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Marine water quality studies at Tuticorin harbour coastal area

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Rapid population growth and increasing industrial activities including marine activities have resulted in increasing water pollution, which is considered as one of the primary issues of environmental pollution in coastal region of developing countries including coastal area of Tuticorin harbour in Tamilnadu, India. Seawater samples were collected from three different sampling points in Tuticorin coastal area to study the physical and chemical characteristics, using various analytical techniques. The studies reveal that the physical and chemical composition of all the samples collected from the sites mainly depend on the discharge from the sources of pollutants and all the physico-chemical parameters are within the permissible limits.

[Keywords: Marine pollution; Water quality; Chemical parameters; Tuticorin harbour]

Introduction

The ocean covers approximately 70% of the earth's total surface area. In the total water content of the earth, 97% is present in the oceans. Oceans are rich source of biodiversity in which population may exceed in trillions. Oceans are the main regulatory agent of the earth's climate. About 60% of the world's population live within 60 km of coastline and use the coastline for their livelihood. It was thought that human being, living only on one-third of the portion of globe, cannot pollute this vast amount of water, as the marine ecosystems are capable of serving as sink for all the pollution caused by us. However, in reality this is not true. We have come to realize that our waste, even in small quantities, has huge effect on ocean communities and species. However, it is difficult to believe that something so massive and seemingly resilient can really be adversely affected by our activities.

Environmental pollution of the coast, inshore water and deep ocean is one of the important topical issues in the context of human health and global warming. The major pollutants like oil in coastal and marine environments and their source are shown in Figure 1. Coastal environment plays a main role in nation's wealth by virtue of the resources, productive habitats and rich biodiversity. The contamination of seawater, including trace metal concentration affects marine organisms and then people consuming them causing some carcinogenic and non-carcinogenic impacts in their body. Hence, pollution prevention and cleanup activities are required to be taken. The seawater quality should be upgraded to meet the clean seawater standards and to make the seawater suitable for fishing. The main objective of this work was to study the physical and chemical characteristics of seawater in and around Tuticorin harbour coastal area at the fishing harbour, thermal power station and new harbour area for the months of September and October 2015.

Study area

Tuticorin is the port town located between 8°40'-8°55'N Latitude and 78°0'- 78°15'E Longitude in the Gulf of Mannar. The coast of Tuticorin is sheltered by Srilanka and the coastal stretch extends up to 164 km. The population of Tuticorin is 0.4 Million which generates waste water of about 18 MLD. Tuticorin is becoming a hot spot polluted area owing to rapid industrialization and urbanization. Import of raw material for the industries and exporting the products happens regularly at Tuticorin harbour, which is now one of the busiest harbours of India[2]. Such activities contribute a lot of pollution load to the coastal area and almost entire basin. The coastal area of Tuticorin receives waste water via**.** 20 numbers of sewage outfalls. Sewage, aquaculture and non-aquaculture industries contribute major pollution load[3]. The urban effluents of Tuticorin, including significant industrial effluents contained loads of organic matter and anthropogenic metals[4].

The city generates waste water of around 18 MLD which consists of a mixture of domestic sewage and industrial waste water of some small scale industries. It has been observed that no treatment facilities are available for sewage treatment and is disposed off directly into the sea through canals. Major industries situated along the coastal stretch include: Tuticorin Thermal Power Station (TTPS), Southern Petro Chemical Industries (SPIC), and Tuticorin Alkali Chemicals (TAC)[5]. These industries are the manufacturers of various chemicals including caustic soda and fertilizers. They contribute waste water quantity of around 11MLD. Tuticorin is basically a harbour city which attracts a lot of tourists and industrialists. This leads to the development of numerous recreational spots and resorts which automatically discharges plastic and other wastes near the coast[6]. Shipping activities is also high near the coast, which contribute a considerable pollution load to the coast.

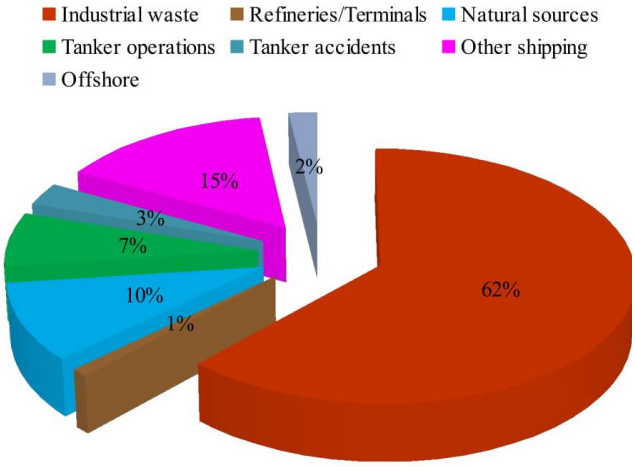


Fig. 1 — Statistics on various sources of marine oil release.

