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# Assessing the Health of Sediment Ecosystem of Mithi River of Mumbai: Use of Physico-Chemical Measurements

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**Abstract** The present paper deals with assessment of physico-chemical properties of sediments samples collected along Mithi River of Mumbai. The study was carried for the period of two years i.e. 2009-10 and 2010-11 at three different sampling stations namely Jarimari near airport, CST Kalina road and Taximen's colony at Bandra Kurla Complex (BKC). It was observed that pH values at the above three sampling stations recorded during 2009-10 were 6.75, 6.63 and 4.30 respectively, which decreases to 4.95, 4.06 and 4.02 respectively during 2010-11. The above pH values were lower than that reported by Maharashtra Pollution Control Board (MPCB) in 2004.The chloride content recorded at three sampling stations during 2009-10 were 3177 mg/L, 2849 mg/L and 1825 mg/L which increases to 3256 mg/L , 3176 mg/L and 2148 mg/L respectively during the year 2010-11. Similarly sulfate values recorded were 2204 mg/L, 3545 mg/L and 5811 mg/L during the year 2009-10 which increases to 4682 mg/L, 4266 mg/L and 5318 mg/L respectively for the three sampling stations during the year 2010-11. The above observed chloride and sulfate values were higher than that reported by MPCB in 2004. The other physico-chemical parameters like electrical conductivity, sulphide and phosphate contents were also found to be higher in 2010-11 as compared to that in 2009-10.

**Keywords** Sediments, Physico-Chemical Parameters, pH, Electrical Conductivity, Sulfate, Sulfide, Chloride, Phosphate, MPCB, Mithi River, Mumbai, India

## 1. Introduction

Sediment is the loose sand, clay, silt and other soil particles that settle at the bottom of a body of water (United State Environmental Protection[1]. It can come from soil erosion or from the decomposition of plants and animals. Wind, water and ice help carry these particles to rivers, lakes and streams. Sediments comprise an important component of aquatic ecosystems, providing habitat for a wide range of benthic and epi-benthic organisms. Exposure to certain substances in sediments represents a potentially significant hazard to the health of these organisms. Effective assessment of this hazard requires an understanding of the relationships between concentrations of sediment associated chemicals and the occurrence of adverse biological effects. Sediment quality guidelines are scientific tools that synthesize information regarding the relationships between the sediment concentrations of chemicals and any adverse biological effects resulting from exposure to these chemicals. Bottom sediments consist of particles that have been transported by water, air or glaciers from the sites of their origin in a terrestrial environment and have been deposited on the floor of a river, lake, or ocean. In addition to these particles, bottom sediments will contain materials precipitated from chemical and biological processes. Natural processes responsible for the formation of bottom sediments can be altered by anthropogenic activities. Many man-made materials have entered bodies of water through atmospheric deposition, runoff from land, or direct discharge into the water. Most hydrophobic organic contaminants, metal compounds, and nutrients, which enter the water, become associated with particulate matter. This particulate matter then settles and accumulates in the bottom sediments. Under certain conditions the contaminants in the bottom sediments may be released back into water or enter the food chain. Consequently, bottom sediments are a sink as well as a source of contaminants in the aquatic environment[2]. These contaminants may pose a high risk to the environment on a large scale and hence need to be monitored at regular intervals. Extensive research work is carried out previously to study the water pollution arising due to discharge of industrial effluents[3-13], however relatively less attention has been given to understand the relationship between

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pollution load and physico-chemical properties of sediments[14-19].

The present study to understand the physico-chemical properties of sediments is therefore carried out to understand the pollution load on Mithi River of Mumbai. The Mithi River (aka Mahim River) is a river in Salsette Island, the island of the city of Mumbai. It is a confluence of tail water discharges of Powai and Vihar lakes. It flows for a total of 15 km before it meets the Arabian Sea at Mahim Creek flowing through residential and industrial complexes of Powai, Saki Naka, Kurla, Kalina, Vakola, Bandra-Kurla complex, Dharavi and Mahim. This river is treated like an open drain by the citizens who discharge raw sewage, industrial waste and garbage unchecked. Besides this, illegal activities of washing of oily drums, discharge of unauthorized hazardous waste are also carried out along the course of this river. It is estimated that the Mithi River receives approximately 5 MLD domestic wastewater from areas like Sakinaka to Kurla, Chunabhatti, Mahim, nearby hutments through various drainages. The organic waste, sludge and garbage dumping has reduced carrying capacity of the Mithi river. The water with mixture of sewage and industrial waste is a threat to marine life and the river is showing sign of total loss of such support system. Preliminary short term survey conducted in 2004 indicates that the pollution levels have reached an alarming stage[20]. A survey on Mithi River was undertaken jointly by Central Pollution Control Board and Maharashtra Pollution Control Board, Mumbai as per the direction of Honorable Court to assess the various activities undergoing on the banks of Mithi river, which is ultimately contributing the pollution load in the river and also to suggest preventive measures to be adopted to revive the river from this precarious situation. The report suggest the presence of cyanide, one of the most poisonous substances at places like Jarimari, near Saki Naka and the airport; this is an indicator of the illegal industries functioning in these regions. Sulfates and chlorides were also noticed near Mahim Creek and farther upstream. When the river was not as polluted as it is today, it was used to serve as an important storm water drain for Mumbai but as it has been used as a sewer over the years, its importance as a storm water drain has reduced and on the contrary, it poses as a hazard during high tide bringing polluted water into the city.

