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# To Study the Effect of Concrete with the Aid of Bacteria Incorporating GGBFS

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**ABSTRACT:** The durability properties of the structures are affected by the cracks in the concrete during the service period. For a better life of structure, the crack width needs to be repaired, so a reliable self-healing concrete should be designed for a new way of durable concrete structures. The scope of present work is to check the effect of bacteria in concrete and also the effect of GGBS when replaced with cement on the durability characteristics. The phenomenon of consistent precipitation of calcite by using the bacteria in the concrete is called microbiologically induced calcite precipitation. For the bacterial awareness of  $10^5$  cells/ml of water increases compressive and split tensile power. Bacterial concrete when in comparison to standard concrete is extra durable.

## I. INTRODUCTION

Concrete is the most essential material used broadly in construction all around the world. Because, the cost of construction material and maintenance is low also it's easily available. Concrete is very weak in tension and very strong in compression. Self-healing concrete acts as water tight due to the filling of cracks. In self-healing concrete the cracks are automatically sealed and there will be no chance for the water to pass through the concrete. Due to this method a lot of money will be saved for the repair purpose and it also can fulfill the durability requirement and it is eco-friendly too. This self-healing technique is mostly used in abroad countries for important structures like bridges, retaining walls and aqueducts. Because the life span of the structures is more so they should survive for a long period with low maintenance cost.

## II. LITERATURE REVIEW

According to literature survey the overall performance of the concrete may be better by way of incorporating the bacteria in the concrete. The phenomenon of consistent precipitation of calcite by using the bacteria in the concrete is called microbiologically induced calcite precipitation. For the bacterial awareness of  $10^5$  cells/ml of water increases compressive and split tensile strength. Bacterial concrete when in comparison to standard concrete is extra durable.

Applications of bacterial concrete.

- Compressive strength of concrete is improved
- Permeability is reduced
- Corrosion of reinforced concrete is minimized
- Remediation in crack

### Scanning Electron Microscopy

A scanning electron microscopy (SEM) is a type of electron microscope that produces pics of a sample through manner of scanning it with a targeted beam of electrons. The electrons interact with atoms within the pattern, producing several signals that may be detected and that consists of facts about the sample's floor topography and composition. The electron beam is typically scanned in a raster experiment pattern, and the beams role is mixed with the detected sign to deliver a picture. SEM can obtain resolution better than 1nm. Specimens may be observed in immoderate vacuum, in low vacuum, in wet situations (in environmental SEM) and at a huge sort of cryogenic or improved temperatures.



**Objectives**

1. To investigate the effect of variation of bacterial concentration on the durability properties of concrete.
2. To investigate the influence of partial replacement of cement by GGBS on the durability properties of Bacterial concrete and Normal concrete.
3. To study the mechanism of microbial calcite precipitation in concrete through “Scanning Electron Microscopy”.

**Problem Statement**

The main aim of this experiment is to study the effect of pseudomonas bacteria on the durability properties of concrete with and without GGBS. The replacement of cement by GGBS is 40% of weight of cement. Different cell concentrations (0, 10<sup>3</sup>, 10<sup>5</sup>, 10<sup>7</sup> cells/ml) of bacteria were used in making the concrete mixes. Tests were performed for durability properties like water absorption, water sorptivity and sulphate attack. Specimens were tested for SEM analysis. The study was done on M25 grade of concrete. The study is experimental oriented.

**Scope of the present work**

The durability properties of the structures are affected by the cracks in the concrete during the service period. For a better life of structure, the crack width needs to be repaired, so a reliable self-healing concrete should be designed for a new way of durable concrete structures. The scope of present work is to check the effect of bacteria in concrete and also the effect of GGBS when replaced with cement on the durability characteristics.

**Materials**

1. Cement : In this project 43 grade OPC cement with name ULTRA TECH become used. The cement which became used did not have any lumps. The checking out of cement was accomplished as in keeping with IS: 8112-1989. The cement changed into determined to have 3.15 as the specific gravity.
2. Fine aggregate: The M-Sand used for the project become manufactured sand locally acquired. The specific gravity of high-quality combination turned into found to be 2.74.
3. Coarse aggregate: Coarse aggregate having size of 20 mm and down were used. The coarse aggregate was found to have specific gravity 2.74.
4. Ground granulated blast furnace slag: GGBS used was of JSW brand for the present project.
5. Bacteria; The culture of Pseudomonas Putida was obtained Laboratory

**III. RESULTS**

**Table.1: water absorption with 40% replacement of cement with GGBS**

Bacterial concentration (cells/ml)	Average Water Absorption
10 <sup>0</sup>	4.0
10 <sup>3</sup>	3.9
10 <sup>5</sup>	3.4
10 <sup>7</sup>	3.50

**Table 2: Water Sorptivity with 40% replacement of cement with GGBS**

Cell concentration (Cells/ml)	Average Water Sorptivity
10 <sup>0</sup>	4.30
10 <sup>3</sup>	3.80
10 <sup>5</sup>	3.40
10 <sup>7</sup>	3.60



**Table.3: Rapid Chloride penetration Test**

Bacterial Concentration(cells/ml)	Average charges passed (coulombs)	% decrease in charges passed w.r.t Reference mix
10 <sup>0</sup>	1060.	-
10 <sup>3</sup>	1020.65	4.20%
10 <sup>5</sup>	845.22	19.10%
10 <sup>7</sup>	1039.47	2.23%

**Table .4: Comparison for Water Absorption in experimental and analytically results**

Bacterial concentration (cells/ml)	Average water absorption	Predicted water absorption from experimental results
0	4.0	4.10
10 <sup>3</sup>	3.9	3.45
10 <sup>5</sup>	3.4	3.50
10 <sup>7</sup>	3.50	3.50

**Table .5: Comparison for Water Sorptivity in experimental and analytically results**

Bacterial concentration (cells/ml)	Average Water Sorptivity	Predicted waterabsorption from Regression Analysis
10 <sup>0</sup>	4.30	4.30
10 <sup>3</sup>	3.80	3.83
10 <sup>5</sup>	3.40	3.50
10 <sup>7</sup>	3.60	3.68

**Table.6:Comparison for Sulphate Attack in experimental and analytically results**

Bacterial concentration (cells/ml)	Average SulphateAttack	Predicted Sulphate Attack from experimental results
0	11.82	11.30
10 <sup>3</sup>	12.40	13.40
10 <sup>5</sup>	15.30	14.00
10 <sup>7</sup>	13.0	13.10



#### IV. CONCLUSIONS

- 1 The experimental study shows that the addition of bacteria *Pseudomonas Putida* in concrete shows improvements in various properties of concrete.
- 2 Bacterial concrete with a concentration of bacteria of  $10^5$  cells/ml was found to give best results out of the samples used.
- 3 Water absorption, water sorptivity became reduced by means of addition of *Pseudomonas Putida* that may in flip increase durability of concrete.
- 4 Bacterial concrete exhibited lower charge of water absorption than conventional concrete. This is due to the bacteria brought on formation of Calcium Carbonate within the pores present in concrete, leading to a lesser voids and hence a lesser permeability
- 5 *Pseudomonas Putida* causes discount in chloride penetration, which in turn increases the sturdiness of concrete specimens. Thus, bacterial concrete provides resistance too chloride penetration, and as a result improves the sturdiness of concrete structures.
- 6 *Pseudomonas Putida* can be cultured in the laboratory which is safe and cost effective.

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