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WATER QUALITY STUDY AT TUTICORIN HARBOUR

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Abstract - *The rapid population growth and increasing industrial activities including marine activities have resulted in increasing water pollution, which is considered as one of the primary issue of environmental pollution in coastal region of developing countries including Tuticorin in India. The study area map of Tuticorin harbour is collected. Seawater samples were collected from three different sampling points in Tuticorin coastal to study physico-chemical characteristics and parameters such as temperature, pH, salinity, nitrite, ammonia, silicates, dissolved oxygen and inorganic phosphate were studied using various analytical techniques. The studies reveal that the physical and chemical composition of all the samples collected from the sites mainly depends on discharge from the sources of pollutants.*

Key Words: Physico-chemical characteristics, temperature, pH, Colour, TDS.

1. INTRODUCTION

Water is an indispensible component of human resource, which covers about 3/4th of the earth surface, among which the major part is contributed by Seas and Oceans (97%).Most of the coastal areas of the world is identified to be polluted which in turn significantly affects commercial coastal and fisheries. Pollution can be measured in terms of water quality or the effects of pollutants on marine biota. Water quality is the general descriptor of water properties such as its physical, chemical and biological characteristics. Water quality can be affected by the release of effluents from either point or non-point sources. Monitoring and assessing the quality of surface waters are critical for managing and improving its quality.

Study Area

Tuticorin is the Port town which is located between 8o40'-8o55'N Latitude and 78o0'-78o15'E Longitude in Gulf of Mannar. The coast of Tuticorin is sheltered by Srilanka and the coastal stretch extends upto 164 kms. 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 materials for the industries and exporting the products happens at harbour and is one of the busiest harbours of India. Such activities contribute lot of pollution load to the coastal area and almost entire basin. Due to the accelerated development activities the coastal area experience significant changes.

2. Materials and Methodology

Water quality

The operational definition is "The water quality is that a body of water should be able to support its designated uses, which could include shell fishing, swimming, other body contact, recreational boating or fishing". Any physical, chemical, or biological condition that prevents the designated use(s) of a body of water represents poor water quality. The EPA and the State of North Carolina have defined limits for many water quality parameters that are considered to prevent designated uses. Some of the important water quality parameters and regulatory limits for them are:

Dissolved oxygen

Dissolved oxygen (DO) is critical for aquatic life and also controls chemical processes. DO is important to aquatic organisms for several reasons: most of them (like fish) need it to breathe and many of the microbes need it to perform their decomposition function ("aerobic" decomposers). DO enter the water from the air and from aquatic plant photosynthesis. Oxygen is consumed by respiration (Biochemical Oxygen Demand) and some chemical reactions. North Carolina considers values less than a daily mean of 5.0 mg/litre (ppm) or instantaneous value of 4.0 mg/l to be low and less than 2.0 mg/l to be dangerous to aquatic life.

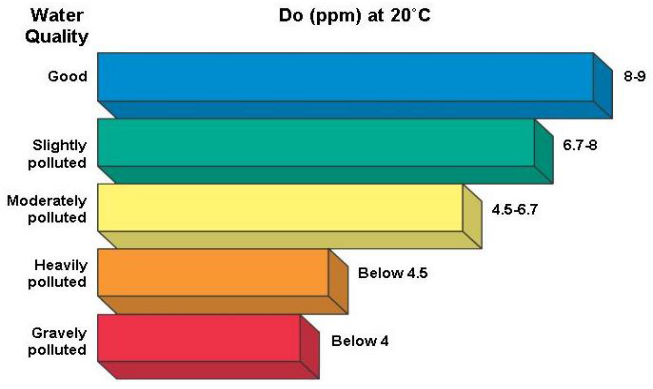

Fig 1: Dissolved oxygen

Turbidity

Turbidity is caused by suspended material that blocks light. Turbidity is a measure of how much light is scattered by materials suspended in the water. Scattered light is much less

available for aquatic plants, so high levels of turbidity can limit the growth of aquatic plants. Consequently, there are standards for turbidity in fresh (50 NTU) and salt (25 NTU) waters. NTU is Nephelometric Turbidity Unit.

Faecal coli form bacteria

Faecal Coliform Bacteria are indicators of recent contamination by faecal matter from warm blooded creatures, including humans, other mammals and birds. The MFC membrane filtration technique, which is a standard EPA, approved method, to enumerate faecal coli forms in water samples. Most of the bacteria detected by this method are E. coli, the most abundant bacterium in the guts of humans. Coli form bacteria themselves are not necessarily pathogenic, but they indicate the likelihood that more dangerous organisms, such as the organisms that cause salmonellosis, cholera or hepatitis, are present. Although contamination of waters by human wastes is especially serious, animal wastes can also transmit disease. Consequently, high levels of faecal coli form bacteria, regardless of the source, imply a high risk of disease transmission.

