Restoration of Mithi River

In-situ ABR Treatment with Pernickety®713

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- Wastewater Problems & Decomposition
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- Cost Analysis of ABR Treatment
- Recommendations

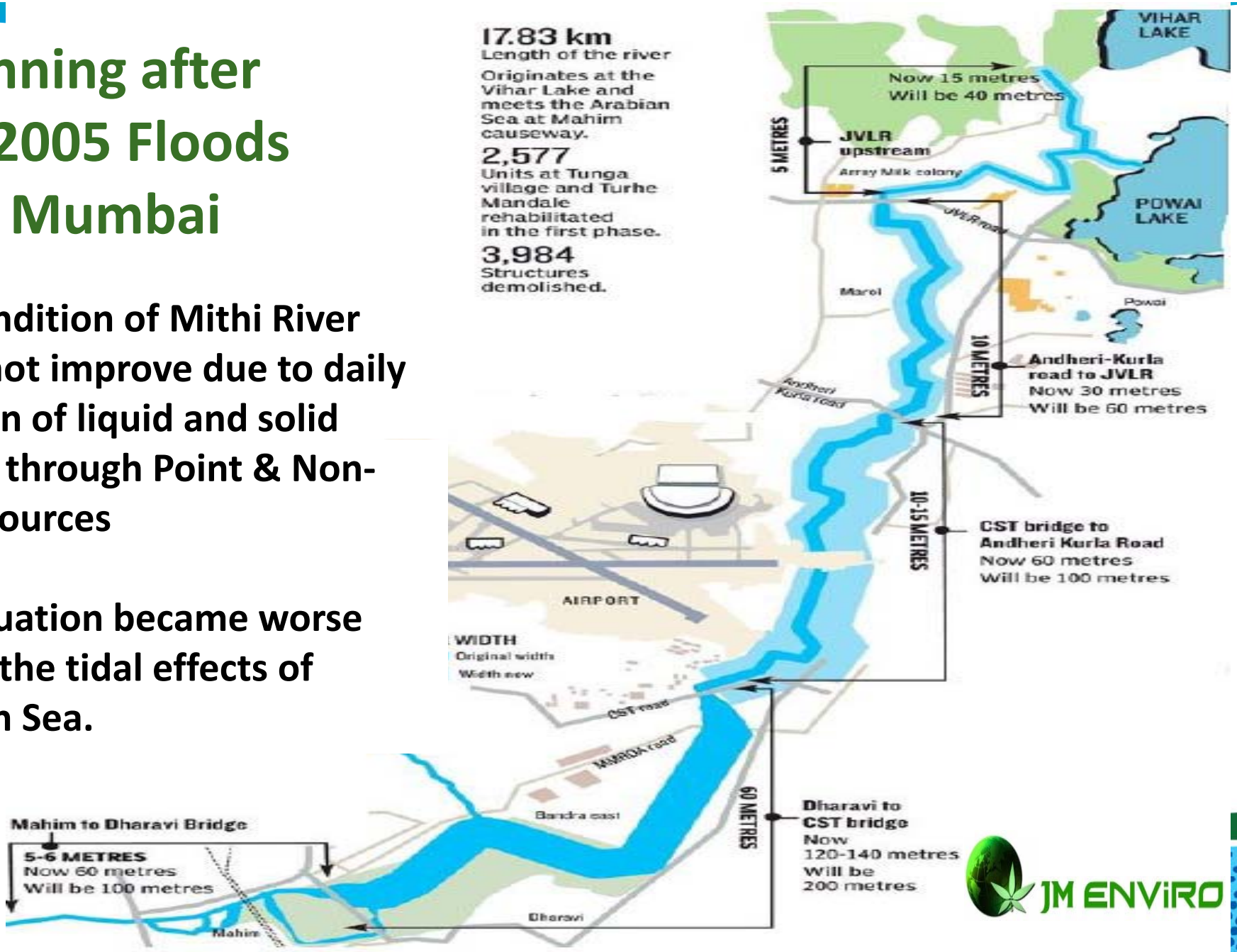
Introduction

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.**



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Wastewater Problems & Decomposition

Background of the Project

Odour

- H_2S 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

Major Problems Associated with Wastewater Discharges

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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

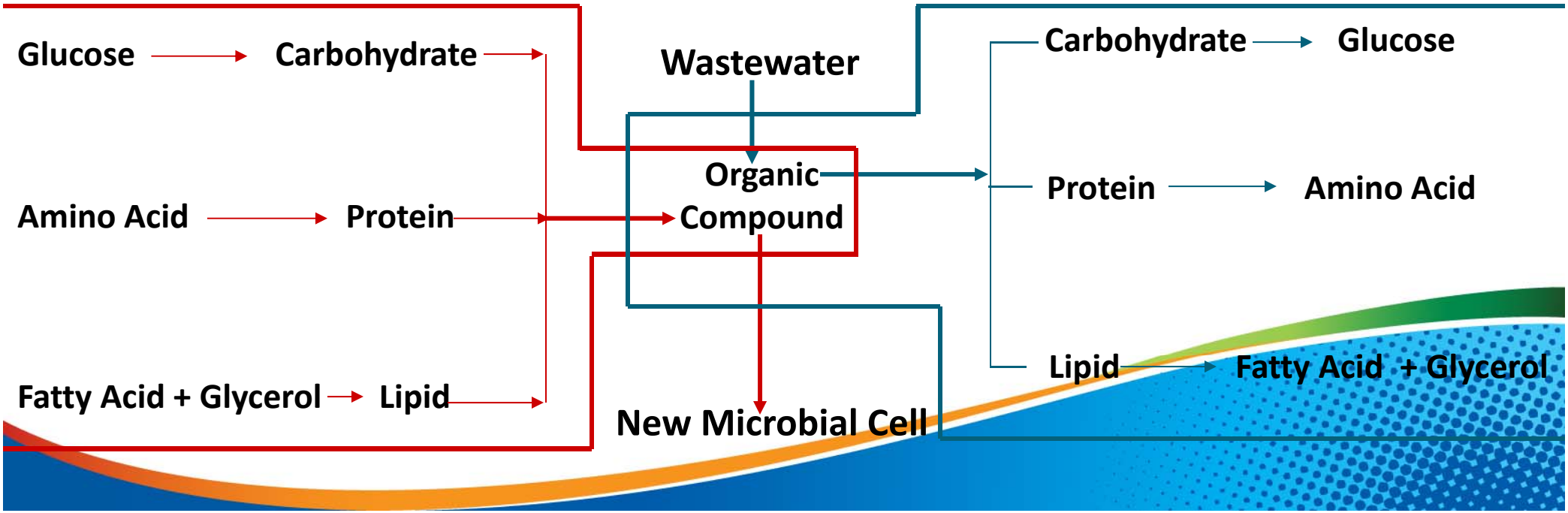
(Role of Microorganisms)

