# DETECTION OF WATER POLLUTING CHEMICALS AFFECTING MANGROVES OF BELAPUR CREEK, THANE

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**Abstract:** Coastal zones are highly dynamic area of interaction between terrestrial and marine process. Mangroves are salt tolerant trees that grow in coastal areas of tropical and subtropical regions where river inters into the ocean. Mangroves are coastal habitats which are highly loaded with immense nutrient and always share it with adjoining coastal habitats. The system supports many endangered and endemic species throughout the tropical coast. They serve as a custodian of the many species of fishes, crabs, shrimps and provides nursery to juvenile stock and form most valuable biomass. Experiences have shown that the presence of mangrove ecosystem in coastal areas saves lives and property during natural calamities like cyclones, tsunami, storms and erosion. Anthropological pressure and natural calamities are the enemies of mangrove ecosystem. The continued decline of the forest is caused by conversion to agriculture, aquaculture, tourism, urban development and overexploitation. With the view to have a systematic approach , studies such as metal contents of mangrove sea water and its effect on the pneumatophore a breathing root system, checking the coastline changes and their effect on coastline life. The data has been collected from Belapur Creek of Mumbai suburb showing endangered effects on mangroves ie. On Pneumatophore and Zooplankton, heavy metals have been detected.

**Keywords:** Mangrooves, Belapur Creek, Anthropological changes, Pneumatophore and Zooplankton

**Introduction:** The word mangrove refers to a group of extensive trees of medium height that grows in saline coastal sediment habitat in the tropic and sub tropics mainly between latitudes of $25^0$N and $25^0$S. They are unique as they have the ability to grow in unstable tough environment as they thrive in areas like which is poor in oxygen content i.e. in salt water, in fresh water and in brackish water. The word "Mangrove "is a combination of words "Mangal" (Portuguese) "Grove" (English. They produce stilts roots which rise above the mud and water to absorb oxygen. This taxonomically diverse group of salt tolerant mainly arboreal, flowering plants plays important economic and socio- economic roles by acting as a nutrient filter between land and sea. They are tolerant to fluctuating water salinity. The prop roots and the stilt roots form a firm anchorage in the sinking substratum also trap the fine suspended particles in water leading to accumulation of sediments and formation of the mudflats. The mudflat enhances the growth of different mangrove species and their associate plants thereby developing mangrove forest or mangrove ecosystem. The saline conditions tolerated by various mangrove species ranges from brackish water through sea water( 30 to 40 ppt) to water concentrated by evaporation to over twice the salinity of ocean sea water(up to 90ppt).. Thus for a plant to survive in this environment it must tolerate broad ranges of salinity, temperature, moisture as well as other key environmental factors . Mangrove plants have a number of highly specialized adaptations to survive in regular tidal inundation by saline waters such as breathing roots that allow them to survive in anaerobic sediments, supporting structures such as buttresses and columnar roots which enable them to grow in unstable substrate, low water holding potential and high intracellular salt concentration to maintain favorable water relation in saline environments, foliage salt excretion to remove excess salt from the sap, xerophytes leaves to cope with periods of high salinity stress and buoyant viviparous propagules for dispersal and establishment in new areas. The mangroves grow mainly between latitudes of $25^0$Nand $25^0$S. Approximately 75% world's mangroves are found in just 15 countries. Asia has the largest amount (42%) of the world mangrove followed by Africa (21%), North/Central America (15%), Oceania (12%) and South America (11%).

**Types of Mangroves:**

The four broad types of Mangroves that exist around the world:

1. **Red Mangrove:** They are highly salt tolerant plant groups have characteristics modified roots called prop roots that grow from the lower part of a stem or trunk. The prop roots allow them to live on anaerobic substrate provide gas exchange facilities, anchoring system and absorbing ability.
2. **Black Mangrove:** They are moderately salt tolerant species. The wood of these trees are dark brown to nearly black. These trees have special breathing roots and these roots emerge out of the soil. Breathing roots have special air channel for gas exchange and air enters at zones of pneumathodes.
3. **White Mangrove:** They have white smooth white bark, thus easily differentiated from other mangrove species by its leaves and root system.

The leaves are rounded at the base and the tip and are smooth underneath.

4. **Buttonwood Mangrove :** They are shrubby mangroves usually low branching and multi trunked. Its fruits are red brown in colour and have cone like figure.

**Zonation :** On the basis of salinity five zones of mangrove distribution are considered. They are Euhaline, Polyhaline, Mesohaline, Oligohaline and Limnatic zones.