Materials and Methods

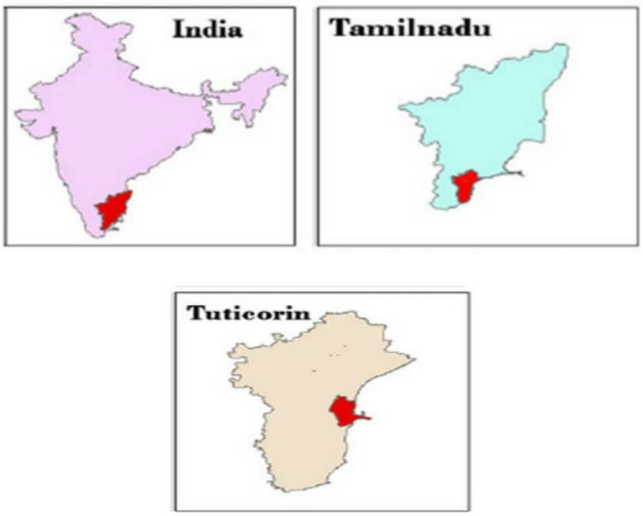
The surface water sample was collected on September 2015 and October 2015 for all the stations as per the standard methods mentioned by CPHEEO[1] manual on water supply and treatment. The sample container was cleaned by 1.0 mol/L of nitric acid and left for two days followed by thorough rinsing by distilled water. The samples were collected in clean polythene bottles without any air bubbles. The bottles were rinsed before sampling and tightly sealed after collection and labeled in the field. The sample collection was carried out for the three stations shown in Figures 2a and 2b.

Station 1: Near fishing harbour area in which the sewage of the Tuticorin corporation population area is usually discharged into the sea.

Station 2: Near the Tuticorin Thermal Power Station area.

Station 3: Near the Tuticorin New Harbour area in which the major port activities take place.

The temperature was measured in the field itself at the time of sample collection as per standard methods. The pH value, calcium, magnesium, sodium, potassium, EC, carbonate, bicarbonate and chloride were analyzed as per the standard methods for the above collected samples and the average values are listed in Table 1.



A

B

Fig. 2a — Location maps of Tuticorin District and harbour area; Fig. 2b — Location maps and sampling sites of Tuticorin Harbour area.

Table 1 — Average values (September 2015 and October 2015) of the surface water quality for the selected sampling sites of Tuticorin harbour area.

Parameters	Station 1	Station 2	Station 3
Temperature (°C)	30.3	29.2	32.3
pH	8	7.89	8.27
Sodium (mg/l)	7034	7358	7611
Calcium (mg/l)	354	363.8	384
Magnesium (mg/l)	994	965	1044
Potassium (mg/l)	243.5	239.85	266
Carbonate (mg/l)	24	24	24
Bi-Carbonate (mg/l)	63.2	48.8	73.2
Chloride (mg/l)	17532	16254	18970
Oil and grease (mg/l)	9	9.33	9.93
EC (dS/m)	44.4	39.5	42.6
Sodium absorption ratio	45.41	41.76	43.23
Calcium carbonate (meq./l)	0.80	0.80	0.80
Calcium bicarbonate (meq./l)	1.20	0.96	1.43
Magnesium chloride (meq./l)	87.03	84.5	91.41
Sodium chloride (meq./l)	330.94	346.18	358.08

Results

The physico-chemical parameters of the collected surface water samples were analysed for the period of September 2015 and October 2015 as per the standard methods mentioned by the CPHEEO[1] manual on water supply and treatment. The average values (September 2015 and October 2015) of the physico-chemical parameters of the water samples were recorded and are tabulated in Table 1. During the study period, the average water temperature for the months of September and October 2015 varied from 29.2 ˚C to 32.3 ˚C for the three stations. The average minimum temperature was recorded at Station 2 and average maximum temperature was recorded at Station 3. From these observations, it could be understood that the water temperature is governed by the atmospheric temperature of the area. The average pH value for the months of September and October 2015 of the water samples in the study area ranged from 7.89 to 8.27. The station 2 recorded average minimum pH value, while Station 3 recorded the average maximum pH value. Generally, during north-east monsoon period the pH value is slightly decreased, may be due to dilution effect of rainfall. The average value of sodium concentration for the months of September and October 2015 varied from 7034 mg/l to 7611 mg/l. The average minimum was recorded at Station 1 and the average maximum was recorded at Station 3.

The maximum value observed in Station 3 may be due to the discharge of untreated sewage and marine activities in the area. The average values of calcium concentration varied from 354 mg/l to 384 mg/l. The average minimum calcium concentration was recorded at Station 1and the average maximum was recorded at Station 3. The average values of magnesium concentration varied from 965 mg/l to 1044 mg/l. The average values of potassium concentration varied from 240 mg/l to 266 mg/l. The average values of chloride concentration varied from 16254 mg/l to 18970 mg/l. From the study, it was found that sodium and chlorides values are found rich in coastal water. The average values of oil and grease and all other chemical parameters are found to be within the permissible limits as per Environmental Protection Agency (EPA), US Federal standards for harbour water.

Conclusion

This work was aimed to monitor the quality of surface water present in and around Tuticorin harbour coastal area. The physico-chemical characteristics of the collected seawater samples were analysed for the period of September and October 2015 and it was observed that all physico-chemical parameters and oil and grease values were found to be within the permissible limits as per marine water standards and the waste water was suitable for marine organisms at present in that area. This can be maintained by proper management and disposal of wastewater.

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