Anabolism

Formation of energy compounds from food

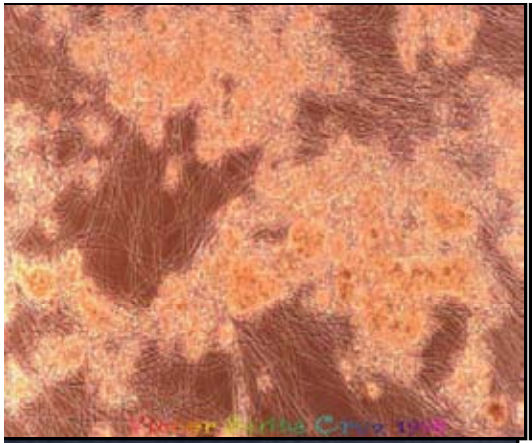
Catabolism

Break down of Compound into Simpler forms



Common Microorganisms for Wastewater Decomposition

Fungi



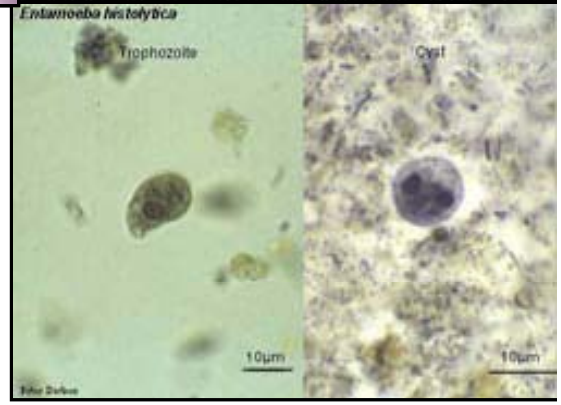
Algae

Paramecium

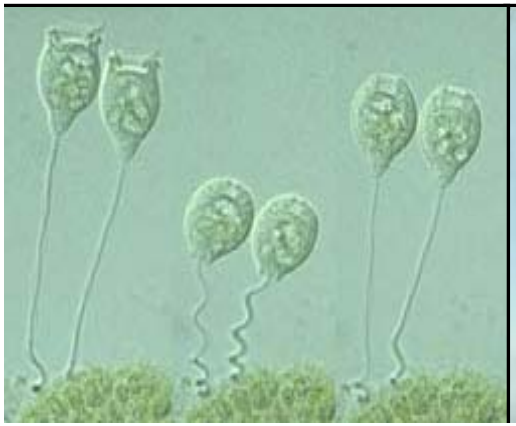
Bacteria

Rotifers

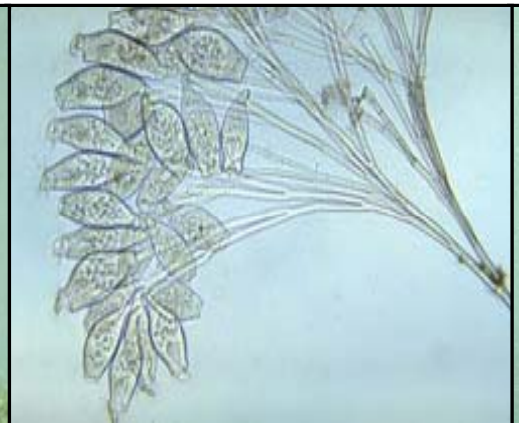
Amoeba



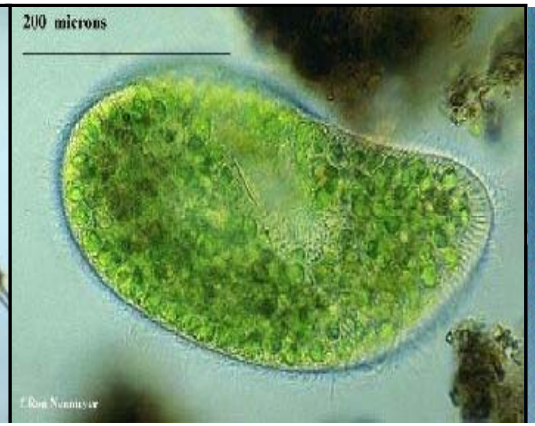
Vorticella



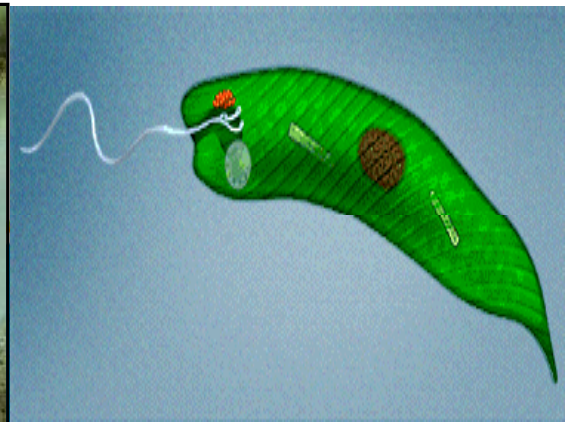
Stalked ciliates



