BIOREMEDIATION OF DOMESTIC WASTE WATER OF THURAIYUR MUNICIPALITY

Q. ASHOKA CHAKKARAVARTHY
LECTURER IN ENVIRONMENTAL SCIENCE,
ST. JOSEPH’S COLLEGE, TIRUCHIRAPPALLI - 2
INTRODUCTION

- Water is an essential component for the sustenance of life on our planet. A prerequisite of sustainable development must be to ensure uncontaminated streams, rivers, lakes and especially ground water. The rapid growth of population and technological and industrial boom has brought enormous problem and degradation of environment. Chemical and toxic elements are being let into the drains streams and even open spaces adjoining industrial area without any check.
Human utilization of freshwater is vital and primarily aimed at drinking, bathing, recreation (tourism), agriculture, industry, inland transportation and fishery. Only 0.014% of earth’s water (0.0001% in the atmosphere, biota and rivers; 0.008% in lakes and 0.005% in the soil) is biospheric freshwater and an additional 1.97% is ice and 0.016% groundwater, while the rest of 97.406% is saline water. The meager 2.594% of earth’s biospheric water has a large significance in human society (La Rivere, 1989).
‘Bioremediation’ encompasses biological methods for clean-up of contaminated soil and groundwater. It is also referred to as Biorestoration. ‘Bioremediation’ means giving nature a helping hand. ‘Bioremediation’ involves establishing the conditions in contaminated environment so that appropriate micro-organisms flourish and carry out the metabolic activities to detoxify the contaminants. During bioremediation, micro-organisms may use the contaminants (hazardous chemicals) as nutrients or energy source or it may be degraded by co-metabolism.
Advantages of Bioremediation

1. It is less costly.
2. Toxic chemicals are removed from the environment and not merely separated.
3. It has a potential to be dominant treatment technology.
• About 80% of the Indian population is directly or indirectly dependent on the river waters. Further, 80% of the infectious diseases are water borne and 50% of the deaths among the children are due to diarrhoeal diseases.
• Thuraiyur Municipality (the study area) is located in the Trichi district. The table following shows the details of Thuraiyur Municipality. It is located about 43 Kms northern side via Mannachanallur from Trichi, 38 Kms form Perambalur in National Highways 45 and 58 Kms from Attur (Salem District). It has a population of 32,631 in the year 2003. The growth rate is 2.6% per year and the Male to Female ratio is 1.05. The actual birth to death ratio is 12.28. It has an area of 14.55 sq. Km and consists of 24 Wards.
FEATURES OF CHINNA ERI (SOURCES: PWD)

- Thuraiyur Chinna Eri is situated in the municipal limit of Thuraiyur. It is a P.W.D tank. It receives supply from the left flank surplus of Thuraiyur big tank in addition to its free basin 2.273 Sq.Km. It is situated at latitude of 11°9’ and longitude of 78°36’. The surplus from the tank falls immediately over poramboke lands and flows for a distance of 1,500 m and falls into Madurapuri tank. The discharge capacity of the existing surplus arrangement is 266.5 m³/sec. The maximum flood discharge is 3650 m³/sec.
Site Survey

Fig. 1 View of the Lake (Chinna Eri)
Detailed analysis of various physico-Chemical and Bacteriological parameters namely, Turbidity, Electrical Conductivity, Total Dissolved solids, Total Hardness, Chlorides, Sulphates, phosphorous, BOD, COD, Total Nitrogen, Ammonia Nitrogen, Total Coliforms and Faecal Coliforms were carried out for all the wastewater samples collected in the Eri as per standard methods. At each location, samples collected in triplicate for analysis and the average values are presented.
The following criteria were employed to selected specific cultures for immobilization and subsequent studies:

- Growth in sewage without additional carbon or nitrogen sources.
- Amylase production.
- Caseinase production.
- Gelatinase production.
- Urease production.
- Lipase production.
RESULTS

• Results were recorded in three directions with the following objectives:

• To find out the influence of sewage water (S1) on Lake water (Chinna Eri, S2), the water samples were subjected to hydrological and bacteriological analysis.

• To find out the impact of rain, the Lake water samples were analysed before after the rain.

• Bacterial strains isolated from sewage were used with a Laboratory model packed bed column reactor for bioremediation experiments.
MICROBIAL CHARACTERISTICS

• Total Heterotrophic bacterial population (THB), Total coliforms (TC) and faecal coliforms were monitored at both the stations.

• THB population showed significant variation between the two stations. Sewage water recorded $2.2 \times 10^5$ cfu / mL.

• Total coliforms recorded $3.7 \times 10^4$ cfu / mL in sewage water and $(1.2 \times 10^4 / \text{mL})$ in Lake water. Faecal coliform was found higher in sewage water $(1.6 \times 10^3 / 100\text{ml})$ than in Lake water $(1.1 \times 10^3 / 100\text{ml})$. 
BIOREMEDIATION STUDIES

- Micrococci and pseudomonas immobilized in calcium alginate beads packed in burette (height 20cm) and the sewage was subjected to treatment by passing through the packed bed column at the flow rate of 100mL/hr. Optimization of various characters like inoculum concentration, bead size, flow rate, were already standardized by Mohandass, C.(1992). The initial levels of BOD and COD was markedly reduced to 50%).
### Selection of Bacteria and Percentage Reduction of BOD and COD

<table>
<thead>
<tr>
<th>Genera</th>
<th>Growth in sewage cell protein mg/mL</th>
<th>BOD</th>
<th>COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micrococci</td>
<td>0.200</td>
<td>52</td>
<td>51</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>0.198</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td>Bacillus</td>
<td>0.200</td>
<td>49</td>
<td>46</td>
</tr>
<tr>
<td>Staphylococci</td>
<td>0.185</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>Aeromonas</td>
<td>0.190</td>
<td>49</td>
<td>47</td>
</tr>
</tbody>
</table>
DISCUSSION

• In the present study, the physiochemical characterization of the sewage before and after mixing with lake water indicated that most of the parameters exhibited significant variations. There was no significant change in turbidity of the sewage after mixing with lake water. Turbidity of water is caused by silt, soil particles, plant fragments of phytoplankton. Light penetration is reduced in turbid waters and this affects the depth to which aquatic vegetation can grow. Turbidity, therefore, limits the growth of organisms which are adapted to clean water conditions. Data with respect to total dissolved solid reveals significant decrease in the sewage after mixing with lake water.
• From the present study, it is evident that rainfall has influenced the water quality parameter of Lake (Chinna Eri). Turbidity, Electrical conductivity, Total Hardness, FreeAmmonia, Nitrate, Nitrite, Chloride, Sulphate, Phosphate, Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, were found to decline due to the rainfall event. On the other hand, total harness exhibited and increasing trend.
Bioremediation is the best solution for treatment studies. Taking this into consideration, the present attempt was made to treat the sewage with immobilized cells of selected bacteria isolated from sewage by continuous treatment. The results clearly enunciate the potential of both the genera of bacteria to express greater activity in continuous treatment. Further studies on the improvement of the selected genera in species level and scaling up the process would facilitate later transfer of technology for the safety disposal of domestic sewage in major cities of India.
Thank you