Previous pollution load data based on short term survey conducted by Maharashtra Pollution Control Board (MPCB) along the Mithi river in 2004[20] points out to the need of systematic and regular monitoring of pollution level for further improvement in the waste water treatment methods. Understanding the existing status, in the present investigation an attempt has been made to study the physico-chemical properties of water samples collected at three sampling stations namely Airport, CST Kalina road, and Taximen's Colony BKC along the Mithi River of Mumbai.

# 2. Materials and Methods

### 2.1. Area of Study

Airport site near Jari Mari area from where Mithi River flows is thickly populated and has many small scale industries including scrap dealers. Previous short term study conducted by Maharashtra Pollution Control Board shows the presence of cyanide, consistent high COD, oil and grease found at this station indicating some chemical activity in that area. Development of Bandra-Kurla Complex has resulted in diversion and unnatural turn along the Mithi River at few places thereby affecting natural flow of the river and seriously affected the drainage. This part of the river is a dumping ground for garbage and it is reflected in higher values of suspended solids. Unauthorized encroachments by illegal industrial units, scrap dealers and oil mixing business at CST road near Kalina, have further resulted in discharge of solid waste, organic waste, industrial waste, heavy metals, oils and tar in the river. This sampling point is surrounded by many small scale industries including recyclers, barrel cleaners, workshops and other units. This area has thick density of population. Illegal activities like washing of oily drums have resulted in discharge of unauthorized hazardous waste which is carried out along the bank of this river. The organic waste, sludge and garbage dumping has reduced the carrying capacity of the Mithi River. The above solid wastes which is discharged in to the Mithi river from the surrounding illegal industries and the slums has resulted in sever water logging during 26/7 deluge in Mumbai. The map showing flow of Mithi River is shown in Figure 1.

### 2.2. Climatic Conditions

The area is located along western Arabian cost of India from 18 deg. 53' north to 19 deg. 16' north latitude and from 72 deg. east to 72 deg. 59' longitude. The area experiences tropical savanna climate. It receives heavy south west monsoon rainfall, measuring 2166 mm on an average every year. The temperature ranges from 16 deg. centigrade to 39 deg. centigrade with marginal changes between summer and winter months. Whereas relative humidity ranges between 54.5 to 85.5%.

### 2.3. Requirements

The chemicals and reagent were used for analysis were of AR grade. The procedure for calculating the different parameters were conducted in the laboratory. The laboratory apparatus were acid soaked (nitric acid) before the analysis. After acid soaked, it is rinsed thoroughly with tap water and de-ionised distilled water to ensure any traces of cleaning reagents were removed. Finally, it is dried and stored in a clean place[21]. The pipettes and burette were rinsed with solution before final use.

### 2.4. Sediment Sampling, Preparation and Analyses

The sediment samples were collected randomly four times in a month in morning, afternoon and evening session from three different sampling stations namely Airport near Jarimari (S-1), CST Kalina road (S-2), and Taximen's

Colony BKC (S-3) along the Mithi River of Mumbai (Figure 1). The samples were collected and subsequently analysed for a span of two years starting from October 2009 to September 2011. The sampling was done in three shifts i.e. morning shift between 07:00 a.m. to 09:00 a.m., afternoon shift between 02:00 p.m. to 04:00 p.m. and evening shift between 07:00 p.m. to 09:00 p.m. Sediment samples were collected by hand-pushing plastic core tubes (7 cm diameter) as far as possible into the sediment. The sediment cores retrieved in the field were sliced on arrival at the lab at 1-cm depth intervals for the first 15 cm, 2-cm depth intervals from 15–25 cm, and then every 5 cm for the deeper sections of the cores. The sediments were kept cool in icebox during the transportation to the laboratory[22, 23]. They were then ground manually to a fine powder in an alumina mortar; it is passed through a 2-mm mesh screen and stored in polyethylene bags based on method used by for further analysis.