Free swimming ciliates



Flagellates



JM Enviro's Treatment Technology

Anoxic Bioremediation Technology

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ABR

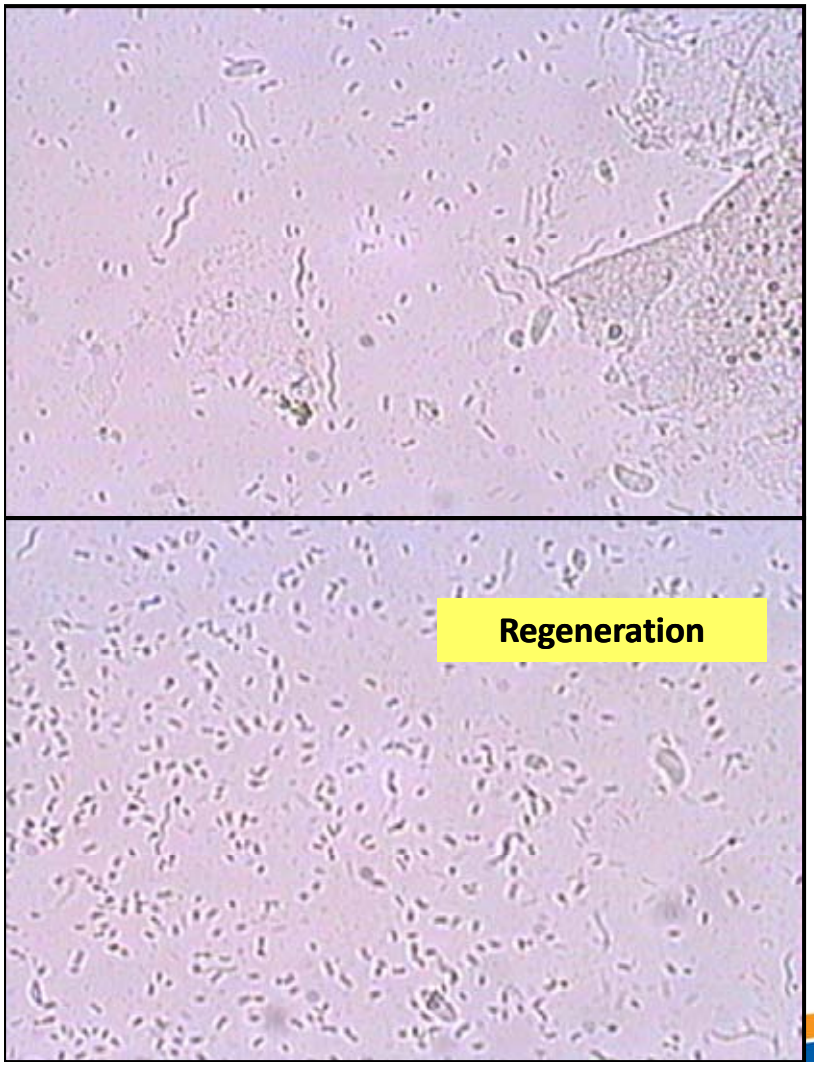
Anoxic Bioremediation

Decomposition of organic waste under Anoxic conditions with a Biological Product

Persnickety®713

Persnickety® 713

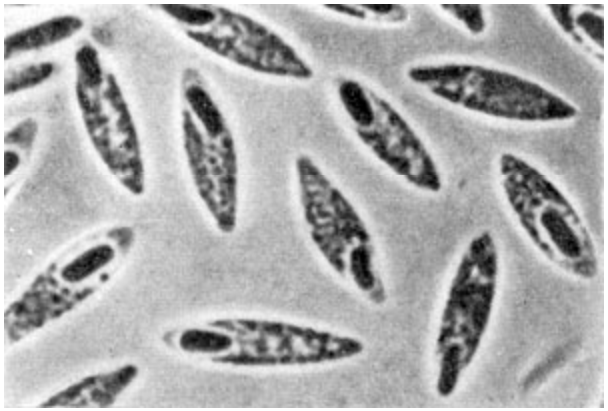
Precisely balanced blend of naturally occurring, Strict & Facultative Anaerobic Bacteria in a liquid medium