1. **The Euhaline Zone:** The salinity ranges from 30ppt to 40ppt. Wave action is maximum and the gradient is not steep, thus sediment accretion will take place in the region of confluence which is known as delta.
2. **The Polyhaline Zone:** The salinity ranges from 18ppt to 30ppt has a low wave action and its substratum is sandy clay.
3. **The Mesohaline Zone:** The salinity ranges from 5ppt to 18ppt has silty clay bottom and feeble wave action.
4. **The Oligohaline Zone:** The salinity ranges from 0.5 ppt to 5 ppt due to this more freshwater influx and its substratum is silty.
5. **The Limnatic Zone:** The salinity ranges from 0.5ppt and the substratum is full of gravel and coarse grain of sand. It has more fresh water influx.

**Biology of Mangroves**:

1. **Adaption To Low Oxygen:** Red mangroves which can survive in most inundated areas, prop themselves live on a higher grounds and make many pneumatophores (special root like structures which stick up out of the soil like straws for breathing) which are also covered in lenticels. These breathing tubes typically reach height up to 30cms and in some species over 3m. The four types of pneumatophores are stilt or prop type, snorkel or peg type, knee type and ribbon or plank type. Knee and ribbon types may be combined with buttress roots at the base of the tree. The roots also contain wide aerenchyma to facilitate transport within the plants.
2. **Limiting Salt Intake:** Red mangroves exclude sail by having significantly impermeable roots which are highly submersed, acting as an utrafication machismo to exclude sodium salts from the rest of the plant. Analysis of water inside mangrove has shown 90% to 97% of salt has been excluded at the roots. Red mangrove can also secrete salt in vacuoles.
3. **Limiting Water Loss:** Because of the limited fresh water available in salty intertidal soils, mangroves limit the amount of water they lose through their leaves. They can restrict the opening of their stomata (pores on the leaf surface which can exchange $co_2$ gas and water vapour during photosynthesis). They also vary the orientation of their leaves to avoid the harsh midday sun and so reduce evaporation from the leaves.
4. **Nutrient Uptake**: Because the perpetually waterlogged little free $0_2$ is available. Anaerobic bacteria liberate nitrogen gas, soluble iron, inorganic phosphates, sulphides and methane which make the soil much less nutritious. Pneumatophores (Aerial Roots) allow mangroves to absorb gases directly from the atmosphere and other nutrients such as iron from the inhospitable soil. Mangroves store gases directly inside the roots, processing them even when the roots are submerged during high tide.
5. **Increasing Survival Of Off Spring:** Mangroves have a special mechanism for the survival of their offspring. Mangroves seeds are buoyant and are therefore suited to water dispersal. In many mangroves (e.g. red mangroves) are viviparous whose seed germinate while still attached to the parent tree. Once germinated the seedlings grows either within the fruit (e.g. Aegialitis, Avicennia and Aegiceras) or out through the fruit (e.g. Rhizophora, Ceriops, Bruguiera and Nypa) to form a propagule (a ready to go seedling) which can produce its own food through photosynthesis. The major propagule then drops into the water which can transport it great distance. Propagules can survive desiccation and remain dormant for over a year before arriving in a suitable environment. Once a propagule is ready to root, its density changes. So the elongated shape now floats vertically rather than horizontally. In this position it is more likely to lodge in the mud and root. If it does not root it can alter its density and drift again in search of more favourable conditions.

**Importance of Mangroves:**

**Shoreline Stabilization and Protection:** Located along the coastline, mangroves play an important role in soil formation, shore protection and stabilization. The mangrove forest's extensive ,above ground root structure(Prop Roots, Drop Roots and Pneumatophores) act as a sieve, reducing current velocities and shear and enhancing sedimentation and sediment retention (carlton1974,Augustinus 1995). By enhancing sedimentation, sediment retention, soil formation, mangrove stabilizes a soil which reduces the risk of erosion.

**Animal Habitat and Food Source:** Mangroves arial root system provides a substrate for colonization by algae, wood borers and fouling organism such as barnacles, oysters' molluscs and sponges. From the diverse group of invertebrates found in mangroves anthropoids, crustaceans and mallusks are among the most abundant. Some species like crabs and

snails are important component of detrive food chain, help break down leaf litter through grazing. Shrimp, bivalves like oysters, mussels and clams are commonly found and act as nursery habitat for diverse community of fish especially during juvenile stages. Numerous insect species play a vital role as mangroves pollinators, herbivores, predators and as a food source for other animals. Amphibians and reptiles such as frogs, lizards, snakes and crocodiles also inhabit mangrove. Birds use mangroves for refuge nesting and feeding. Mammals include racons, wild pigs, rodents, deer, monkeys, bats, Turtles, manatees, dolphins and porpoises are the occasional visitors to mangrove dominated estuaries.

