Restoration of Mithi River

In-situ ABR Treatment with Pernickety®713

Dr. MAMTA TOMAR
Director

JM EnviroTechnologies Pvt. Ltd.
Nehru Place Delhi
Introduction & Background of the Project
Wastewater Problems & Decomposition
JM Enviro’s Treatment Technology
Details of Mithi Project
Criteria of the Project
Treatment Strategy
Results & Data Analysis
Conclusions
Cost Analysis of ABR Treatment
Recommendations
Introduction

Background of the Project
Planning after July 2005 Floods in Mumbai

- The condition of Mithi River could not improve due to daily addition of liquid and solid wastes through Point & Non-point Sources.

- The situation became worse due to the tidal effects of Arabian Sea.
Wastewater Problems & Decomposition

Background of the Project
Major Problems Associated with Wastewater Discharges

- **Odour**
  - H₂S emission
  - Black Colour

- **Oil & Grease**
  - Floatables
  - Hindrance for surface oxidation

- **Organic Matter**
  - Carbohydrates
  - Protein

- **Excessive Nutrients**
  - N & P
  - Eutrophication

- **Sludge Accumulation**
  - Scarcity of DO
  - Fatal to Aquatic Life
## Types of Bacteria Associated with Pollution

### Aerobic Decomposition

*(Need Aerators to maintain DO)*

\[ \text{Organics} + O_2 \rightarrow \text{New Cells} + CO_2 + H_2O + \text{Energy} \]

### Anaerobic Decomposition (Odour Generation)

*(Don’t need Dissolved Oxygen, DO)*

\[ \text{Organics} + SO_4 \rightarrow \text{New Cells} + CO_2 + H_2S\uparrow + \text{Energy} \]

### Anoxic Decomposition

*(Consume Oxygen present in Nitrates)*

\[ \text{Organics} + NO_3 \rightarrow \text{New Cells} + CO_2 + N_2 + \text{Energy} \]
Metabolism
(Role of Microorganisms)

Anabolism
Formation of energy compounds from food

- Glucose → Carbohydrate
- Amino Acid → Protein
- Fatty Acid + Glycerol → Lipid

Catabolism
Break down of Compound into Simpler forms

- Wastewater
  - Carbohydrate → Glucose
  - Protein → Amino Acid
  - Lipid
    - Fatty Acid + Glycerol

New Microbial Cell
Common Microorganisms for Wastewater Decomposition

- Fungi
- Algae
- Paramecium
- Bacteria

- Vorticella
- Stalked ciliates
- Free swimming ciliates
- Flagellates
JM Enviro’s Treatment Technology
Anoxic Bioremediation Technology
ABR
Anoxic Bioremediation
Decomposition of organic waste under Anoxic conditions with a Biological Product
Persnickety®713
Persnickety® 713

Precisely balanced blend of naturally occurring, Strict & Facultative Anaerobic Bacteria in a liquid medium

Major Strains of Persnickety® 713

- *Clostridium butyricum* (oil/Grease Control)
- *Thiobacillus denitrificans*  (1st Stage Odour Control)
- *Thiobacillus thioparus*  (2nd Stage Odour Control)
- *Chromatium - purple sulfur bacteria*  (3rd Stage Odour Control & Sludge digestion)
- *Bacillus subtilis*  (Protein Digestion)
- *Saccharomyces cerevisiae*  (Protein & Carbohydrate Digestion)
**Clostridium butyricum**

- Gram +ve, rod shaped, strict anaerobic Microorganism
- Metabolizes glycerol and fatty acids from Oil & Grease molecules into simpler organic forms

**Metabolism of Oil & Grease**

- Wastewater
- Oil & Grease
- Glycerol
- Fatty acid
- Glucose
- Glyceraldehyde 3 phosphate
- Acetyl-coA
- Ethanol
- Butyrate
- Acetate
Thiobacillus denitrificans

- Strict Anaerobic Bacteria & consume H₂S to gain energy from chemical decomposition
- *T. denitrificans* utilizes NO₃ instead of O₂ (Anoxic Treatment) as shown in the reaction:

\[
5H_2S + 2NO_3^- \rightarrow 5S + N_2 + 2OH^- + 4H_2O
\]