### 2.5. Physico-chemical Study

The present study provides a detailed description of the physico-chemical criteria of sediment samples collected from Airport, CST Kalina road, and Taximen's Colony BKC along the Mithi River of Mumbai. The physico-chemical parameters assessed were pH, electrical conductivity, chloride, sulfate, sulfide and phosphate. The standard techniques and methods were followed for physical and chemical analysis of sediment samples[24, 25].

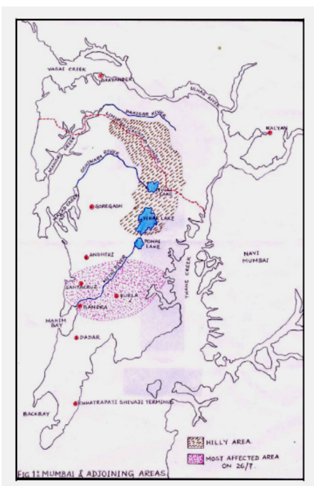

**Figure 1.** Map showing flow of Mithi River in Mumbai

### 2.6. Quality Control/Assurance

Sediment samples were collected with plastic-made implements to avoid contamination. Samples were kept in polythene bags that were free from heavy metals and organics and well covered while transporting from field to the laboratory to avoid contamination from the environment. Analytical grade reagents were used for all analyses. All reagents were standardised against primary standards to determine their actual concentrations. All instruments used were calibrated before use. Tools and work surfaces were carefully cleaned for each sample during grinding to avoid cross contamination. Duplicate samples were analysed to check precision of the analytical method and instrument.

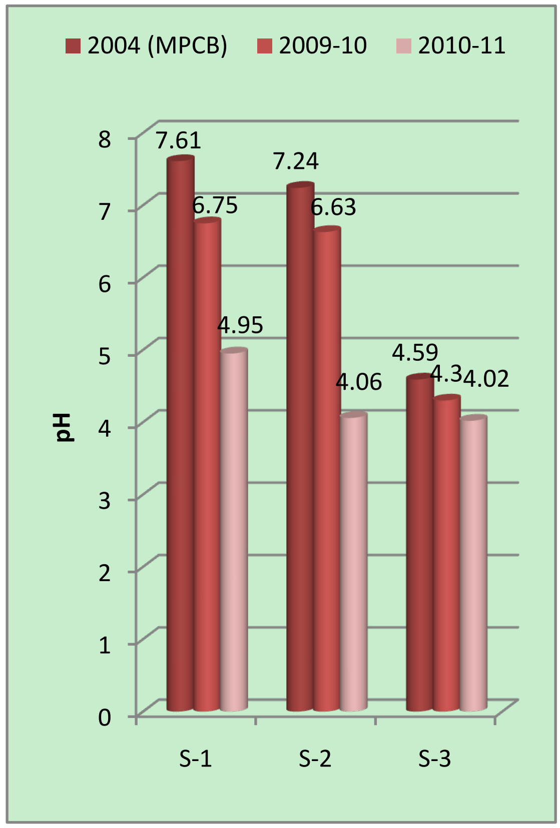


**Figure 2.** Variation in pH values of sediment samples collected at different sampling stations along Mithi River of Mumbai

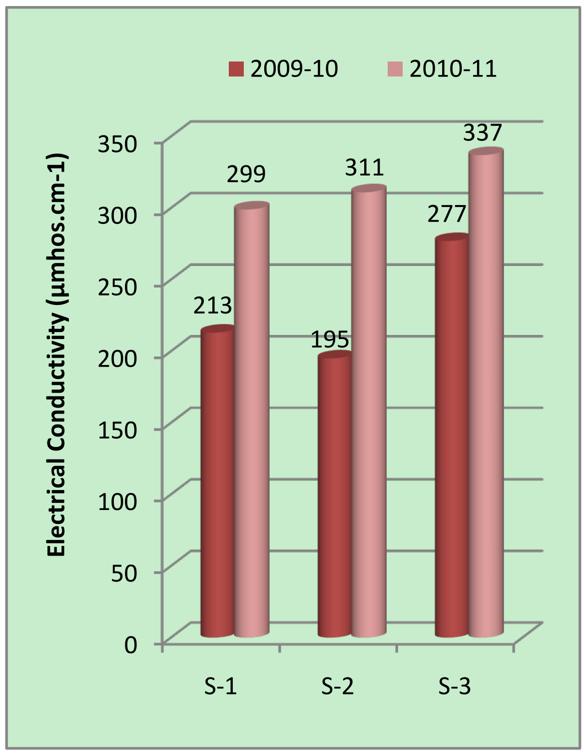


**Figure 3.** Variation in electrical conductivity values of sediment samples collected at different sampling stations along Mithi River of Mumbai

