IMPACT OF POLLUTION ON MARINE ENVIRONMENT-A CASE STUDY OF COASTAL MUMBAI

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ABSTRACT

Marine water quality has become a matter of serious problems because of its effects on human health and environment including rich array of marine life. The rapid population growth and enormous urban and coastal development in coastal regions have caused considerable concern that anthropogenic pollution may reduce biodiversity and productivity of marine ecosystems, resulting in reduction and depletion of human marine food resources. In addition, pollution reduces the aesthetic value and also the intrinsic value of the marine environment. Globalization has brought in its wake increased demand on scarce resources leading to rapid depletion of a wide range of non-degradable products viz., metals, plastics, rubber products, which in turn generate huge amounts of solid wastes causing pollution at the entry of marine waters. Besides,the coastal Mumbai is characterized by slums with poor sanitation facilities aggravating the problem. Hence, itisessentialtomonitorcoastalwaterquality.Theaimofstudyistoassessthecoastal water quality in Mumbai.The study suggeststhat designated water quality can be achieved by restricting non-point sources through improvement incollection systemandits online treatment.

Keywords –Coast, Mumbai city, Sea Outfall, Sewage, SW-II standards, Water Quality

I. INTRODUCTION

The term Marine Pollution is defined by WHO and Group of Experts on Scientific Aspects of Marine environmental Protection (GESAMP) as "Pollution means introduction by man, directly or indirectly of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of seawater and reduction of amenities".

Sea water normally contains 20% less oxygen than that contained in fresh water of a river stream. Moreover, sea water normally contains a large amount of dissolved matter. As such, the capacity of sea water to absorb sewage solids is not as high as that of fresh water of a stream. However, since the sea contains too larger volumes of water, most of these deficiencies are removed, provided the sewage is taken deep into the sea and away from the coast line.

Three major parameters which affect the natural treatment of wastewater these are;

- Quantity of wastewater discharged.

- Quality of wastewater discharged.
- Time available for self-purification.

For coastal cities, one of the options for disposal of the waste is sea outfall. Wastewaters are partially treated at treatment plant and discharge into the marine environment. The major aim is to use the natural assimilating capacity of huge water bodies to minimize the adverse effects of the discharged wastewater. [6]

Along with the land, creeks and other water bodies, the oceans present themselves as possible sites to receive some portion of these wastes. Major part of wastewater is disposed into the sea, which pollutes the marine environment.

Coastal waters are the ultimate receivers of the organic waste materials generated by upstream cities and towns .This waste can cause dissolved oxygen depletion due to increased oxygen demand, affecting the natural ability of water bodies to withstand certain amount of pollution-the waste assimilative capacity.

The assimilative capacity of the sea is high enough to have considerable dilution effects on parameters such as BOD, DO, Nutrients and other physicochemical parameters. If the sewage is continued to be discharged without treatment, the coastal water quality will be adversely affected as there will be severe stress on the assimilative capacity of the receiving water body. [7].

II. OBJECTIVE OF THE STUDY

1. To identify the factors responsible for causing marine pollution
2. To estimate the effect and impact due to pollution to marine life.
3. To monitor the quality of coastal water and its impact on marine environment.
4. To compare the analytical results with CPCB standards.
5. To suggest policy measures to prevent marine pollution.

All bodies of water have a natural assimilating capacity to clean themselves of a certain amounts of pollution. As pollution enters the sea, it can be greatly diluted by waves, tides and currents. Pollutants tend to be concentrated in three zones of the water column; on the sea floor, in the pycnocline and the neuston layer. Pollutants can be eventually broken down by various oceanographic biological process.

Sea disposal is typically accomplished by sea outfalls that consist of a long section of pipe to transport the wastewater some distance from shore and in the best examples diffuser section to dilute the sewage with seawater.

At the end of outfall, primary treated wastewater is released in a simple stream or jetted through a manifold or multiple point diffusers. At this point the wastewater mixes with surrounding sea water and rises to the surface where it drifts as a waste water field in accordance with prevailing sea currents. This drift or movement with the currents is termed as ‘advection’. At the same time, the field is also diffusing outward into the surrounding water. If the sea is sufficiently stratified at the point of discharge, it may be possible to maintain a submerged wastewater field.

III. STUDYAREA

Mumbaiisthe capitalofMaharashtrastate,locatedatthe westcoastofIndia(Fig. 1).Thestudyarea liesbetween18^{o} 52' to19^{o}20'Nlatitudeand72^{o}48'to73^{o}05'Elongitudewithan area438sq.kmandpopulationofover13million.Many parts ofthecityliejustabove sealevel, withelevations rangingfrom10m to15m.Cityreceives around 4500 MLDwatersupply from different sources situatedin the vicinity of Mumbai.

