

Coastal water deterioration and associated fish mortality due to effluent discharge from a fish meal factory at Pattanamaruthor coast, north of Tuticorin

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Tuticorin coastal water is under the threat of pollution from various anthropogenic activities. Industrial discharge, untreated sewage effluents and wastes from processing and manufacturing units are the major source of pollution along Tuticorin coast. Most of the industries are letting their effluents in monsoon season in bulk quantities for the rapid mixing and dilution with rain water. Such effluent discharges very often dragged the public attention due to the extent of damages caused to the coastal ecosystem.

An incidence of fish mortality and sea shore deterioration was reported along the coastal waters of Pattanamaruthor coast, north of Tuticorin during the last week of November and first week of December 2011. On enquiry, it was understood that a fish meal factory, located 20 km north of Tuticorin, discharged foul smelling effluents along with rain water to the adjacent sea which caused severe damages to the coastal ecosystem. While inspecting the spot, it was informed that through the broken pipelines, the stored fish body fluid got mixed up with seawater and caused the related problems. Mortality of juvenile fishes of sardine and barracuda were noticed 4 km north of discharge point (Fig. 1). Fishermen complained about the mortality of lobsters



Fig. 1. Fish mortality noticed 4 km north of discharge point

and cobia juveniles maintained in cages, 5 km south of discharge point. Sticky oil balls of different sizes were found scattered around the beaches (Fig. 2) in the adjoining areas. Foul smell was experienced along the sea shore, the sea was found highly turbid and black in colour near the discharge point and the fishermen experienced body itching and irritation.

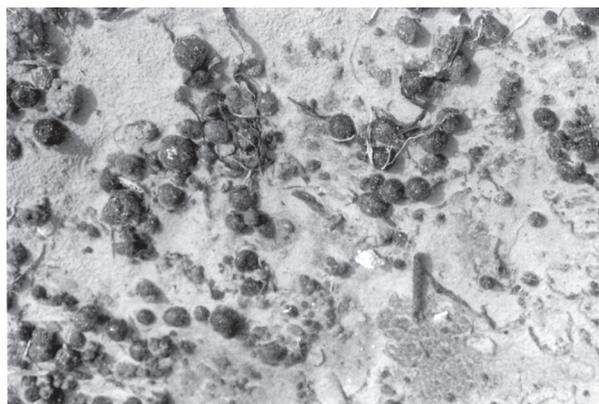


Fig. 2. Sticky oil balls of different sizes found scattered around the beaches

In order to ascertain the extent of damage caused and the possible reason for fish mortality, a follow up survey was conducted on 7th December 2011 and seawater samples were collected for analysis of water quality parameters and sediment for analysing oil and grease content, from two stations. Station 1 (St.1) -Tharuvaikulam, 20 km south of discharge point and station 2 (St. 2) – Pattanamaruthor the affected area *i.e.*, the discharge point. Sampling was again done at four stations on 16th December 2011 by fixing the stations St.1 and St. 2 as same along with two additional stations *viz.*, St. 3, about 3 km north of St.1 and St. 4 about 7 km north of discharge point. The oil sludge was also quantified to assess the extent of oil pollution along the beaches of four stations. At St.1 the oil sludge was estimated around 0.6 kg m⁻², while at St. 2 - the oil sludge was estimated around 2 kg m⁻². At St.3, sludge was found immersed

in the beach sand and estimated around 1 kg m⁻². At St. 4, no sludge formation was noticed. Due to the prevailing current and wind pattern towards the northern direction, the oil sludge formation was noticed 5 km north of discharge point and 3 km south of discharge point. All the parameters were analysed following the standard procedures and the results are given in Table 1.