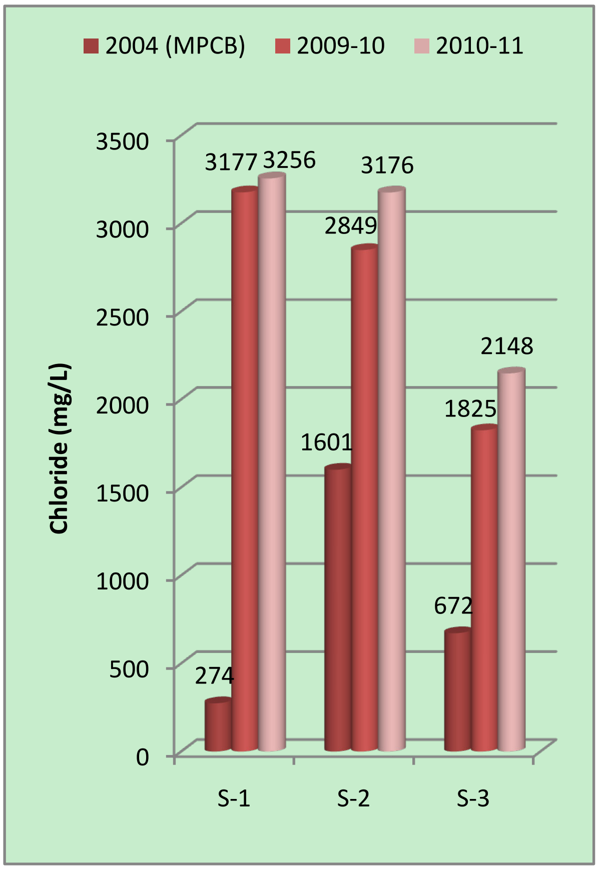


**Figure 4.** Variation in chloride content of sediment samples collected at different sampling stations along Mithi River of Mumbai

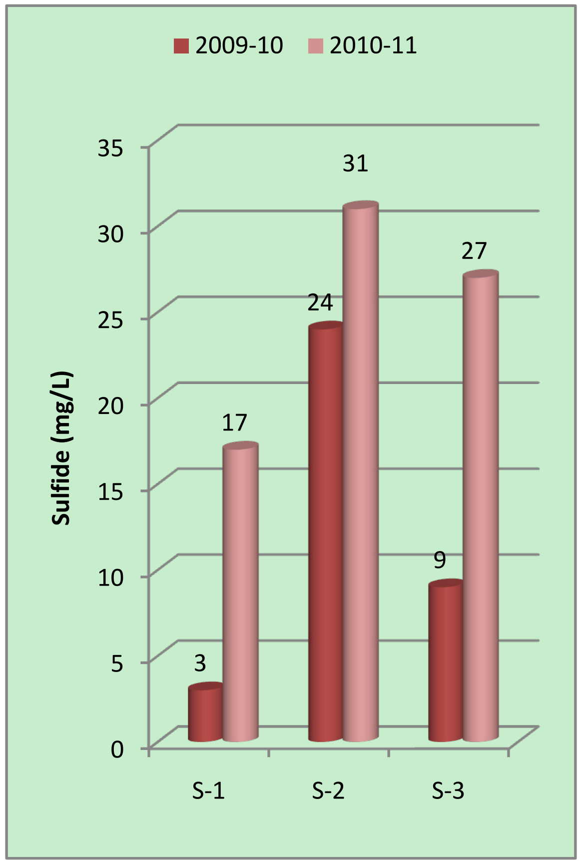


**Figure 6.** Variation in sulfide content of sediment samples collected at different sampling stations along Mithi River of Mumbai