**Water Quality Improvement**: Mangrove habitats maintain water quality, by trapping sediments in the mangrove root system thereby protecting coastal ecosystem such as oysters, sea-plants and coral reefs from excessive sedimentation. Mangroves also improve water quality by removing organic and inorganic nutrients from the water column, through centrifugation and soil nutrients burial, mangroves lower nitrate and phosphorus concentrations in contaminated water, preventing downstream and coastal eutrophication.

**Mangrove Economic Values and Uses:**The most common use of mangrove wood as a source of fuel either charcoal or firewood as a primary material for the construction of houses, boats, furniture etc. Besides wood, mangrove bark has been used as a source of tannins which is used as a dye and to preserve leather. The pneumatophores of different mangrove species are used in making corks, fishing floats, in perfumes and condiments. The ash of Avicennia and Rhizophora mangal is used as a soap substitute. Other mangrove extracts are used to produce synthetic fibres and cosmetics. They are also used as a source of food (e.g. honey, vinegar, salt and cooking oil) and drinks (alcohol, wine). Mangroves have medicinal uses also like many mangroves are used to treat toothache, sore throat, constipation, fungal infections, bleeding, fever, kidney stones, rheumatism, dysentery and malaria. Mangroves also contain toxic substances that have been used for their antifungal, antibacterial and pesticidel properties. Mangroves are attractive to tourists because of the flora and fauna they inhabit. Mangroves leaves when dried smell like tea. Thus extract of this are responsible for the smell, flavour and colour of the leaves and to develop a protocol for extracting black tea like beverage from the mangrove leaves

**Screening of Uv-B Radiations:** Mangroves are capable of radiating high doses of solar- UV-β radiation back to atmosphere by virtue of accumulating "UV- Screen" compounds like flavanoids in their leaves. Thus the mangroves can be cultivated for making the coastal zones free from lethal effects of the UV-β radiations. There is also a possibility of extracting the UV screen compounds for their application in cosmetics and pharmaceuticals to deter the harmful effects of UV (Moorthy and Kathiresan, 1996).

**Case Study : Belapur:** Established in 1972, Navi Mumbai is a planned township in Mumbai and is located in the west coast of Maharashtra. Certain conditions led to the formation of the city. As Mumbai is surrounded by sea on three sides - east, west and south, the scope of development in the city was limited. In the late 1960s, eminent architects and urban planners came up with an idea to create another city as an alternative to Mumbai which would also help to disperse and control the population of the city. Navi Mumbai is a well-planned and well-balanced modern city. It has been planned and developed by the City and Industrial Development Corporation (CIDCO), a state public sector undertaking registered under the Companies Act, 1970. There are four suburban stations in Navi Mumbai-Nerul, Vashi, Belapur and Panvel Navi Mumbai spreads over parts of two districts of Maharashtra, Thane & Raigad. The region is hilly in some parts, and certain areas of the region are protected wetlands. Navi Mumbai temperature varies from 22°C to 36°C. In winter temperature is between 17°C to 20°C while summer temperature ranges from 36°C to 41°C. Out of total rainfall, 80% rainfall is experienced during June to October. Average annual rainfall is 2000–2500 mm and humidity is 61-86 %, making it a humid-perhumid zone. The driest days are in winter while the wettest days experienced in July. The soils of this region are high in saline in the vicinity of creeks with lower saline at other places. They are calcareous, neutral to alkaline in reaction (pH 7.5 to 8.5), often contain clay, with a high amount of bases and high water holding capacity (200–250 mm/m). The soils located on moderately sloping residual hills are lateritic in nature and show intensively leached surfaces. They are loamy and slight to moderately acidic (pH 5-6.5) with moderate base status (<75%)

**Objective of the Study:**

a) To study present mangrove scenario in CBD Belapur a Navi Mumbai suburban's area.
b) Survey on creek area of Belapur region.
c) Check the heavy metals content in creek water in study area.
d) Study metal effect on the roots of mangrove in study area.
e) To study & analyze the Government policies on mangrove conservation
f) Suggesting mitigation measures for mangrove conservation & care to maintain ecological balance.

**Methodology of study:**

**Collection of Samples:**Water samples were collected forenoon from 10-15cm depths below the water surface during mid July of 2016 and roots samples are also collected on the same day from the same site.

**Sample preparation and analytical methods:** Water samples were collected and transferred into acid-cleaned plastic bottles of 100 ml and the mouth of bottles are tied with Teflon tape and stored in a fridge ($4^{o}$C) until analysis and collected root samples from same sites were transferred into acid-cleaned plastic bottles of 100 ml and are preserved with 4% formalin and 96% water and then stored in fridge until analysis...