The analysis of water quality parameters of the samples collected on 7th December 2011, indicated not much variation in salinity and pH among stations. The dissolved oxygen concentration was nil at the discharge point (St. 2) and lower than normal value at St.1. Very high organic load, evident from the high BOD (biological oxygen demand) value of 21.41mg l⁻¹, higher than permissible limit and high suspended solids of 0.438 g l⁻¹ at St. 2 indicated pollution due to organic waste. The depletion of oxygen to nil level also indicated the anaerobic process of decomposition in the area. Higher nutrient levels, especially nitrite and phosphate were also noticed in the seawater at discharge

Table 1. Water quality parameters recorded at the sampling stations

Date	Sampling stations	Air temperature (°C)	Water pH	Salinity	DO (ppt)	BOD (ml l ⁻¹)	Chlorophyll (mg ml ⁻¹)	Ammonia (µg ml ⁻¹)	TSS (µg ml ⁻¹)	CO ₂ (g l ⁻¹)	NO ₃ (mg l ⁻¹)	NO ₂ (µg l ⁻¹)	PO ₄ (µg l ⁻¹)	SiO ₃ (µg l ⁻¹)	Oil content (µg l ⁻¹)	Water (µg l ⁻¹)	Sediment (mg kg ⁻¹)
07-12-2011	St. 1	26	27.8	7.92	36.61	1.5584	1.37	2.2744	0.0309	0.305	0	0	0.5524	0.56	0.0089	-	-
"	St. 2	26.5	28	7.65	33.38	0	21.41	1.9947	0.0229	0.438	0	0	1.348	1.673	0.0079	40.4	1160.7
16-12-2011	St. 1	27.5	28	8.2	33.11	1.198	3.0825	2.7808	0.0369	0.267	0	0	0.6629	0.1521	0.0067	23.84	1076.05
"	St. 2	29.5	30	8.1	33.38	0.959	3.7674	0	0.0767	0.504	14	0.00058	1.3258	2.4332	0.0067	80.8	2137.3
"	St. 3	29.8	30.2	8.25	33.65	2.3976	0.6848	3.1916	0.0377	0.315	0	0	2.2017	1.7235	0.0049	56.96	427.07
"	St. 4	30	30.2	8.42	32.57	2.6374	1.37	0.474	0.0323	0.288	0	0	1.1768	1.5207	0.0067	34.88	0

area. Ammonia and silicate concentrations were normal at the affected area. The oil content estimated was 40.4 µg l⁻¹ and 1160.7 mg kg⁻¹ in the water and sediment from St. 2 respectively, which were higher than the permissible limits prescribed by GESAMP. The higher organic load coupled with lack of dissolved oxygen concentration might have caused fish mortality at St. 1 and 2.

The result of the water quality analyses of samples collected on 16th December 2011, indicated no variations in the salinity, pH and temperature between stations. Though the level of dissolved oxygen concentration improved, still very low with the lowest of 0.9590 ml l⁻¹ observed at the affected area (St. 2) followed by 1.19 ml l⁻¹ at Tharuvalkulam (St.1). Dissolved oxygen concentration was normal in the waters of St. 3 and 4. The BOD value was normalised in the affected area, still higher than the limit prescribed by the Central Pollution Control Board was noticed at St. 2 and 1. Chlorophyll was absent in the affected area (St. 2) and normal at St. 1, 3 and 4. The total suspended solid level was also still higher in the water at St. 2 and normal at St.1, 3 and 4. The presence of CO₂ was detected only at St. 2. The level of ammonia, nitrite and phosphate were also still higher in the water at St. 2. Extremely high values of oil content was noticed in the water (80.8 µg l⁻¹) and sediment (2137.3 mg kg⁻¹) at St. 2. The oil content estimated in the water and sediment of other stations (St.1, 3 and 4) were also higher than the permissible limit as specified by GESAMP.

From the results of the present study, it could be inferred that the anaerobic decomposition of high organic load present in the coastal waters, due to the effluent discharge had led to the depletion of oxygen. Along with this, the high oil content in the water and sediment were the causative agents for the coastal water deterioration and associated fish mortality. Though the fish meal factory used edible fish, oil sardine as raw material for their process, the body fluid on prolonged storage, might have produced, obnoxious substances like trimethylamine, ethylmercaptan and even poisonous compounds such as hydrogen sulphide by bacteriological and enzymatic decay. Due to the timely interference of the concerned State Government Department, it was told that the factory stopped further discharge of stored effluent and took immediate remedial measures.