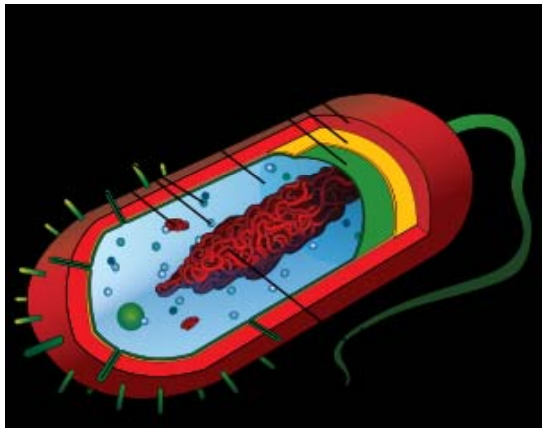


Major Strains of Persnickety®713

- ***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)***

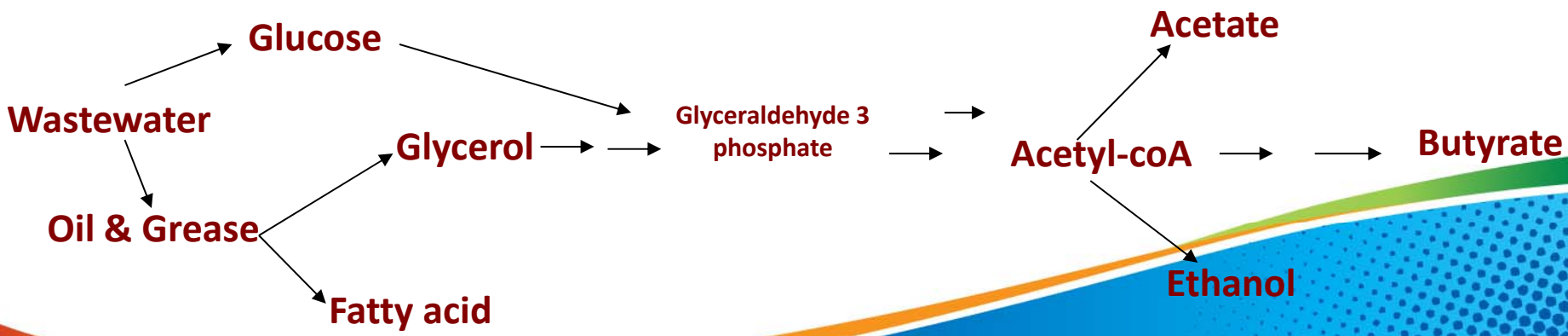
Clostridium butyricum



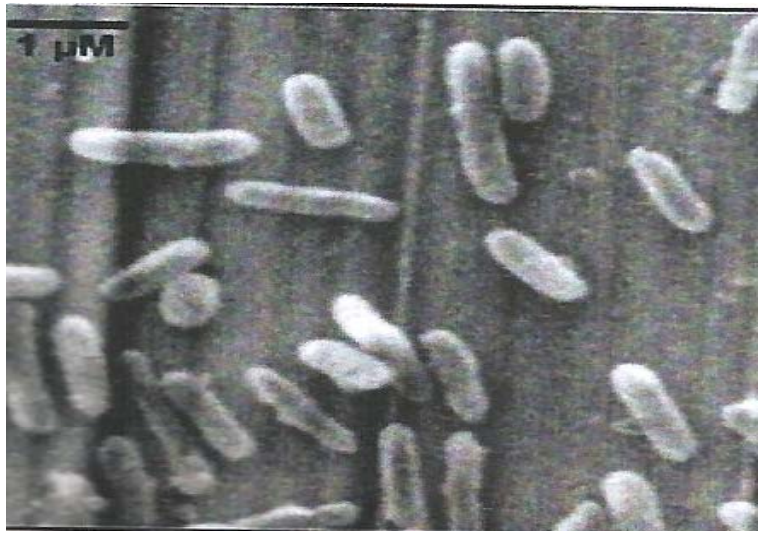


- **Gram +ve, rod shaped, strict anaerobic Microorganism**
- **Metabolizes glycerol and fatty acids from Oil & Grease molecules into simpler organic forms**

Metabolism of Oil & Grease



Thiobacillus denitrificans



- **Strict Anaerobic Bacteria & consume H_2S to gain energy from chemical decomposition**
- ***T. denitrificans* utilizes NO_3 instead of O_2 (Anoxic Treatment) as shown in the reaction:**

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

First Stage of odour control

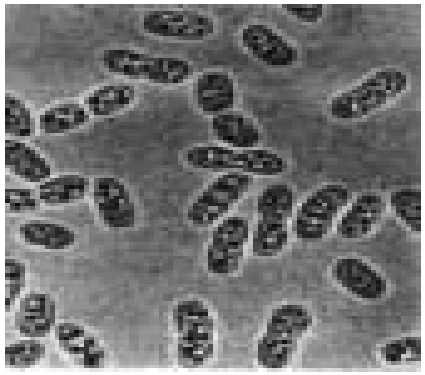
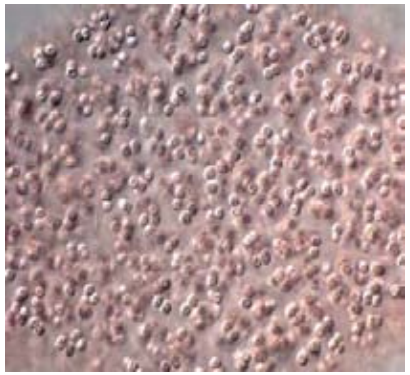
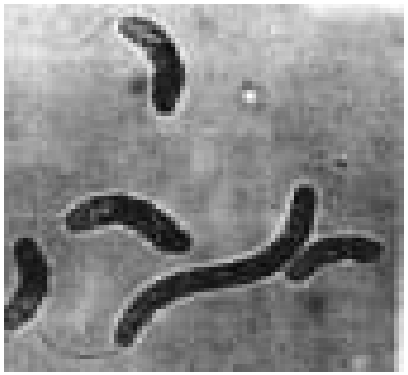
Thiobacillus thioparus

- 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 ^{0}C

$$\text{N-C-S-} + 2O_2 + 2H_2O \xrightarrow{\text{Sulfide Oxidase}} SO_4^{2-} + NH_4^{+} + CO_2 + \text{energy}$$

Second Stage of odour control

Chromatin - purple sulfur bacteria

- **Gram – ve, Anoxygenic (not producing O_2) like other Photosynthetic bacteria using energy of sunlight to reduce carbon dioxide to carbohydrate**
- **Unlike plants they use H_2S instead of H_2O 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**

$$2\ H_2S + CO_2 \rightarrow (CH_2O) + H_2O + 2\ S$$

Third Stage of odour control

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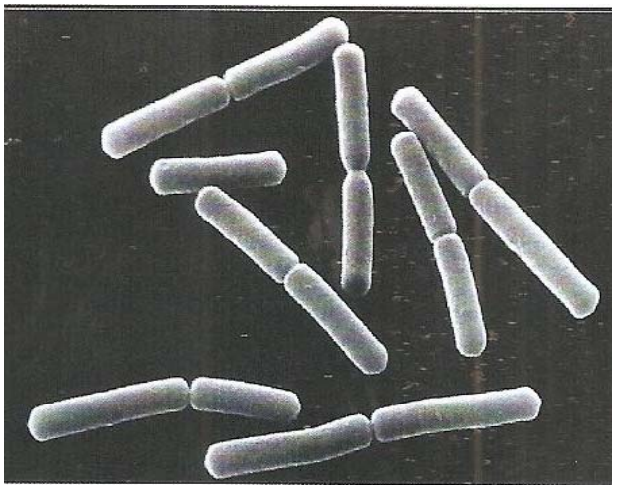
Bacillus subtilis



