Study on Water Quality and Lime Leaching in Dams

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• The Soil Mechanics & Research Division have been monitoring the health status of the dams in TNWRD through Water Quality & Lime leaching studies.

• Till 1984, the studies were confined to (1) Periyar (2) Vaigai and (3) Manimuthar Dams

• and gradually extended to 14 dams till March 2014 and now 9 more dams are added.
**Tamil Nadu Reservoirs**

- **Mordhana**
  - pH 8.18
  - TDS 315 ppm
  - Fluoride 0.9 ppm

- **Sathanur**
  - pH 7.50
  - TDS 378 ppm
  - Chloride 120 ppm
  - Nitrate 1.0 ppm

- **Mettur**
  - pH 6.50
  - TDS 77 ppm

- **Bhavani Sagar**
  - pH 6.50
  - TDS 200 ppm
  - Fluoride 0.9 ppm

- **Parambikulam**
  - pH 5.5 to 6.5
  - TDS 20 to 30 ppm

- **Sholayar**
  - pH 5.5
  - TDS 37 ppm

- **Lower Nirar**
  - pH 6.90
  - TDS 17 ppm

- **Periyar**
  - pH 7.50
  - TDS 33 ppm

- **Pechiparai**
  - pH 6.90
  - TDS 39 ppm
  - Nitrate 1.2 ppm

- **Perunchanalai**
  - pH 6.90
  - TDS 17 ppm

- **Vaigai**
  - pH 7.5
  - TDS 149 ppm
  - Alkalinity 125 ppm

- **Amaravathi**
  - pH 5.5
  - TDS 149 ppm

- **Pechiparai**
  - pH 6.90
  - TDS 39 ppm
  - Nitrate 1.2 ppm

**Legends**

- **Pink**
  - Hard Waters
- **Green**
  - Low Hard Waters
- **Red**
  - Soft Waters
Case study 1: Water quality of River and Dam of Kodaganar
- Impact on dam structures (Shutters)

- Originating from western Ghats
- Dam at 64 km
- Confluence with Amaravathy at 104 km
Need of the Study

• Failure of Kodaganar Dam shutters necessitated to take up the study as a special case

• Preliminary investigation reveals
  - unnatural surface water
  - results indicated industrial contamination
River Kodaganar sample locations

- Authur Anicut
- Authur Reservoir
- Sithalakundu - Thamaraikulam Anicut
- Boothipuram Anicut
- Kodaganar Anicut
- Venkatrama Iyengar Anicut
- Lakshmanampatti Anicut
- Bhoothipuram Anicut
- Kodaganar Dam

Pollution Entry 1: Downstream of Dam
Pollution Entry 2: Ground Water
Kodaganar Dam

OBSERVATIONS:

- pH value at site is between 8.0 and 9.0
- Water is polluted with chlorides and sulphates
- Deposits found all over the Shutters and structures
- Scaling formed throughout the structure
- Shutters are completely corroded
Reason for the Non-operation of shutters

Chloride attack on Shutters

- increase in volume
- Decrease in strength
Back side - Thick Corroded shutter which was mobile

Scale formation in the front side
# Total Dissolved Salts in mg/l

<table>
<thead>
<tr>
<th>Number</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Authoor Reservoir</td>
</tr>
<tr>
<td>2</td>
<td>Sithalakundu - Thamaraikulam</td>
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<tr>
<td>3</td>
<td>Boothipuram Anicut</td>
</tr>
<tr>
<td>4</td>
<td>Kodaganar Anicut</td>
</tr>
<tr>
<td>5</td>
<td>Near Bridge NH7</td>
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<tr>
<td>6</td>
<td>Veikatarama Iyengar Anicut</td>
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<tr>
<td>7</td>
<td>Lakshananapatti Anicut</td>
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<tr>
<td>8</td>
<td>Bhoothipuram Anicut, Vedachandur</td>
</tr>
<tr>
<td>9</td>
<td>Kodaganar Dam</td>
</tr>
<tr>
<td>10</td>
<td>D/s Kodaganar Dam</td>
</tr>
<tr>
<td>11</td>
<td>Ground Water</td>
</tr>
</tbody>
</table>

**Pollution Entry Points:**
- **Pollution Entry point 1:**
- **Pollution Entry point 2:**
Case Study 2: Lime Leaching Study of Manimuthar Dam

- Comparison of water quality in reservoir and gallery reveals the loss of lime from the dam structure.
- Low pH & Low TDS main causes for Lime leaching

Reference
- Methodology confirmed by the “Guidelines for Measurement, Testing and Analysis of Seepage from Masonry and Concrete Dams” by CBIP, New Delhi.
LI is based on pH, Ca hardness, TA, TDS, etc.
# Various stages of Lime Leaching process

<table>
<thead>
<tr>
<th>Stage I</th>
<th>No Deposit</th>
<th>pH 13.0</th>
<th>NaOH, KOH</th>
</tr>
</thead>
</table>

| Stage II      | White Colour | pH 13.0 – 12.5 | CaO       |
Various stages of Lime Leaching process

Stage III

Creamy white
pH 12.5 – 12.0
Calcium Oxide + little Alumina & Iron Oxide

Stage IV

Yellowish brown
pH 12.0 – 10.0
More Alumina & less Iron Oxide
Various stages of Lime Leaching process

Stage V
- Dark Brown
- pH 12.0 – 10.0
- Less Alumina & More Iron Oxide & at last Silica gel

Stage VI
- Black
- pH 10.0 – 8.0
- Fungi
INSPECTION GALLERY
Between Block 10 and Block 8

Advanced stage of Lime leaching
• Seepage water from 15 Nos. of V notches of Manimuthar Dam is being tested for Lime content.

• Lime leached out from the Manimuthar Dam from 1959 to August 1984
  
  Percentage of Lime leached out = 3.89 %

• Lime leached out from the Manimuthar Dam from September 1984 to March 2014

  Percentage of Lime leached out = 0.99 %

• Total Lime lost (from 1959 to 03/2014) = 3.89 + 0.99 = 4.88 %