Eutrophication in Visakhapatnam Harbour, East Coast of India

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Waters from stations located along the decreasing grade of organic pollution in the harbour revealed abnormally high concentrations of nutrients, poor transparency, fluctuating salinity, high BOD and highly varying dissolved oxygen in contrast to waters from open sea station which is comparatively free of pollution. High inputs of industrial and domestic wastes containing phosphorus and nitrogen coupled with sluggish circulation appear to be the probable causes for the eutrophication of water in harbour area.

During recent years several major industries (notably of petroleum products, fertilisers, polymers, zinc etc.), around Visakhapatnam harbour, have started discharging their effluents into the harbour waters, through a monsoon-fed stream, Mehadri Gedda, which is also the major fresh water source into the harbour. Appreciable quantities of domestic sewage also find their way into the harbour waters adding to the bulk of organic pollution in this area. In this communication, changes in water quality in the harbour as a result of pollution, observed for 2 years (1976 and 1977), are presented.

Six stations (Fig. 1) namely sts Va, Vb (depth 1-2 m), Vc (5-7 m), Ila (10-11 m) in the inner harbour; st Ilb (15-18 m) in the outer harbour, and st I (30 m) in the open sea were selected marked by a decreasing gradation of pollution.

Both surface and sub-surface samples of water were collected at periodic monthly intervals during both phases of the tide. Temperature, transparency, turbidity, salinity, dissolved oxygen, BOD, nitrite, nitrate and inorganic phosphate were more frequently monitored, while pH, total sulphide and ammonium-phosphorus occurred in the harbour waters compared to open sea (Table 1). Abnormally high concentrations of nitrogen and phosphorus occurred in the harbour waters compared to open sea (Table 1).

At station IIb, where comparatively healthy conditions prevailed owing to the proximity of the open sea, there was a marked decrease in turbidity accompanied by a rise in transparency. Here, the ambient salinity was relatively stable, pH normal, dissolved oxygen fairly high and BOD relatively low (Table 1).

At st I, comparatively stable and healthier conditions prevailed as characterised by high transparency, decreased turbidity, high dissolved oxygen, negligible BOD and relatively stable salinity (Table 1).
Several successive outbursts of phytoplankton, particularly *Skeletonema costatum*, were reported in the harbour area, which often reached bloom proportions. At st IIa high value of Chl a (49.41 mg. m$^{-3}$) was observed indicating severe eutrophication of waters in this area. Away from the outfall, the nutrient values, however, decreased progressively in the direction of the open sea (Table 1).

In the harbour, the discharge of large quantities of untreated domestic sewage containing a heavy organic load (NH$_3$ – N, 40 mg.l$^{-1}$; BOD, 1,294 mg.l$^{-1}$; and COD, 1,873 mg.l$^{-1}$) accompanied by the fertilizer factory effluents (37 mgd) rich in nitrogen (14 ppm) and phosphorus (10 ppm) largely contributed to the enrichment of waters in this area. The construction of the outer harbour had completely offset the tidal flushing in the harbour thereby increasing stagnation. Over a period of several years, the harbour appears to have acted as a sink for nutrients, in that the nitrates and phosphates are absorbed by plankton during growth and the same deposited by the dying organisms only to be recycled. In addition, the extensive mangrove swamps fringing the harbour which seem to act as the real nutrient traps might have also contributed to the enrichment of waters in this area.

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### References