Aesthetics of seafronts and beaches of Mumbai is poor and unhygienic due to high concentration of pollutants in the water. This result in deterioration of environmental quality at seafronts and beaches requires urgent remedial measures to improve their recreational value. [12]

Citygeneratesabout3500MillionLitres per Day (MLD)of sewage from seven service zones namely Colaba, Lovegrove (Worli) ,Bandra, Malad, Versova, Bhandupand Ghatkopar. Waste water is collected and transported through various pumping stations to the wastewater treatment facilities and discharges it into the adjoining west coast and creeks namely Malad, Marve and Thane in the Arabian Sea.

Water quality impacts on west coast and creek waters around the city are the most important considerations for future planning of marine environment.The coastal water quality of Mumbai is deteriorating due to various point and non-point wastewater sources.

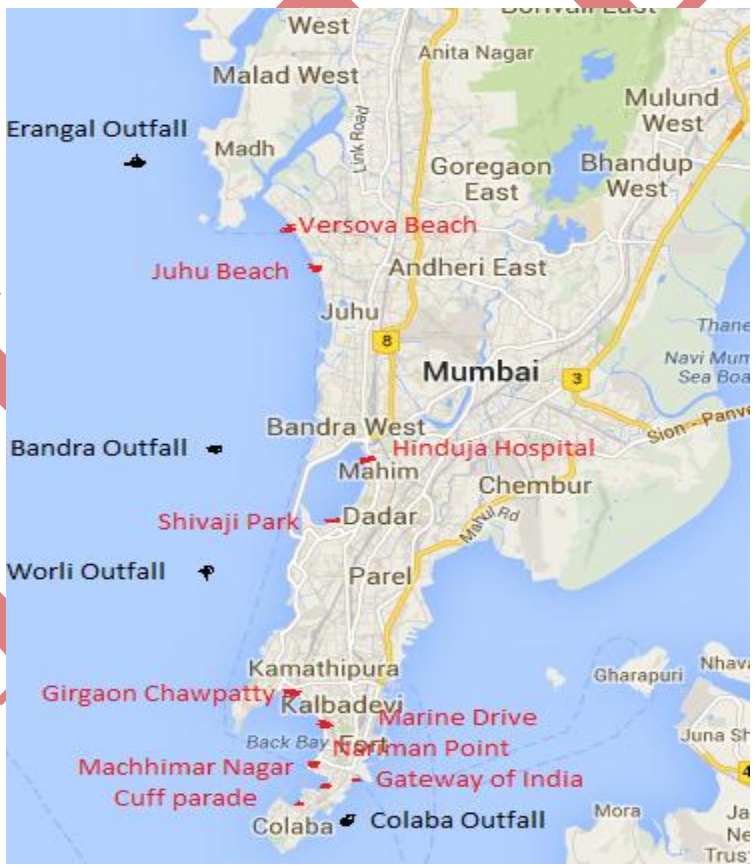

Fig.1 Location of Outfalls and Sampling stations

(Source: https://www.google.com/)

IV. MATERIALS AND METHODS

The Standard Operating Procedure is used for seawater sampling performed at long-term marine waters monitoring stations for grab sampling and ship-board sampling. [4]The grab samples collected at colaba outfall and 10 different locations in the Coast, seafronts, and beaches were analysed for physico-chemical parameters and compared with SW II classification of Central Pollution Control Board (CPCB).80 samples from west coast includingbeachesandseafronts,25 from sea outfalls were collected. The samples were analysed for physico-chemical parameters such as pH, Turbidity, conductivity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD)and Total Suspended Solids (TSS)and resultswerecomparedwithSW-IIstandardsasprescribedbyCentralPollutionControlBoard,India.

Table No 1. Classification of Seawater uses as per CPCB

SN	Designated Best Use	Class
1.	Salt pans, shell fishing, mariculture andecologically sensitive zone	SW I
2.	Bathing, contact water sport and commercial fishing	SW II
3.	Industrial cooling , recreation(non-contact) aesthetics	SW III
4.	Harbour	SW IV
5.	Navigation and controlled waste disposal	SW V

Table No 2. Primary Water Quality Criteria for Class SW- II Waters

S.N.	Parameters	Standards
1	pH	6.5-8.5
2	Turbidity	30 NTU
3	DO	4 mg/l
4	BOD (3days at 27°C)	3 mg/l

Table No 3. Standards for wastewater effluents to be discharged into sea outfall. (I.S.1968-1976)

S.N	Constituent pollutants	Tolerance limit
1	BOD	100 mg/l
2	COD	250 mg/l
3	pH	5.5 to 9.0
4	Total Suspended Solids	100 mg/l

V. RESULTS AND DISCUSSION

The samples were analysed in the laboratory for physical, chemical parameters and the result obtained were compared with the SWII standards (Table2). The water quality observed at Colaba, Worli, Bandra and Erangal outfalls area l so presented inTable4.

Table No 4. Physico-Chemical Analysis of Sea water at Sea Outfall.