Total Nitrogen and Phosphorus

Total Nitrogen is a measure of the quantity of the important plant nutrient, nitrogen present in the water in dissolved and particulate forms. It is measure of the degree of nitrogen loading to surface waters. Total Phosphorus is a measure of the important plant nutrient, phosphorus, which not only stimulates aquatic weed growth, but also blooms of nitrogen-fixing blue-green algae (cyan bacteria) and bacteria. These plant nutrients occur at variable but typically low levels in natural waters. Elevated levels of nitrogen and/or phosphorus can stimulate excessive plant growth ("eutrophication"), which can be very harmful to aquatic ecosystems.

Total suspended solids

Sediment loading to surface waters raises turbidity and suspended solids levels and causes siltation, other pollutant loadings and problems for aquatic life. Suspended solids cause siltation, clog the gills of aquatic animals and carry toxic chemicals and nutrients with them when they enter the water. High levels of suspended solids are considered to be one of the most widespread water quality problems, and are frequently caused by human activities.

Sources of pollution

The coastal area of Tuticorin receives waste water via, 20 Nos. of sewage outfalls. Sewage, aquaculture and non-aquaculture industries contributes major pollution load. The urban effluents of Tuticorin, through including significant industrial (SPIC-Southern Petro Chemical Industries) effluents contained important loads of organic matter and anthropogenic metals.

Domestic waste water

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. The sewage contributes high Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solids (TSS) concentration to the sea water.

Industrial waste water

Major industries situated along the coastal stretch of include Tuticorin Thermal Power Station (TTPS), Southern Petro Chemical Industries (SPIC), and Tuticorin Alkali Chemicals (TAC). These industries are the manufacturers of various chemicals including caustic soda and fertilizers. They contribute waste water quantity of around 11MLD.

Commercial and Recreational centers

Tuticorin is basically a harbour city which attracts a lot of tourist and industrialists. This leads to the development of numerous recreational spots and resorts which automatically discharges plastic and other wastes near the coast. Shipping activities is also high near the coast and they contribute a considerable pollution load to the coast.

Table 1: Characteristics of polluted coastal water

S.No	Parameter	Concentration
1	pH	7.8-9.8
2	Temperature (^{0}C)	38-42
3	Salinity (ppt)	10.2-39.41
4	DO (mg/L)	3-6
5	Chlorophyll-a (mg/L)	0.1-85
6	Nitrite (µmol/L)	0.36-1.25
7	Nitrate (µmol/L)	0.12-3.98
8	Ammonia (µmol/L)	2.6-6.3

Need for the study

Sewage is associated with high count of bacteria and harmful pathogens which causes health effects on the people exposed to the coastal seawater that is contaminated with sewage pollution. The development of anoxic conditions in estuaries should be prevented with continuous monitoring which otherwise may lead to mortality of marine organisms.

Coastal area serves as recreational and commercial center, hence monitoring methods aids in sustainable management of the area and hence reduces expenditure for maintenance. The contamination of seawater and trace metal concentration affects marine organisms which may enter those people consuming them causing some carcinogenic and non-carcinogenic impacts in their body. Hence pollution prevention and cleanup activities are to be taken. The seawater quality should be upgraded to meet the clean sea water standards and to make the seawater suitable for fishing.

The objectives of this study are as follows:

1) To Study the Surface water Characteristics at Tuticorin.

2) Collection of sea water samples from various stations viz, Fishing harbour, new harbour, Backwater zone of thermal power station.

3) To determine the physico-chemical characteristics.

Sample collection

Monitoring methods are in practise to analyse and to study the quality of marine environment. Monitoring and assessing the quality of surface waters are critical for managing and improving its quality. In situ measurements and collection of water samples for subsequent laboratory analyses are currently used to evaluate water quality. The sample collection was done as per standard method. The sample container was cleaned by nitric acid and left it for 48 hours followed by thorough rinsing of 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 following 3 stations.

Station 1: Fishing harbour, where the municipal sewage of the town enters the sea. The source of pollution from industries and vessels.

Station 2: Back water zone near by the Thermal power station. The source of pollution is fly ash and waste water from salt pans.

Station 3: New harbor. The source of pollution from major industries like Southern Petrochemical Industries Corporation (SPIC) and Tuticorin Alkali Chemicals (TAC) etc.

The temperature was measured in the field itself at the time of sample collection as per standard method. The pH value, calcium, magnesium, sodium, potassium, carbonate, bicarbonate and chloride were analyzed as per standard method for the above collected samples.

3. RESULT AND DISCUSSION

The variations in physico-chemical parameters in water were recorded from the study area in month of Oct 2017. The physico-chemical parameters analysed as per standard methods.