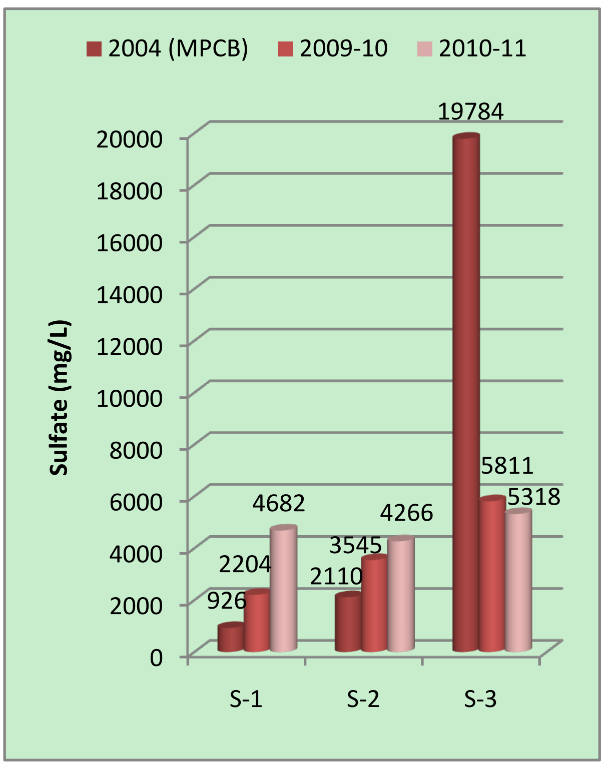


**Figure 5.** Variation in sulfate content of sediment samples collected at different sampling stations along Mithi River of Mumbai

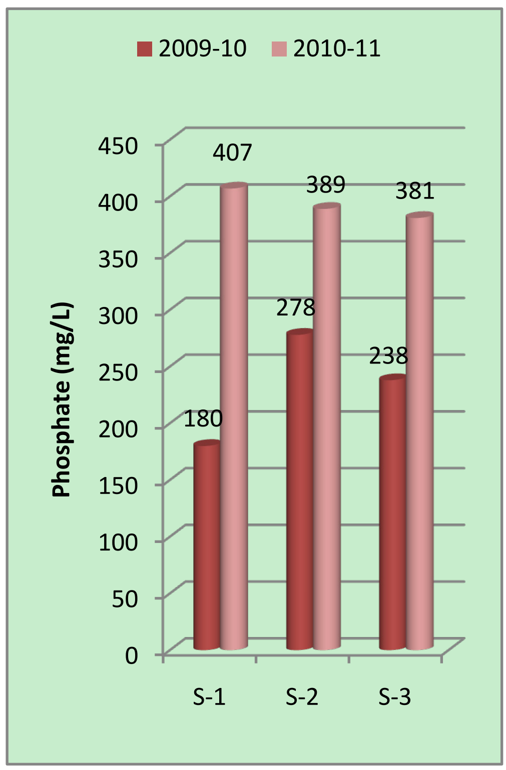


**Figure 7.** Variation in Phosphate content of sediment samples collected at different sampling stations along Mithi River of Mumbai

## 3. Results and Discussion

The experimental data on physico-chemical properties of water samples collected at three different sampling stations along the Mithi River of Mumbai is presented in Tables 1-3.

Acid mine drainage, industrial effluent, and atmospheric emissions of sulphur and nitrogen oxides are largely responsible for the acidification of surface waters and sediments. pH of the sediments is a measure of their acidity or alkalinity and is one of the stable measurements. Fish, shellfish and aquatic insects have different tolerances to acidic medium and species diversity will decrease along with increased acidification. Young organisms tend to be more sensitive to acidic medium: for example, at a pH of 5, most fish eggs cannot hatch, while only some adult fish will be affected. The toxicity of heavy metals also gets enhanced at particular pH. Acidic sediments also mobilize metals that can be toxic to aquatic species (e.g., aluminium). Metal toxicity can cause reduced survivorship in fish through chronic stress, which impairs health and decreases the affected individuals' ability to secure food; shelter, or reproductive partners[26].Thus, pH is having primary importance in deciding the quality of sediments. In the present investigation, the biyearly average pH values of sediment samples collected from different sampling stations vary between minimum 4.16 to maximum of 5.85 at S-3 and S-1 sampling stations respectively (Tables 1 and 3).

**Table 1.** Physico-Chemical Properties of Sediment Samples Collected at S-1sampling Station near Jarimari along the Mithi River of Mumbai