- **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.**

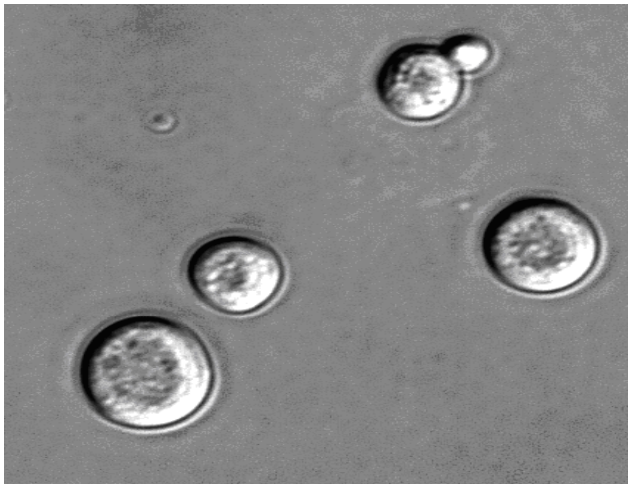
Proteolytic Enzymes

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 → **Carbohydrate** → **Polysaccharides** → **Monosaccharides** → **Glucose**

Wastewater → **Protein** → **Polypeptide** → **Peptide** → **Amino acids**

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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

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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

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Details of Mithi Project

Investigated Area Allocated for Treatment

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- 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

Targets to Achieve in Mithi River In-situ Bioremediation

Parameters	Levels	Remarks
Water		
Dissolved Oxygen	>2 mg/l	Should be achieved even in low tide (measurement at 3 places in given transect)
Biochemical Oxygen Demand (BOD)	<50 mg/l	---do---
Chemical Oxygen Demand (COD)	100-150 mg/l	---do---
Air		
NH_3	<400 µg/m^3	Measurement 4 hr. interval on avg. at 10 m distance from river bank round the clock
Sediment		
Reduction of Sediment Level	20 % after 3 months	The biological sediment must reduce due to intervention and should be shown to have reduced in at least 5-6 locations (critical areas)

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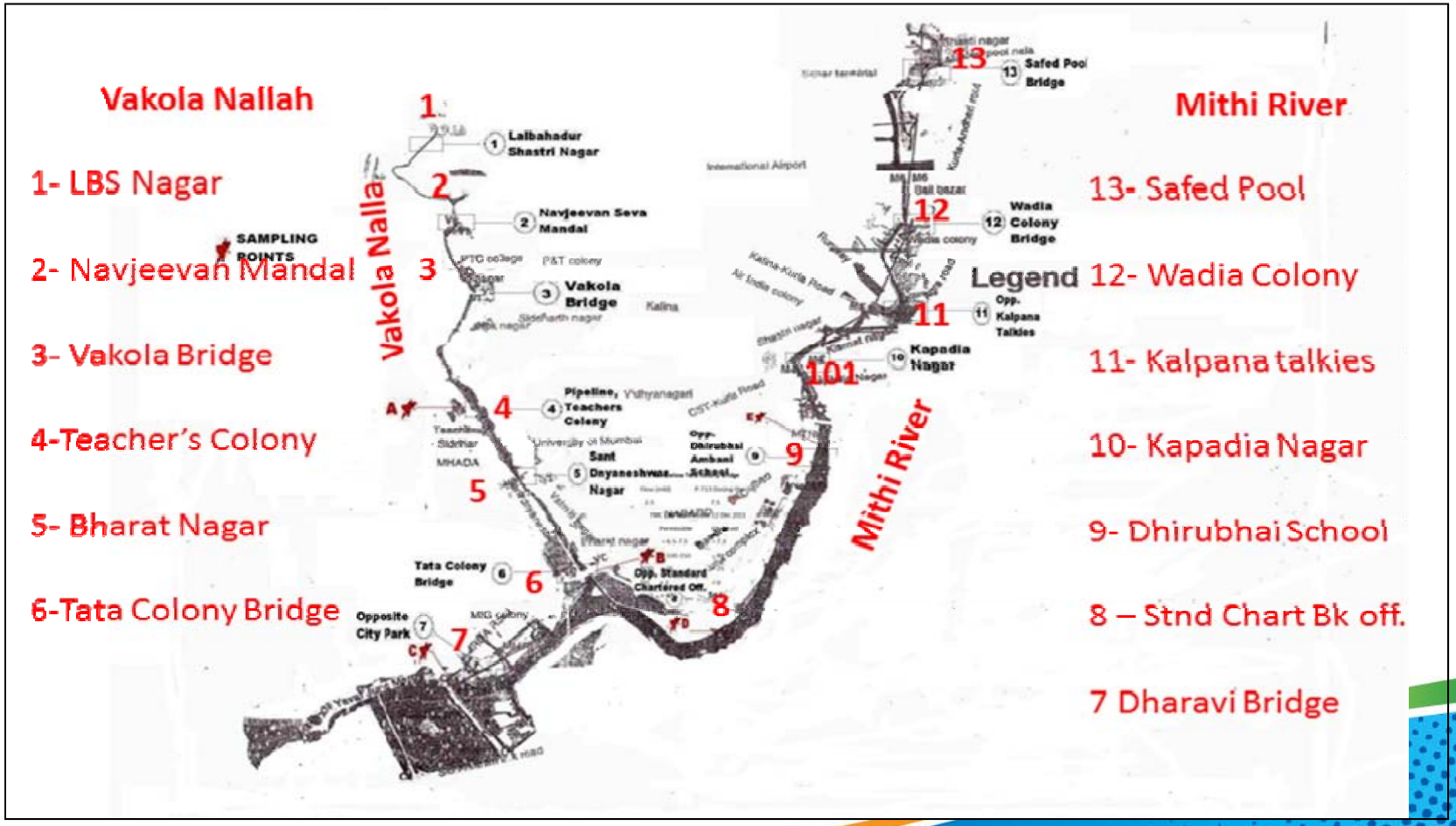
Treatment Strategy