To determine the degree of contamination in the water sample of study area, four indices of pollution were studied using the technique of ICP-AES, benefit tools to assess the concentration of heavy metals and in a similar fashion the root sample underwent the US_EPA3051A method. The methodologies of these techniques are as follows:

**Inductively coupled plasma atomic emission spectroscopy:** (ICP-AES), also referred to as inductively coupled plasma optical emission spectrometry (ICP-OES), is an analytical technique used for the detection of trace metals. It is a type of emission spectroscopy that uses the inductively coupled plasma to produce excited atoms and ions that emit electromagnetic radiation at wavelengths characteristic of a particular element. It is a flame technique with a flame temperature in a range from 6000 to 10000 K. The intensity of this emission is indicative of the concentration of the element within the sample.

**US-EPS3051A Method:** A representative sample is extracted and/or dissolved in concentrated nitric acid, or alternatively, concentrated nitric acid and concentrated hydrochloric acid using microwave heating with a suitable laboratory microwave unit. The sample and acid(s) are placed in fluorocarbon polymer (PFA or TFM) or quartz microwave vessel or vessel liner. The vessel is sealed and heated in the microwave unit for a specified period of time. After cooling, the vessel contents are filtered, centrifuged, or allowed to settle and then diluted to volume and analyzed.

**Observation:**

| S.NO | Parameters | BIS Guideline values in mg/l | Water Sample | Root sample | General Health Effects |
|---|---|---|---|---|---|
| 1 | Pb | 0.05l | 0.005 | 0.005 | Reduces mental capacity, mental retardation, interference with kidneys and neurological functions, hearing loss , blood disorders, hypertension, death at high levels, causes plumbism-tiredness, lassitudes |
| 2 | Cd | 0.01 | 0.001 | 0.001 | Highly toxic, causes 'itai-itai" disease-painful rheumatic condition, cardio vascular system affected, gastro-intestinal upsets and hypertension. |
| 3 | Mg | 100l | 15.813 | 13.33 | Encrustation to water supply structure and adverse effects on domestic use |
| 4 | S | 0.05 | 2.536 | 6.9 | Sulphur in water can create slime that results in the growth of other bacteria, like iron bacteria, in water. Presence of these bacteria can lead to problems with plumbing and appliances, eventually corroding pipes and fixtures. |

**Conclusion:** The research investigation concludes that the hazardous metal contents are found to be present in water and roots collected from Belapur creek area.

As such Lead, Cadmium, Magnesium and Sulphur which cause disturbances in the mangroves, fishes and micro-organisms and they are dangerous for human health due to vaporization.

For successful implementation of conservation program it is necessary to involve public at various levels.

TMC is regularly conducting awareness program on various occasions such as *World Water Day, Environmental Day* etc. Awareness program create awareness and emotional attachment towards the conservation of creek and environment. With the initiative of NGO's, social workers along with government institutions awareness towards environment and livelihood to locals can be created.

We simply cannot blame industrialization and vast population for the degradation of our ecology. It is the irresponsible and negligent attitude causing devastation to the ecology.

The time has come to maintain chemical discharge standards to maintain our health and environment. If the existing situation is not controlled, it can cause irreversible damage in the ecology & environment at large.

**References:**


1. Singare PU, Lokhande RS, Pathak PP.; "Study on physico-chemical properties and toxic metal content of the soil samples from Thane Creek of Maharashtra, India."
2. Singare PU, Lokhande RS, Jagtap AG.; "Water pollution by discharge effluents from Gove Industrial Area of Maharashtra, India: Dispersion of Toxic metals and their Toxic effects."
3. A.Sofi, B.R.Phanikumar, Tarun Sama, Mechanical Properties of Concrete Containing High Volume Pond-Ash and Steel Fibre; Engineering Sciences international Research Journal: ISSN 2320-4338 Volume 3 Issue 1 (2015), Pg 77-81
4. Singare PU, Lokhande RS, Bhattacharjee, SS.; "Physico-chemical analysis of the sediment samples collected from Thane Creek of Maharashtra, India."
5. Gokhale K.S. and R.P.Athalye, (1995) "Study of impact of Pollution on Mangrove Fauna of Thane Creek near Thane City" Report submitted to the Ministry of Environment and Forests. New Delhi.
6. Daketi Srinivas, Architecture and Culture: the Dynamics of the Changing House-form in Rural Settlements of Andhra Pradesh; Engineering Sciences international Research Journal: ISSN 2320-4338 Volume 3 Issue 1 (2015), Pg 82-87
7. Laboratory analysis conducted at CERA Laboratory, Masrani lane, Kurla, Mumbai – 400 070


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