| Physico-Chemical Properties / Month-Year | pH | Electrical Conductivity µmhos.Cm$^{-1}$ | Chloride mg/L | Sulfate mg/L | Sulfide mg/L | Phosphate mg/L |
|---|---|---|---|---|---|---|
| Oct-09 | 7.99 | 103 | 1873 | 4319 | 2 | 103 |
| Nov-09 | 7.02 | 156 | 2986 | 3426 | 0 | 287 |
| Dec-09 | 7.56 | 209 | 3018 | 3015 | 0 | 199 |
| Jan-10 | 7.23 | 199 | 4599 | 1987 | 5 | 352 |
| Feb-10 | 7.48 | 243 | 4016 | 2018 | 8 | 211 |
| Mar-10 | 7.19 | 176 | 3877 | 2134 | 3 | 276 |
| April-10 | 7.42 | 275 | 3929 | 2542 | 1 | 310 |
| May-10 | 6.56 | 301 | 4004 | 1009 | 0 | 143 |
| June.-10 | 6.87 | 315 | 2975 | 983 | 4 | 65 |
| July-10 | 5.99 | 245 | 1849 | 545 | 7 | 78 |
| Aug-10 | 5.26 | 188 | 2002 | 1176 | 0 | 19 |
| Sept-10 | 4.37 | 151 | 2998 | 3288 | 6 | 119 |
| Oct-10 | 5.19 | 391 | 5231 | 7919 | 20 | 652 |
| Nov-10 | 5.60 | 405 | 4981 | 7818 | 16 | 287 |
| Dec-10 | 5.99 | 423 | 4756 | 7544 | 17 | 134 |
| Jan-11 | 6.18 | 380 | 4495 | 6923 | 22 | 21 |
| Feb-11 | 6.51 | 351 | 4532 | 7019 | 25 | 55 |
| Mar-11 | 5.56 | 301 | 4218 | 7325 | 18 | 103 |
| April-11 | 4.89 | 275 | 3019 | 6528 | 29 | 499 |
| May-11 | 5.47 | 234 | 3253 | 2619 | 20 | 565 |
| June-11 | 5.01 | 199 | 2516 | 1454 | 21 | 72 |
| July-11 | 4.49 | 201 | 1419 | 717 | 13 | 916 |
| Aug-11 | 1.28 | 180 | 128 | 79 | 0 | 800 |
| Sept-11 | 3.19 | 243 | 523 | 243 | 5 | 774 |
| AVERAGE | 5.85 | 256 | 3217 | 3443 | 10 | 293 |
| MPCB Report (Average)**[20]** | 7.61 | - | 274 | 926 | - | - |

It was observed that for the assessment years 2009-10 the pH values recorded were higher as compared to that recorded during 2010-11. The pH values recorded for the two assessment years were below that reported in the survey conducted by MPCB in 2004[20] (Figure 2).

It is well known that electrical conductivity is a good measure of dissolved solids. Conductivity is a measurement used to determine mineralization and determining amounts of chemical reagents or treatment chemicals to be added to the water. In the present investigation, the biyearly average conductivity values of the sediment samples varies from minimum of 253 µmhos/cm at S-2 sampling station to maximum of 307 µmhos/cm at S-3 sampling stations (Tables 2 and 3). It was also observed that the average conductivity values increases for the two assessment years (Figure 3), indicating increase in deposition of dissolved salts.

**Table 2.** Physico-Chemical Properties of Sediment Samples Collected at S-2 sampling station along the Mithi River of Mumbai

| Physico-Chemical Properties / Month-Year | pH | Electrical Conductivity $\mu mhos.Cm^{-1}$ | Chloride mg/L | Sulfate mg/L | Sulfide mg/L | Phosphate mg/L |
|---|---|---|---|---|---|---|
| Oct-09 | 7.85 | 216 | 2549 | 2032 | 25 | 153 |
| Nov-09 | 7.98 | 298 | 2792 | 3428 | 32 | 201 |
| Dec-09 | 8.01 | 301 | 2836 | 3554 | 18 | 89 |
| Jan-10 | 6.95 | 227 | 2432 | 3099 | 15 | 57 |
| Feb-10 | 6.5 | 254 | 2628 | 2879 | 10 | 103 |
| Mar-10 | 7.14 | 276 | 2567 | 3989 | 5 | 187 |
| April-10 | 7.73 | 176 | 2982 | 4278 | 9 | 235 |
| May-10 | 7.21 | 199 | 2812 | 2431 | 23 | 289 |
| June.-10 | 5.42 | 105 | 2875 | 1765 | 32 | 348 |
| July-10 | 6.19 | 94 | 2759 | 3987 | 40 | 546 |
| Aug-10 | 4.11 | 89 | 3387 | 4566 | 45 | 530 |
| Sept-10 | 4.5 | 100 | 3564 | 6532 | 28 | 599 |
| Oct-10 | 3.18 | 413 | 5018 | 7015 | 55 | 653 |
| Nov-10 | 2.99 | 389 | 3265 | 6734 | 49 | 398 |
| Dec-10 | 4.56 | 376 | 4562 | 6819 | 42 | 476 |
| Jan-11 | 6.03 | 400 | 4903 | 6698 | 38 | 29 |
| Feb-11 | 5.58 | 423 | 4109 | 6922 | 45 | 221 |
| Mar-11 | 5.95 | 321 | 3827 | 4356 | 33 | 58 |
| April-11 | 4.89 | 198 | 3919 | 5987 | 38 | 37 |
| May-11 | 3.95 | 227 | 4213 | 3218 | 27 | 201 |
| June-11 | 3.01 | 335 | 2872 | 2245 | 15 | 278 |
| July-11 | 2.86 | 254 | 1002 | 954 | 20 | 656 |
| Aug-11 | 2.58 | 190 | 118 | 88 | 0 | 700 |
| Sept-11 | 3.11 | 208 | 299 | 158 | 12 | 956 |
| AVERAGE | 5.35 | 253 | 3012 | 3906 | 27 | 333 |
| MPCB Report (Average)**[20]** | 7.24 | - | 1601 | 2110 | - | - |