- Dosing Points
- Dosing Systems & Devices
- Dosing Pattern
- Preparation of Active Dosing Solution
- Sampling Points

Selected Dosing Points & Approved by MMRDA



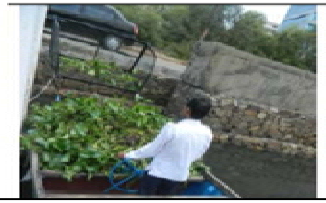
Dosing Systems & Devices

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

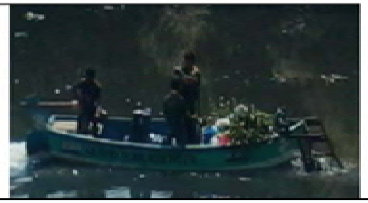
Spray Machines with Pressure Guns

Motor Boat

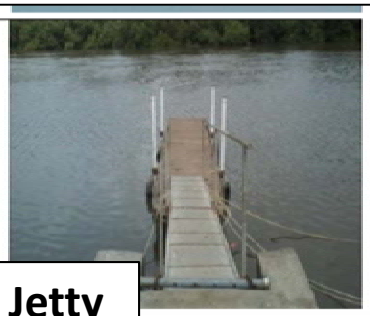
Debris Collection Device



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 the at each selected site based on the sludge accumulation

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Preparation of Activated Dosing Solution of Persnickety®713

1. Concentrate of Persnickety®713 in Drums

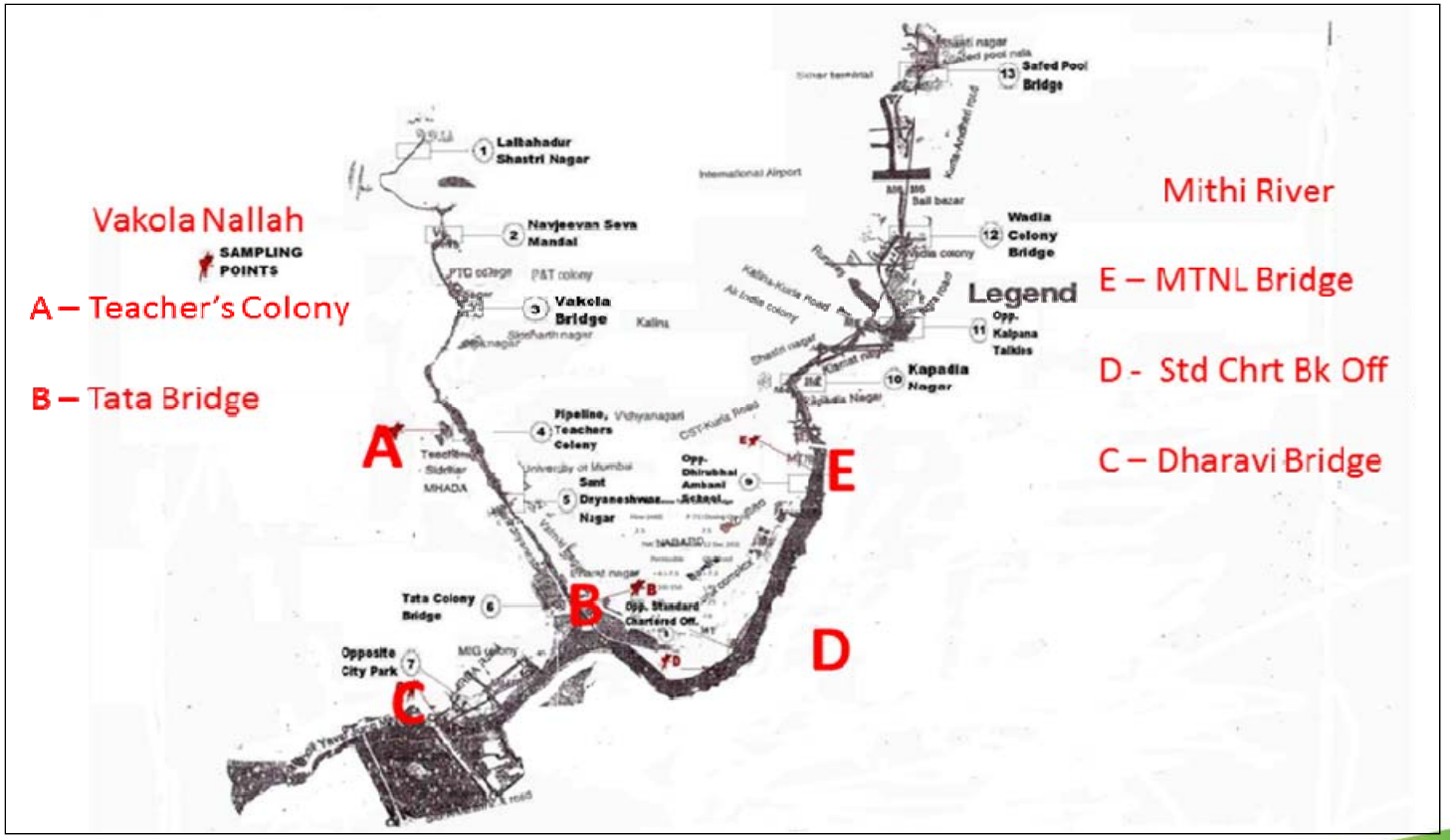
2. Transfer of Concentrate into buckets or Drums directly

