IMPROVEMENT OF CONCRETE DURABILITY
BY BACTERIAL MINERAL PRECIPITATION

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INTRODUCTION:

- Bacillus Pasteruii, a common soil bacterium, can continuously precipitate calcite under favourable conditions. This phenomenon is called microbiologically induced calcite precipitation.

- Due to its inherent ability to precipitate calcite continuously, bacterial concrete can be called a “Smart Bio Material”.

OBJECTIVES:

• To study the effect of different concentrations of bacteria on the durability of concrete.

• To study the efficiency of bacteria when suspended in different mediums (water, phosphate and urea)
A stock culture of B. pasteurii is generally maintained in a solid medium containing:

- 10g trypticase
- 5g yeast extract
- 4.5g tricine
- 5g ammonium sulphate
- 2g glutamic acid

And final concentration of 1.6% agar, which is autoclaved separately and added afterwards.
Microbiologically enhanced crack remediation (MECR) utilizes a biological by-product, CaCO3.

The overall chemical equilibrium reaction of calcite precipitation is,

\[(\text{Ca}^{2+} + \text{CO}_3^{2-} \rightarrow \text{CaCO}_3 \downarrow)\]

\[\text{Ca}^{2+} + \text{Cell} \rightarrow \text{Cell-Ca}^{2+} \ldots (1)\]

\[\text{Cl}^- + \text{HCO}_3^- + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl} + \text{CO}_3^{2-} \ldots (2)\]

\[\text{Cell-Ca}^{2+} + \text{CO}_3^{2-} \rightarrow \text{Cell-CaCO}_3 \downarrow \ldots (3)\]
FUNCTION:

Germination → Spores → Swarming → Subtilin → Quorum Sensing → CaCO₃ precipitation → Filamentous cell formation → Levans glue
DISCUSSION:

• The effects of the following parameters on the durability of concrete were investigated:

  • Bacteria suspended in water (BW).
  • Bacteria suspended in urea-CaCl₂ (BU).
  • Bacteria suspended in phosphate buffer (BP)
FACTORS:

As per IS456:2000 the following are the some of the important factors which affect the durability of concrete:

* Impermeability
* The environment
* The type and quality of constituent materials
* The water/cement ratio of the concrete
* Compaction and efficient curing
**COMPRESSIVE STRENGTH OF REMEDIATED CUBES:**

Cube drilled to a depth of 2 CM

Testing of Cubes sealed with the bioconcrete
<table>
<thead>
<tr>
<th>Description of specimen</th>
<th>Strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (concrete without crack)</td>
<td>33.33</td>
</tr>
<tr>
<td>Cracked specimen</td>
<td>26.66</td>
</tr>
<tr>
<td>Remediated specimen</td>
<td>30.22</td>
</tr>
</tbody>
</table>
**MERITS:**

- More resistance to the freezing and thawing condition
- Reduce plastic shrinkage cracks
- High impermeability
- High resistance to chemical attacks
CONCLUSIONS:

• The presence of bacteria in different mediums increased the resistance of concrete towards alkali, sulphate, freeze-thaw attack and drying shrinkage.
• Phosphate-buffer proved to be an effective medium for bacteria than the other two mediums.
• The compressive strength of bacterial concrete is also increased by 5% to 10%.
CONCRETE CRACK INJECTION
For Repairing
Cracked Poured Walls
Thank you
Queries ???