Chloride occurs in all natural waters in widely varying concentrations. The criteria set for excessive chloride in potable water are based primarily on palatability and its potentially high corrosiveness. Chloride in excess (> 250 mg/L) imparts a salty taste to water and people who are not accustomed to high chlorides may be subjected to laxative effects. Plants do not thrive as well on chlorinated as on unchlorinated water; wild animals develop atherosclerosis by consumption of chlorinated water[27]. The excess of chlorides in river water accumulates in the sediments, under certain conditions they may be released back into water and may affect the plants growth and biological life in the River. The biyearly average chloride content in the river water at S-1, S-2 and S-3 sampling stations were found to be 3217 mg/L, 3012 mg/L and 1986 mg/L respectively (Tables 1-3). It was observed that the biyearly average chloride content at different sampling stations was found to increase for the two assessment years 2009-10 and 2010-11. The chloride content recorded for the two assessment years were very much above as that reported in the survey conducted by MPCB in 2004[20] (Figure 4). These chloride pollutants which are accumulated in sediment may get released in river water as a result of which their concentration in water may exceed the tolerable limit of 600 mg/L set for inland surface water[28]

**Table 3.** Physico-Chemical Properties of Sediment Samples Collected at S-3 Sampling Station along the Mithi River of Mumbai

| Physico-Chemical Properties / Month-Year | pH | Electrical Conductivity µmhos.Cm$^{-1}$ | Chloride mg/L | Sulfate mg/L | Sulfide mg/L | Phosphate mg/L |
|---|---|---|---|---|---|---|
| Oct-09 | 4.95 | 333 | 1546 | 5654 | 10 | 111 |
| Nov-09 | 5.99 | 54 | 1209 | 5760 | 11 | 234 |
| Dec-09 | 4.06 | 286 | 1325 | 5854 | 6 | 56 |
| Jan-10 | 5.32 | 299 | 1674 | 5675 | 3 | 77 |
| Feb-10 | 5.79 | 265 | 1987 | 6432 | 6 | 198 |
| Mar-10 | 5.01 | 306 | 2018 | 5687 | 2 | 267 |
| April-10 | 2.95 | 315 | 1559 | 4321 | 5 | 250 |
| May-10 | 2.67 | 323 | 1745 | 4897 | 3 | 208 |
| June.-10 | 3.59 | 276 | 1699 | 5765 | 8 | 361 |
| July-10 | 3.91 | 250 | 2018 | 5987 | 11 | 498 |
| Aug-10 | 3.38 | 299 | 2299 | 5834 | 16 | 335 |
| Sept-10 | 3.95 | 312 | 2818 | 7865 | 21 | 261 |
| Oct-10 | 7.73 | 453 | 3589 | 10674 | 40 | 656 |
| Nov-10 | 7.95 | 401 | 3657 | 10189 | 41 | 543 |
| Dec-10 | 6.88 | 434 | 3018 | 9432 | 29 | 179 |
| Jan-11 | 6.1 | 430 | 3200 | 2810 | 38 | 28 |
| Feb-11 | 6.54 | 376 | 3143 | 5256 | 35 | 53 |
| Mar-11 | 3.99 | 389 | 2098 | 4554 | 32 | 227 |
| April-11 | 2.04 | 407 | 2564 | 4431 | 36 | 426 |
| May-11 | 1.78 | 278 | 1786 | 5986 | 30 | 498 |
| June-11 | 1.56 | 334 | 556 | 5786 | 26 | 312 |
| July-11 | 1.08 | 198 | 989 | 3018 | 10 | 554 |
| Aug-11 | 1.1 | 130 | 168 | 85 | 0 | 600 |
| Sept-11 | 1.53 | 209 | 1009 | 1599 | 5 | 498 |
| AVERAGE | 4.16 | 307 | 1986 | 5565 | 18 | 310 |
| MPCB Report verage)[20] | 4.59 | - | 672 | 19784 | - | - |