3. Dilution of concentrated Solution of Persnikety®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



Results & Data Analysis

Reduction in Pollutants Levels

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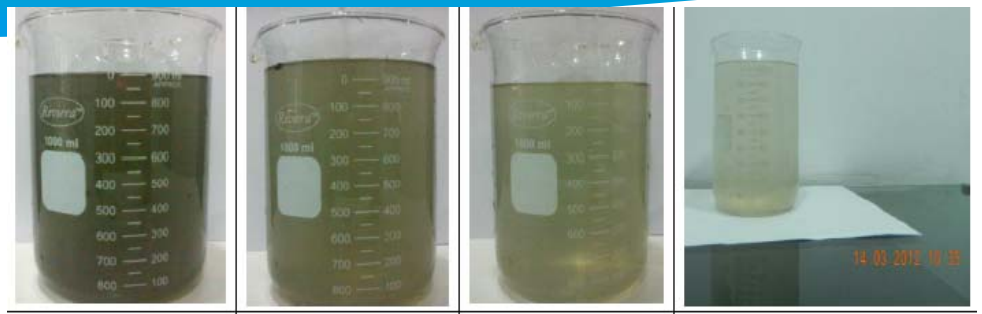
Visual Observation of Project Site Before ABR Treatment

Intermediary Condition of Mithi River

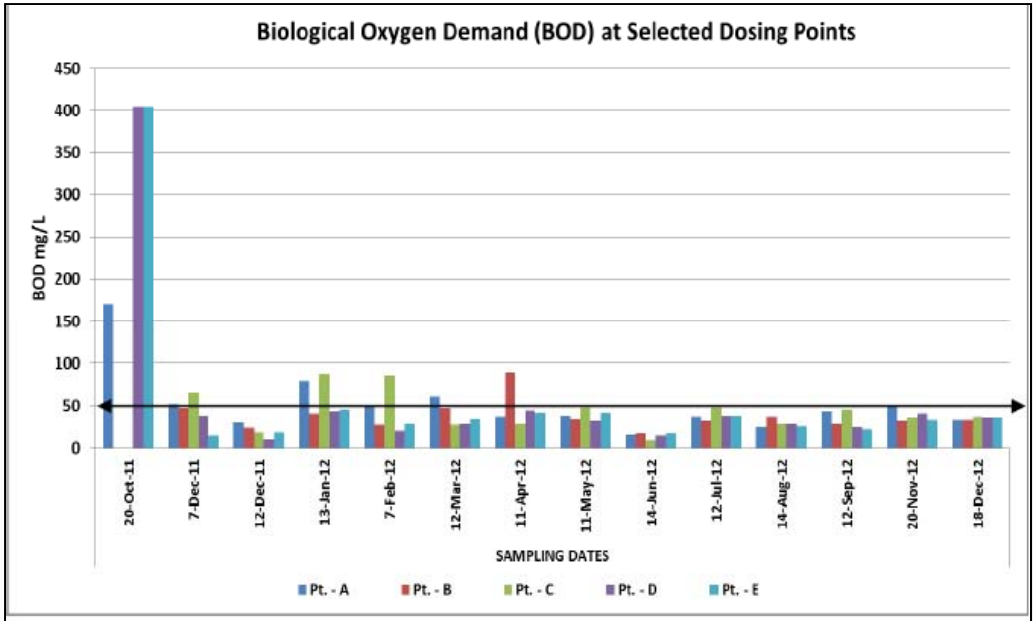
Current Scenario



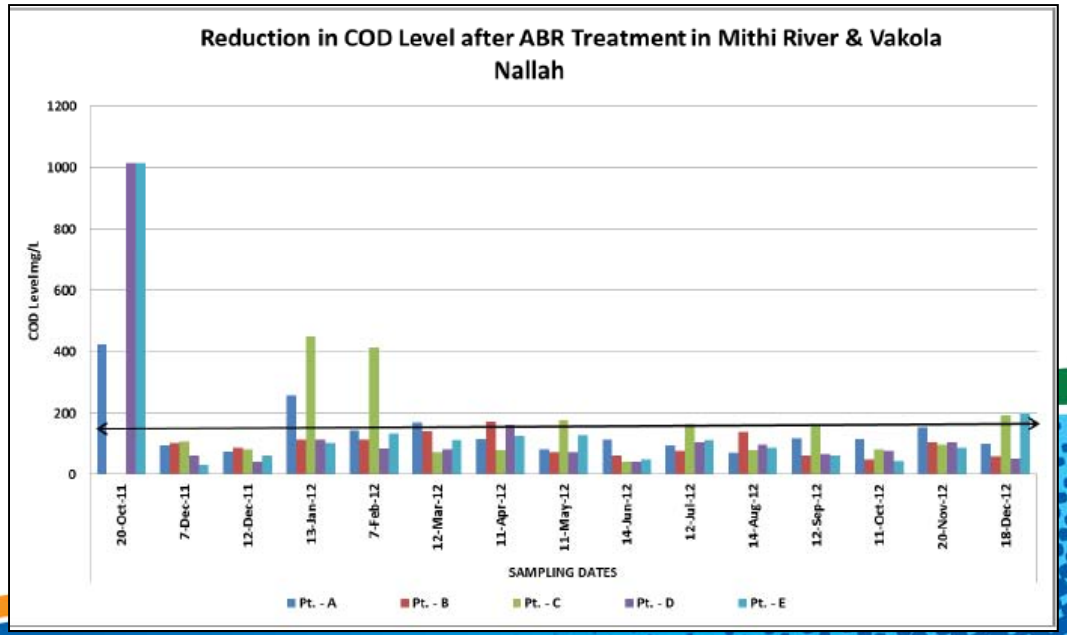
Before ABR Treatment	After 2 months	After 4 months	After 6 months