First Stage of odour control
Thiobacillus thioparatus

- Gram -ve, rod shaped, aerobic bacteria
- Oxidize Reduced Organic Sulfur Compounds such as carbonyl sulfide
- Tolerate high pH range 5 to 9 at 32-35 °C

Sulfide Oxidase

\[ \text{N-C-S-} + 2\text{O}_2 + 2\text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + \text{NH}_4^+ + \text{CO}_2 + \text{energy} \]

Second Stage of odour control
Chromatin - purple sulfur bacteria

- Gram – ve, Anoxygenic (not producing O₂) like other Photosynthetic bacteria using energy of sunlight to reduce carbon dioxide to carbohydrate
- Unlike plants they use H₂S instead of H₂O as source of electrons
- Rods, Cocci & Spiral Chromatium present in Persnickety®713
- Granules of S deposit inside the cells
- Quite active in accumulated sludge & sediment deposits in water bodies

\[ 2 \text{H}_2\text{S} + \text{CO}_2 \rightarrow (\text{CH}_2\text{O}) + \text{H}_2\text{O} + 2 \text{S} \]

Third Stage of odour control
Bacillus subtilis

- Rod shaped, gram +ve bacteria moving with flagella & Facultative in nature
- Capable of producing endospores which are resistant to unfavorable environment
- Having strong Proteolytic action and responsible for breakdown of Protein.

Proteolytic Enzymes

Proteins → Amino acids

Removal of Protein
Saccharomyces cerevisiae

Removal of Proteins & Carbohydrates

- Strains are aerobic or Facultative in nature
- Grow on glucose, fructose, sucrose & maltose, other common sugars
- Assimilation of carbohydrates & proteins

Wastewater

\[ \text{Wastewater} \rightarrow \text{Protein} \rightarrow \text{Polypeptide} \rightarrow \text{Peptide} \rightarrow \text{Amino acids} \]

\[ \text{Carbohydrate} \rightarrow \text{Polysaccharides} \rightarrow \text{Monosaccharides} \rightarrow \text{Glucose} \]
Persnickety® 713

A Best Combination Of 
Aerobic, Anaerobic and Anoxic Bacteria to remove all pollutants Present in Sewage
Overall benefits of ABR Treatment

- ODOR CONTROL
- INCREASE IN DO
- SLUDGE REDUCTION
- TSS REDUCTION
- BOD REDUCTION
- GREASE/OIL CONTROL
- CORROSION CONTROL
- ENERGY SAVER
Product & Performance Certificates

- Ministry of Environment & Forest, Government of India
- Maharashtra Pollution Control Board
- Central Pollution Control Board
- Ministry of Commerce & Industry
- UK Laboratory
- A number of Performance Certificates from Public & Private Agencies

All Certificates can be submitted whenever Required
Details of Mithi Project

Investigated Area Allocated for Treatment
- Mithi confluence of over flow of Virar & Powai lakes
- Falls under Bandra Kurla Complex (BKC) & MMRDA Zone
- Total Length of Mithi River 17.3 Km
- Receiving sewage through 17 open drains
- Biggest tributary is Vakola Nallah
- 3.5 Km area in Mithi allocated for treatment
- Total area covered by JM Enviro including 8 open drains & Vakola Nallah is approx. 8 Km
- Around 1.5 Km area from Dharavi Bridge to Mahim causeway downstream Mithi outside BKC treatment zone which falls under BMC Jurisdiction
Criteria of the Project

Level of Major Pollutants
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Levels</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>&gt;2 mg/l</td>
<td>Should be achieved even in low tide (measurement at 3 places in given transect)</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>&lt;50 mg/l</td>
<td>---do---</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>100-150 mg/l</td>
<td>---do---</td>
</tr>
<tr>
<td>Air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH₃</td>
<td>&lt;400 µg/m³</td>
<td>Measurement 4 hr. interval on avg. at 10 m distance from river bank round the clock</td>
</tr>
<tr>
<td>Sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduction of Sediment</td>
<td>20 % after 3 months</td>
<td>The biological sediment must reduce due to intervention and should be shown to have reduced in at least 5-6 locations (critical areas)</td>
</tr>
</tbody>
</table>
Treatment Strategy

- Dosing Points
- Dosing Systems & Devices
- Dosing Pattern
- Preparation of Active Dosing Solution
- Sampling Points
Selected Dosing Points & Approved by MMRDA
Dosing Systems & Devices

Dual Compartment Brick Tank (L) & Manual Dosing Hose (R)

