waters is shown inFig. 4. The highest value of 7.0 ml l^{-1} for dissolved oxygen was recorded in the month of November. As the estuary is shallow in most of the areas, the effect of wind mixing, apart from biochemical factors, might influence the dissolved oxygen content. Throughout the monsoon period the dissolved oxygen remained at a high value which was in the neighbourhood of 6.0 ml l^{-1}. Comparison

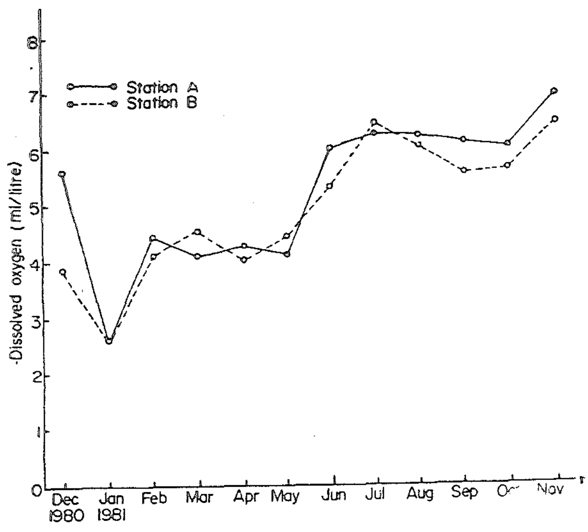

Fig. 4. Variation of dissolved oxygen during pre-monsoon, monsoon and post-monsoon periods

with Figs. 3 and 5 reveals that high dissolved oxygen values correspond to low surface water temperature and low salinity in the estuary. In the pre-monsoon period the dissolved oxygen was more or less at a level of 4.0 ml l^{-1}. This period corresponds to high atmospheric and surface water temperature and also high salinities in the range of 29.5 to 18.3 ‰. The high dissolved oxygen values can be attributed to low atmospheric and surface water temperatures, low salinity, wind and entrapment of air bubbles due to wave action mixing in the shallow basin, rainfall and clear sky promoting photosynthesis.

Based on the data reported by Fox (1907) on oxygen dissolved in sea water in equilibrium with a normal atmosphere of air, saturated with water vapour it was seen from the present results that the surface waters are 80 and 70 % saturated with respect to dissolved oxygen in the monsoon and pre-monsoon periods. A near saturation value and sometimes in excess of it for dissolved oxygen in Palk Bay has been attributed to the wind conditions over the bay (Murthy & Udaya Varma, 1964).

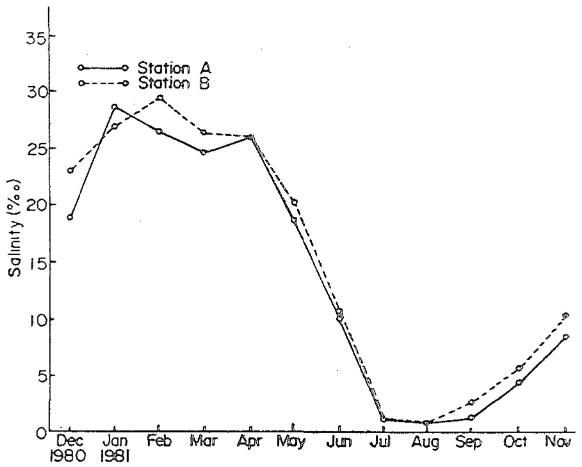

Fig. 5. Variation of salinity during pre-monsoon, monsoon and post-monsoon periods

The effect of monsoon was quite evident from the surface salinity values (Fig. 5). Three characteristic periods of high, low and gradually increasing salinities corresponding to pre-monsoon, monsoon and post-monsoon periods were noticed. Peak salinity values at station A (28.5 ‰) and station B (29.4 ‰) were recorded during January and February respectively. Decline in salinity occurred as a result of untimely pre-monsoon showers in April and May as can be seen from the rainfall data given in Fig. 7. Further progressive decline continued till the end of July and from July to September the salinity attained a low value. During this period a near fresh water condition prevailed all along the estuary. Similar observations were reported by Balakrishnan (1957), Ramamirtham & Jayaraman (1960) and Wallershaus (1972). The fall in salinity occurred fast in station A which is situated remote from the sea while salinity regain occurred fast near the barmouth (station B).

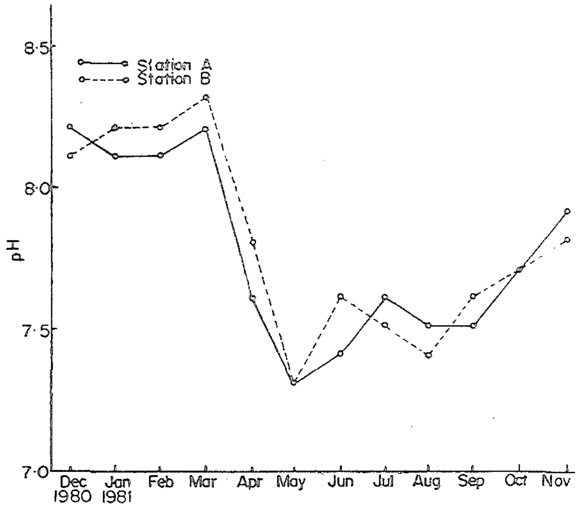

Fig. 6. Variation of pH during pre-monsoon, mon soon and post-monsoon periods

With the onset of monsoon a rapid decrease in salinity at stations lying close to barmouth was reported by Lakshmanan *et al.* (1982).

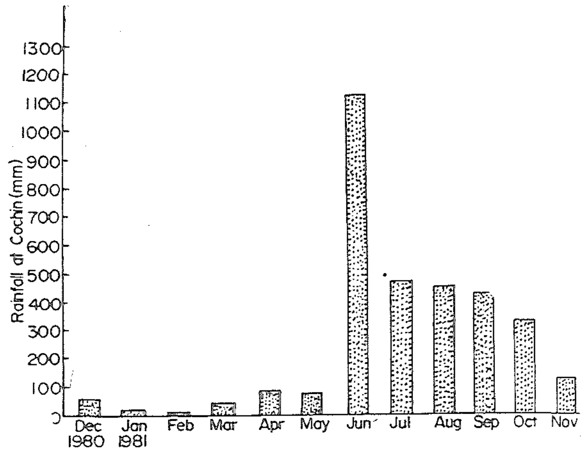

Fig. 7. Rainfall during premonsoon, monsoon and post–monsoon periods

Though in oceans large scale salinity differences do not occur, predominant changes in salinity in the environment of the Cochin harbour are of special interest in the study of marine corrosion and fouling on metals and alloys.

The pH of the surface water ranged from 7.3 to 8.3 and its average monthly variation is shown in Fig. 6. A correlation between the dissolved oxygen and pH profile was not seen though such correlation exists for ocean waters (Rao & Madhavan, 1964; Dexter, 1980). In the case of shallow continental shelf-waters off the east coast of the United States the oxygen and pH profiles do not appear to be closely related (Dexter, 1980). This may be due to the fact that in shallow waters there exists a complex interplay of photosynthesis, biochemical oxidation and mixing of water mass.

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