Improvement in the Appearance of Mithi River & Water Transparency

Reduction Curves of BOD & COD Levels



Note: Dosing Pt. A: Teacher's Colony & Pt. B Tata Bridge in Vakola Nallah and Pt. C Dharavi Bridge, Pt. D Stnd. Charted Bank & Pt. E MTNL Bridge in Mithi River Zone



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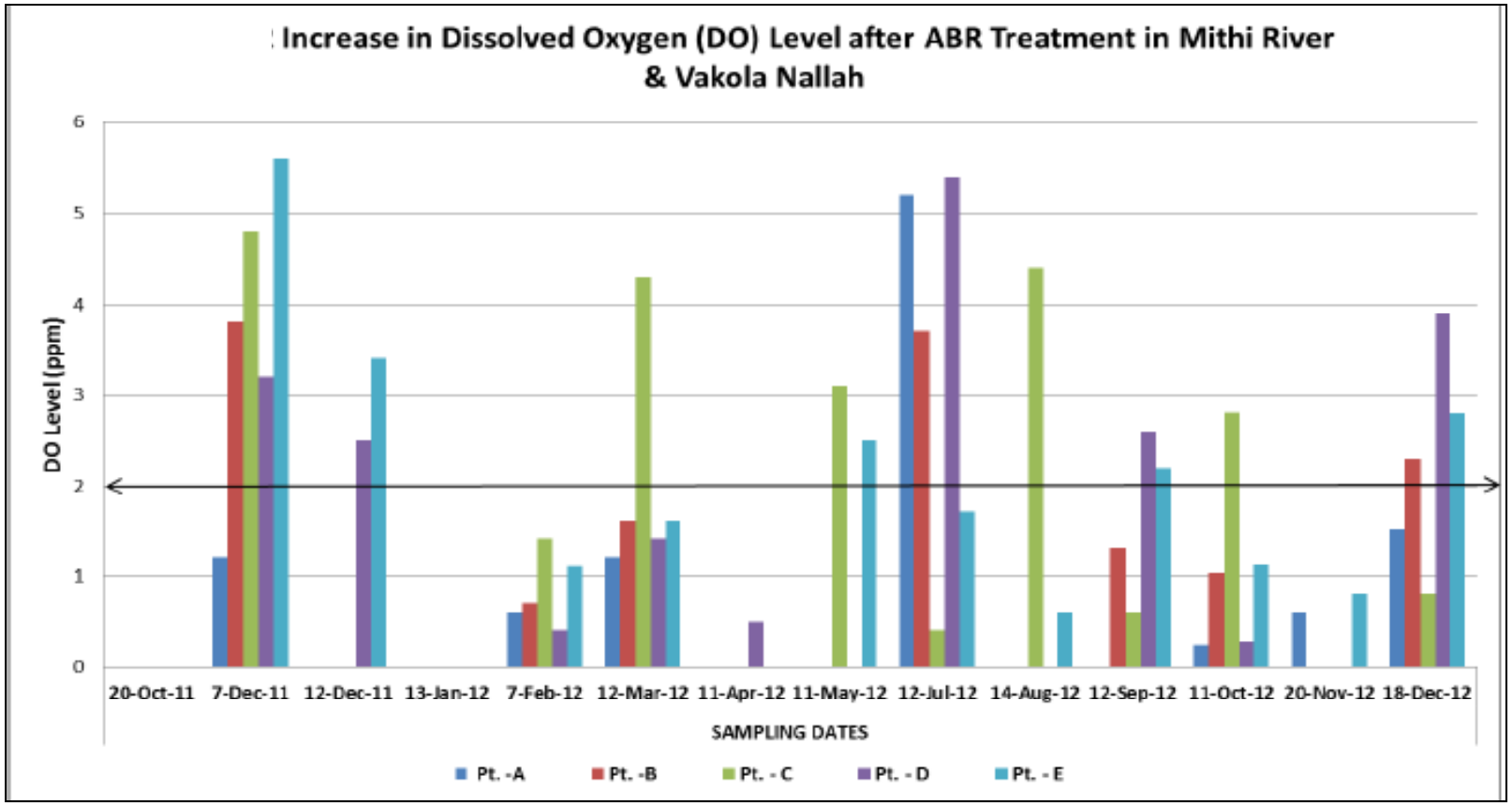
Increase in Dissolved Oxygen (DO) Level after ABR Treatment in Mithi River & Vakola Nallah
DO Level (ppm)
0
1
2
3
4
5
6
20-Oct-11
7-Dec-11
12-Dec-11
13-Jan-12
7-Feb-12
12-Mar-12
11-Apr-12
11-May-12
12-Jul-12
14-Aug-12
12-Sep-12
11-Oct-12
20-Nov-12
18-Dec-12
SAMPLING DATES
Pt. -A
Pt. -B
Pt. - C
Pt. - D
Pt. - E

Conclusions

Achievements & Challenges of the Project

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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

Sr. #	Activities	Conventional STP (Rs. In Crores)	ABR Treatment (Rs. In Crores)	Savings (Rs. In Crores)
1.	Capital cost including construction & machinery (@Rs. 0.5 crore/MLD)	1,842.20[b]	9.60[d]	1,551.60
2.	Cost of Persnickety®713 (@Rs. 600/L)	-	281.00	
3.	O/M Cost	295.50[c]	13.20[e]	282.30
Total Cost for 1 year Treatment		**2137.70**	**303.80**	**1,833.90***

(a) 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
(b) Cost of construction Rs. ≈ 0.5 crore (50 Lacks) /MLD taken from YAP for conventional STP
(c) (≈16% of capital cost)
(d) Capital cost includes the installation of dosing systems, vehicles, boats, site offices, storage areas etc.
(e) 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

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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

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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