Sr.No.	Outfall Locations	pH	Turbidity NTU	DO mg/l	BOD Mg/l	COD mg/l	Conductivity µS/cm	TSS mg/l
1	Colaba	6.7	35	6.5	11.8	54.9	39600	1801
2	Worli	8.2	24.3	6.6	9.5	33.6	42153	1465
3	Bandra	8.1	36	6.2	21.4	72.4	33425	2144
4	Erangal	7.95	28	6.3	8.6	32.8	38644	1163

5.1 Sea Outfalls

Samples were collected from sea outfalls as per standard methods. The samples were analysed for physico-chemical parameters. pH was observed within the prescribed limit of standards. SW II standard for turbidity of 30 NTU exceeded only in limited samples during low tide. DO was observed more than 4 mg/l in the all samples during low and high tides indicating favourable conditions for aquatic life.but BOD and COD levels were high during low and high tides.

Table No 5. Physico-Chemical Analysis of Coastal Water.

Sr. No.	Sea coast	pH	Turbidity (NTU)	Conductivity (µS/cm)	DO (mg/l)	BOD (mg/l)	COD (mg/l)	TSS (mg/l)
1	**Gateway of India**	8.2-8.5	10-15	40800	6.1-6.6	21.2-31.1	102.7-120.4	2125-2394
2	**Machhimar Nagar**	5.5-8.8	32-41	34000	1.8-2.2	52.1-71.2	211.2-243.2	1870-1910
3	**Cuffe Parade**	8.1-8.5	9-12	41000	5.9-6.2	18.5-24.1	91.8-95.3	1993-2011
4	**Nariman Point**	8.0-8.2	8-10	33100	5.6-6.2	22.4-28.6	113.4-161.3	1790-2350
5	**Marine Drive**	7.8-8.2	16-22	32800	4.8-6.1	22-33	149-168	1250-1970
6	**GirgaumChowpatty**	7.9-8.2	28-32	36300	6.1-6.3	38-53	209-257	1680-1960
7	**ShivajiPark ,Dadar**	7.5-8.0	27-38	34700	1-3	59-62	120-162	1517-1800
8	**Hinduja Hospital ,Mahim**	7.2-7.5	72-81	33800	1-2	79-82	309-317	2100-2230
9	**Juhu Beach**	7.9-8.1	12-14	33000	2.5-3.0	48-51	219-229	1700-1800
10	**Versova Beach**	8.0-8.2	12-32	33600	2.6-2.8	48-52	219-249	1682-1800

5.2. Seafronts and Beaches

Observed pH values were in the range of 7–8 satisfying SW II standards indicating neither pollution threat for biological life nor skin-eye irritation problems during contact water sports. The turbidity was observed to be in the range of 8-95NTU.About35 % of total samples were exceeded SWII standard (30NTU).Rest of the sample were in the prescribed limit.

The highest turbid it were observed at Mahim following Shivaji Park, Machhimar Nagar and Girgaon beacheshavingvalues84,38,35and 32NTU respectively. DO wasobserved morethan 4 mg/l(SWII standard)inabout85%samplesexceptMahim where it was practically zero because of heavy sewage/waste water discharge from Mithiriver which opens near Mahim beach and carries huge load of organic waste.Low DO was observed at Shivaji Park ,Machhimar Nagarand versova beaches. All of the samples were showing a larming increase in BOD and worst at Mahim and Versova where it was82 mg/l and52mg/lrespectively.

VI CONCLUSION

The discharge of domestic wastewaters through marine outfalls is commonly used to take advantage of extensive assimilation capacity of the coastal environment. If biodegradable effluents are adequately mixed and dispersed in the receiving environment, dilution could be evaluated as sustainable disposal option.

Analytical results and spatial variation of water quality assesses the impact ofwastewater in the coast, creeks and beaches. Water quality in terms of pH, Turbidity and DO satisfies the compliance level in west coast and outer region south Mumbai due to dilution.

Water quality in Dadar, Mahim and upper stretch of Mahim creek is worst affected by influx of domestic and industrial waste in terms of non- point pollution. Absence of DO and presence of high BOD requires urgent mitigation measures in the creeks. Similarly beaches and seafronts are polluted due to non- point sources. Versova is the site which is next heavily polluted location. All the other sites have similar features and were affected by similar sources and correspond to relatively cleaner areas.

Deterioration of environmental quality in the beaches requires remedial measures to improve recreation value. Spatial study revealed that there is a dire need of suggestive measures to mitigate coastal and creeks water pollution and improvement in water quality.

Measures include identification of non-point sources and improvement in existing wastewater collection system. Appropriate level of treatment and proper disposal may achieve designated water quality for the coastal and creek water environment.

To prevent the backing up and spreading of sewage should preferably be disposed of during low tides. Holding tanks can hold wastewater during high tides. Provision of a large sized sewer, grated with a non-return valve at the outfall end, is also an alternative to hold the wastewater during high tide.

The holding tank provision is difficult in the city like Mumbai, where coastal land is scarce.In Mumbai, the outfall sewers are located at proper distance and depth. Treated sewage should be disposed through outfallsewers.

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