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TITLE: BACTERIAL CONCRETE

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Abstract

The concept of bacterial concrete is considered one step towards the smart concrete technology. The concrete having the ability to adopt itself to the environment is known as smart concrete higher the bacterial dosage, higher the performance. The bone has the ability to grow and repair itself this concept is similar to the bacterial concrete if only the nutrients are supplied properly. Concrete is the top material which is used in building construction but the crack which occurs is unavoidable and this is the main drawback of concrete. Cracks in the concrete occurs due to various mechanism like shrinkage, freeze etc. The concrete having low tensile strength causes micro-cracks and when the load applied is more than the limit this may cause seepage of water and other problems. This may lead to corrosion which isunfavourable for the structure and this may cause failure. To recover this type of failures due to Cracks andfissures bio-mineralization is developed. In the bacterial concrete the present investigation study of potential application of bacteria such asBacillus,Spirilla and Cocci to improve the compressive and split tensile strength of cement concrete.In this process for increasing the performance of concrete, the calcite precipitating spore which formed by the bacteria is introduced. When the water is enters into the cracks, it gets reacted with bacteria and forms precipitate of calcium carbonate as a by-product, which makes the structure crack free.

Key Words:Bacillus,Spirilla,Cocci,Bio-mineralization *etc.*

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1. INTRODUCTION

Cement concrete is most widely used material for construction work in a field of civil engineering. This is mainly due to low cost of material andconstruction. The concrete which is prepared with the help of bacteria such as Spirilla, Bacilli and Cocci is called as bacterial concrete. Bacillus Pasteruiiis the soil bacterium which has the ability to produce calcite. Calcite is widely used in construction material. This produces layer of calcite which is highly impermeable over the surface of already existing mortar layer. Due to the self-repairing property of bacterial concrete it is called as 'smart bio-material'. Bacteria are prokaryotes which consist of a single cell with simple internal structure. Bacteria are microscopic single cell organism that thrive in diverse environment. They can live within soil in the ocean and inside the human gut.

As we all know theconcrete has a high load bearing capacity for compression but it has less bearing capacity for tension. When the concrete crakes in tension due to some reason such as freeze-thaw reaction, shrinkage, low tensile strength of concreteetc.This ultimately leads to the crack formation in the structures. To increase the tension bearing capacity of concrete structures reinforcement are provided but when the water enters through the crakes it leads to the corrosion process and damage the reinforcement and therefore the strength of concrete decreases.So, the technique that comes into the broader category of modern science called as bio-mineralization is adopted. The need of environment friendly and effective alternate cracks recuperative technique leads to development using bio-mineralization method in concrete.

1.1 METHODOLOGY

- **Procuring of bacteria :**
  The bacteria was found from agricultural of concentration 10^8 cell/ml. The holding capacity of bacteria was checked in microbiological sector
- **Serial dilution of bacteria :**

The bacteria was diluted serially with water at specific concentration such as 10^3, 10^5, 10^7cells/ml, under the supervision of microbiological sector.

- **Casting :**

  The four sets of M20 grade of concrete cube and cylinder are used which are cast with both with and without bacteria. Every sets have 10 cubes and 3 cylinder. There are 4 sets of M20 grade of normal concrete have concentration 10^3, 10^5, 10^7 cells/ml. Thus 40 numbers of cube and 12 number of cylinder is cast.

- **Curing :**

As we all know the water is used for curing process. The time required for the curing is 7, 14 or 28 days.

1.2Test on bacterial concrete

1. Compressive strength test
2. Ultrasonic pulse velocity test
3. Splitting tensile strength test

- **Compressive strength test**

  Compressive strength is the capacity of material or structure to sustain loads leads to decrease size as opposed to tensile strength which sustain loads leads to extend. In other word compressive strength resist compression, since tensile strength resist tension.

  The Compressive strength of cement is determined by compressive strength test on mortar cubes is compressed between the two plates of compression testing machine by a slowly applied load. This test gives the ideas about the properties of concrete

DIAGRAM:

- **Ultrasonic pulse velocity test**

  An ultrasonic pulse velocity test is an in-situ, non-destructive test to check the quality of concrete and natural rocks. In this test the strength and quality of concrete is assessed by measuring the velocity of an ultrasonic pulse passing through a concrete structure or natural of rock formation.

DIAGRAM :

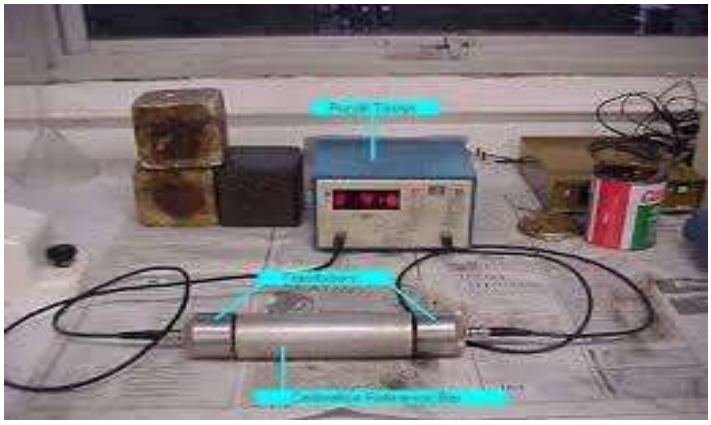

TABLE :

Pulse Velocity (km/second)	Concrete Quality (Grading)
Above 4.5	Excellent
3.5 to 4.5	Good
3.0 to 3.5	Medium
Below 3.0	Doubtful

- **Spliting tensile strength test**

  A method of determining the tensile strength of concrete using a cylinder which split across the vertical diameter it is an indirect method of testing tensile strength of concrete. In the split tensile strength the length of the specimen should not be less than diameter and should more than twice the diameter. The size of cylinder should be 150mm in diameter and 300mm long

TABLE :

Material	Weight basis(kg)	Volume(m^3)
Cement	425.73	0.294
F.A	539.54	0.327
C.A	1231.77	0.782
Water	191.58	0.191

2.ADVANTAGES

1. It increases the resistance to avoid alkali and sulphate attacks.
2. Self-repairing of cracks without any external accessory.
3. Resistance towards freezing and thawing attack.
4. Significantly increases the compressive strength (5% to 10%) and flexural strength.
5. Reduction in permeability of concrete.
6. Reduces corrosion of steel due the cracks formation and improve the durability of steel reinforced concrete.
7. Bacillus bacteria are harmless to human life.
8. It prevents the penetration of harmful gases and chemical into the concrete.

2. DISADVANTAGES

1. Cost of bacterial concrete is more than conventional concrete.
2. Growth of bacteria is not very good in any atmosphere.
3. Investigation of calcite precipitation is expensive.
4. Design of mix concrete with bacterial is not available any Indian Standard (IS) code.

3. CONCLUSION

The overall conclusion of this work is that bacterial concrete makes it very beneficial it improves the property of the concrete which is more than the convensional concrete. Bacteria repairs the cracks in concrete by producing the calcium carbonate crystal which block the cracks and repair it. Due to use of bacteria in concrete their has been increase flexural strength and decrease the permeability of concrete. Thus bacterial concrete can play a major role in modern construction for high cost structure like concrete road, bridges and high rise building. It is very cost effective as well as environmental safe.

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