Sulfates are discharged into the aquatic environment as wastes from industries like pulp and paper mills, textile mills and tanneries. Atmospheric sulphur dioxide ($SO_2$) formed by the combustion of fossil fuels and by the metallurgical roasting process, may also contribute to sulfate content of surface waters. It has frequently been observed that the levels of sulfate in surface water correlate with the levels of sulphur dioxide in emissions from anthropogenic sources[29]. The excess of sulphates will settle down and get accumulated in bottom sediments. These pollutants under some conditions may get released back in to the river water. The presence of sulfate salts in surface water could enhance corrosion of mild steel in the distribution networks[30]. High sulfate loads in polluted Creeks and groundwater have led to increased sulphur fluxes and concentrations in fens and marshes, e.g. in the Louisiana delta plain[31]. Although much is known about sulfide toxicity in marine environments[32, 33], quite a few studies have investigated this in freshwater wetlands. Vegetation development was greatly influenced by the effects of $SO_4$ addition. The accumulation of sulfide led to highly toxic levels resulted in the disappearance of several sensitive species and a much lower total biomass[34]. This toxicity effect was, however, more disastrous under nutrient-poor conditions, where almost all species disappeared completely. In the present investigation, the biyearly average concentration of sulfate in river water at S-1, S-2 and S-3 sampling stations were 3443 mg/L, 3906 mg/L and 5565 mg/L respectively (Tables 1-3). However the biyearly average sulfide concentrations were found to be low of 10 mg/L, 27 mg/L and 18 mg/L respectively (Tables 1-3). The results also indicate that average sulfate and sulfide concentration increase for the two assessment years 2009-10 and 2010-11 (Figures 5 and 6). It is important here to note that the average sulphate content at sampling stations S-1 and S-2 for the two assessment years were very much above as that reported by MPCB in 2004[20]. However sulphate content recorded at S-3 sampling station was below that reported value by MPCB (Figure 5). These sulfate and sulfide pollutants which are accumulated in sediment may get released in river water as a result of which their concentration in water may exceed the tolerable limit of 200 mg/L and 2 mg/L respectively set for inland surface water[28].

Phosphorus pollution caused enormous blooms of the Blue-Green Algae, a form of cyanobacteria, which can produce neurotoxins (affecting the nervous system) and hepatotoxins (affecting the liver). The same toxins can damage aquatic ecosystems, fisheries, and water quality. Excess amounts of phosphorus and nitrogen cause rapid growth of phytoplankton, creating dense populations, or blooms. These blooms become so dense that they reduce the amount of sunlight available to submerged aquatic vegetation. Without sufficient light, plants cannot photosynthesize and produce the food they need to survive. The loss of sunlight can kill aquatic grasses. Algae may also grow directly on the surface of submerged aquatic vegetation. Unconsumed algae will ultimately sink and be decomposed by bacteria in a process that depletes bottom waters of oxygen. The results of present study indicates that the biyearly average phosphate level lies in the range of 293 mg/L at S-1 sampling station to 333 mg/L at S-2 sampling station (Tables 1 and 2). The graphical representation indicates higher concentration of phosphates at all the three sampling stations during the assessment year 2010-11 as compared to 2009-10 (Figure 7). It is important here to note that such high level of phosphate in sediments may get released in river water, as a result of which phosphate concentration may exceed the tolerable limit of 5 mg/L set for inland surface water[28].

# 4. Conclusions

Environmental problems concerning coastal & aquatic bodies cannot be addressed in isolation. They are intricately interwoven with each other. The environments of land and water bodies are interdependent, linked by complex atmospheric, geological, physical, chemical and biological interactions. The human activities that effect, and arise from this environment also depend on economic and social factors. The problem is beyond the limits of physical and institutional bodies, and therefore, there is a need to set common objectives and implement compatitable policies and programmes. Today it is realised that solution to environmental problem can only be achieved through a comprehensive, systematic and sustained approach. During the past few years, attempts were made by various groups to develop strategies directed towards more integrated approach in coastal environments. The present data on pollution in sediments at Mithi River also points out to the need of regular monitoring of water resources and further improvement in the industrial waste water treatment methods. What is more fundamentally lacking is a consistent, internationally recognised and data driven strategy to assess the quality of aquatic bodies and generation of international standards for evaluation of levels of contaminants. The existing situation if mishandled can cause irreparable ecological harm in the long-term well masked by short term economic prosperity.

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