Spray Machines with Pressure Guns

Motor Boat | Debris Collection Device

Hyacinth removal | DCD in operation

Floating Jetty
**Dosing Pattern**

**Stabilization Period**
- 6 months
- 3 ppm for 3 months
- 2 ppm for next 3 months

**Maintenance Period**
- 1 ppm for maintenance depending on reduction of major pollutants levels

**Sludge Treatment**
- 10 L per week divided at each selected site based on sludge accumulation
Preparation of Activated Dosing Solution of Persnickety®713

1. Concentrate of Persnickety®713 in Drums
2. Transfer of Concentrate into buckets or Drums directly
3. Dilution of concentrated Solution of Persnickety®713 in Dosing Tank in the ratio of 1:20 / 1:40 with Fresh Water or Treated Effluent from STP
4. Addition of Activator
5. The Diluted Solution of Persnickety®713 is kept for 12 – 24 hrs. for Activation
Sampling Points

A – Teacher’s Colony
B – Tata Bridge
C – Dharavi Bridge
D – Std Chrt Bk Off
E – MTNL Bridge

Vakola Nallah
Mithi River
Results & Data Analysis

Reduction in Pollutants Levels
Improvement in the Appearance of Mithi River & Water Transparency
Reduction Curves of BOD & COD Levels
Increase in Dissolved Oxygen (DO) Level after ABR Treatment in Mithi River & Vakola Nallah
Conclusions

Achievements & Challenges of the Project
Challenges of the Project

• Flow more than estimated due to Reverse Flow of seawater
• Nonpoint Pollution due to solid waste disposal such as flowers Visarjan, disposal of animal carcasses etc.
• High BOD level at Dharavi Bridge due to reverse flow from Mahim Creek
• Sudden increase in COD levels at certain points illegal discharge of industrial wastes and washing of oil tankers with River water
• Black Tinge in River Water due to very old sediments accumulation
Achievements
New Face of Mithi River
Cost Analysis

Comparison with STP Construction
## Cost of ABR Treatment & Comparison with Conventional STP (UASB) to treat 3,684.3 MLD\(^{(a)}\) Wastewater Discharge of Open Drains for 1 year

<table>
<thead>
<tr>
<th>Sr. #</th>
<th>Activities</th>
<th>Conventional STP (Rs. In Crores)</th>
<th>ABR Treatment (Rs. In Crores)</th>
<th>Savings (Rs. In Crores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Capital cost including construction &amp; machinery (@Rs. 0.5 crore/MLD)</td>
<td>1,842.20(^{(b)})</td>
<td>9.60(^{(d)})</td>
<td>1,551.60</td>
</tr>
<tr>
<td>2.</td>
<td>Cost of Persnickety®713 (@Rs. 600/L)</td>
<td>-</td>
<td>281.00</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>O/M Cost</td>
<td>295.50(^{(c)})</td>
<td>13.20(^{(e)})</td>
<td>282.30</td>
</tr>
<tr>
<td><strong>Total Cost for 1 year Treatment</strong></td>
<td><strong>2137.70</strong></td>
<td><strong>303.80</strong></td>
<td><strong>1,833.90(^*)</strong></td>
<td></td>
</tr>
</tbody>
</table>

- The Flow taken from “Status Of Sewage And Sewage Treatment Plants In Delhi”, Control of pollution services CUPS/57/2004-05,of CPCB New Delhi
- Cost of construction Rs. ≈ 0.5 crore (50 Lacks) /MLD taken from YAP for conventional STP
- (≈16% of capital cost)
- Capital cost includes the installation of dosing systems, vehicles, boats, site offices, storage areas etc.
- Including manpower for implementation, running cost of vehicles, maintenance & other overheads
- * Nearly the capital cost of conventional STP to treat 3,684.3 MLD wastewater of Yamuna River
Recommendations
From JM Enviro
Future of Rivers in India is “BIOREMEDIATION”

- Most Economic & Eco Friendly Treatment
- No sophisticated equipment or amendment in infrastructure required
- More Pollution Free with limited use of Chemicals & Near to Nature
- More coordination in Governmental Authorities Required
- Public Awareness Programmes to control Nonpoint Pollution
JM Enviro team is ready to assist you to make all sizes and shapes of Water Bodies free from Pollution by In-Situ ABR Treatment