Temperature

During the study period, water temperature varied from 29.2˚C to 32.3˚C. The minimum temperature was recorded at station 2 and maximum during at station 3. From these observations it could be understood that the water temperature is governed by the atmospheric temperature.

pH, Sodium

The pH value of the water sample in the study area ranged from 7.89 to 8.27. The station 2 recorded minimum pH value. The maximum pH value was recorded at station 3. Generally, during north-east monsoon the pH value slightly decreased may be due to dilution effect. Salinity range was varied from 25 parts per thousand (ppt) to 36 ppt.

Sodium concentration was varied from 7034 mg/L to 7611 mg/l. The minimum was recorded at station 1 and the 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. So, it is recorded as severe sodium hazardous zone.

Calcium, Magnesium and Potassium

The calcium concentration was varied from 354 mg/l to 384 mg/l. Minimum calcium concentration was recorded at station 1 and the maximum was at station 3. The magnesium concentration was varied from 965 mg/l to 1044 mg/l. During the monsoon, more dissolved potassium in the water are witnessed by its peak values till the post-monsoon period. Its high value in summer may be due to the regeneration by biological activities.

Preventing and cleaning up pollution in coastal waters
Prevention

1. Reduce input of toxic pollutants.

2. Separate sewage and storm lines.

3. Ban dumping of wastes and sewage by maritime and cruise ships in coastal waters.

4. Ban ocean dumping of sludge and hazardous dredged material.

5. Protect sensitive areas from development, oil drilling, and oil shipping.

6. Regulate coastal development.

7. Recycle used oil.

8. Require double hulls for oil tankers.

Cleanup

1. Improve oil-spill cleanup capabilities.

2. Sprinkle nanoparticles over an oil or sewage spill to dissolve the oil or sewage without creating harmful byproducts (still under development).

3. Require at least secondary treatment of coastal sewage.

4. Use wetlands, solar-aquatic, or other methods to treat sewage.

Summary and conclusion

General

Rapid industrialization and urbanization causes unacceptable effects on surface waters especially at the most accessible regions. Coastal zones are important, sensitive ecological systems and are also significant from an economic point of view and are overexploited or subjected to intense environmental pressures. Large loads of land-based pollutants from industrial, urban, and agricultural activities are disposed to coastal areas. Physical, chemical, biological, or thermal pollution can cause adverse effects to the marine environment, ecological damage, and even pose dangers to public health. Hence continuous monitoring of its quality is essential.

Summary

This study aims to monitor the quality of water at Tuticorin harbour. Field data are collected in person at accessible stations along the coast of Tuticorin and they are tested and analysed and compared with standard data available at study area. The results are interpreted with the development of preventive measures on pollution.

Appendix .A

Table 2 :Comparison Study of Water Quality Test

Parameter	Station 1	Station 2	Station 3
Ph	8	7.89	8.27
Sodium (Na, mg/L)	7034	7358	7611
Calcium (Ca, mg/L)	354	363.8	384
Magnesium (Mg, mg/L)	994	965	1044
Potassium (K, mg/L)	253	239.85	266
Carbonate (CO_3, mg/L)	24	24	24
Bi Carbonate (HCO_3, mg/L)	61	48.8	73.2
Chloride (Cl, mg/L)	17612	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 ($CaCO_3$, meq/L)	0.80	0.80	0.80
Calcium bicarbonate ($CaCO_3$, meq/L)	1.20	0.96	1.43
Magnesium chloride (MgCl, meq/L)	87.03	84.5	91.41
Sodium chloride (NaCl, meq/L)	330.94	346.18	358.08
Temperature (°C)	30.3	29.2	32.3

Appendix B

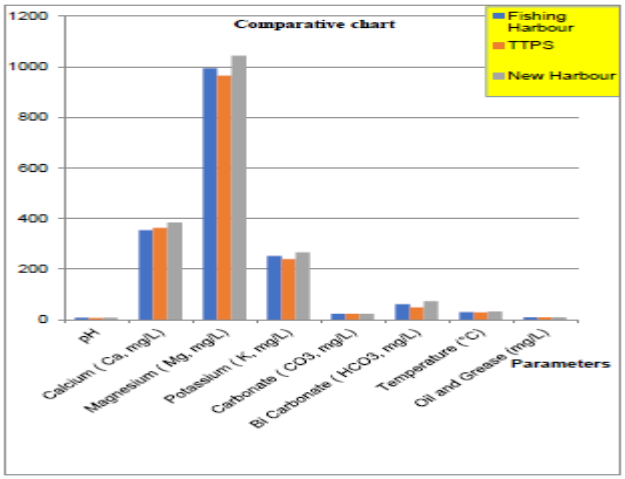

Fig 2:Comparison Chart of Water Quality Test

4. CONCLUSIONS

The physico-chemical characters of sea water evaluated in the present work demonstrates that the changes in the properties are due to discharge of effluents from surrounding environment.

Thus, we conclude that by creating proper awareness among the people in the area and by proper management of disposal can help in reducing the future deterioration of Tuticorin harbour water.

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