



## SELF HEALING CONCRETE OR BIO-CONCRETE TO REPAIR CRACKS

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### Abstract

We know that concrete is important part of building material it provide strength to the building and durability to the building, so we need to improve the quality of concrete, so it produced more strength more durability, so here we introduce the self healing concrete or bio concrete to provide more strength to the building. The main function of this concrete is to healed the cracks which occur in wall of a building which causes structure deteriorate. In this experiment we compare the conventional concrete or bacteria concrete and check the strength of both concrete in compression testing machine. The bacteria which is use for self healing concrete is calcium base bacteria and the chemical name is calcium lactate, it is mix with 0.5% to cement. Now a day it is necessary to introduce this type of concrete so that it will reduce the cracks which cause the corrosion in the reinforcement which can be reduced and the life of the building will be increase. Chemical process of this bacteria is to produce calcium Carbonate when it contact with water or air, in outer layer of concrete which act as water resistance to the concrete and fill the cracks to prevent from water and air which can corrode the reinforcement of the structure.

### 1. Introduction

1.1 Self healing concrete Self healing concrete is a bacterial base concrete which produce lime in outer layer of concrete when it comes contact with water or air. The concrete heal itself a crack in outer layer with a range of 0.05 to 0.01mm. When the water particle react with chemical it produces calcium carbonate and produce lime also and fill the cracks. H. M. Jonker was the first scientist who research in self healing concrete to repair the cracks of

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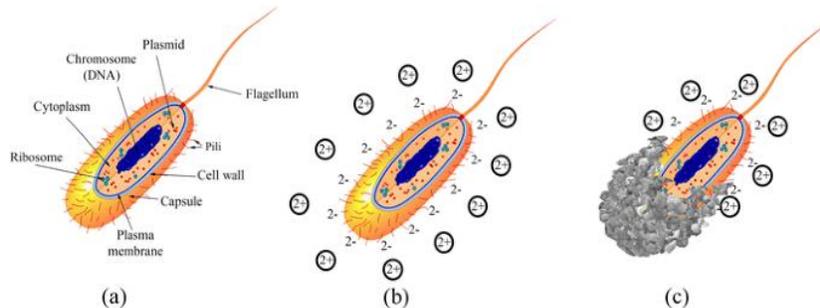
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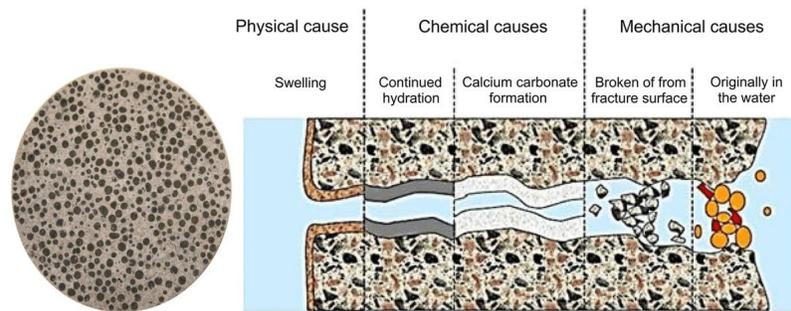
concrete he started his research from 2008 to 2011 he found that by using calcium lactate chemical concrete heal itself. The drawback of bacterial concrete is not capable to survive in a alkaline environment but according to research it observe that bacteria can live in concrete for more than 100 years in the form of pores. There are different type of bacteria which is use for self healing concrete process one of them is calcium lactate which is generally used for healing purpose. This bacteria is eco friendly in nature so that it not harmful for use. The two main reason to adopt this bacteria is first it provide strength to concrete second it heal the cracks also act as water resistance

1. 2 Bacteria Characteristic of bacteria are: \* Bacteria contain thick wall in outer layer, which can resist the sun light, chemical exposures etc. \* The bacteria which belongs to genus bacillus group are 1. Pseudofirmus, 2. Cohnii, 3. Filla, 4. Pasteuriie \* The chemical which found suitable is “Calcium Lactate”

1.3. Chemical process of self healing concrete: Calcium hydroxide is produce when water contact with unhydrated calcium. This calcium hydroxide react with carbon dioxide which present in atmosphere it form limestone and water. Water is evaporated and only limestone left in concrete surface



**Figure 1.1.** Chemical process of self healing concrete.



**Figure 1.2.** Self healing concrete.

## 2. Literature review

1. H. M. Jonker (2011) he was the first scientist who research on bacteria concrete. He use calcium based bacteria to heal the concrete known as self healing concrete it repair the cracks by the help calcium carbonate which form in outer layer of concrete comes contact with water and air but bacteria concrete not successful to give good result it have specific time to survive according to environment condition.

2. S. Soundarya et al. (2014) In this paper the author find that effect of calcite precipitating bacteria and their healing mechanism. The biomineralization method is carried out to study on calcite precipitating bacteria. It uses different type of bacteria to heal the concrete. The application of bacterial concrete and advantage and disadvantage are also explain in this paper.

3. Salmabanu Luhar et al. (2015) In this research paper review by different author. This paper show cracks healed by autogenous mechanism. Bacteria healed in various size 0.5mm to 0.87 mm. It notice that bacteria feed on the nutrient source provided so it is produce the calcium carbonate in the form of limestone and heal the cracks in outer layer of concrete.

4. Meera CM et al. (2016) In this paper discussed about different type of self healing concrete. Different type of mechanism is used for self healing concrete such are autogenous mechanism, self healing mechanism, microencapsulation system, hollow glass fibre system, shape memory system and bacteria based system. The bacteria is used in this experiment is bacillus bacteria along its nutrient. The use of this bacteria is showed improvement in

compressive strength, porosity, split tensile test, acid and chloride resistance. It also observed that bacteria is safe for use and cost effective.

5. Meseret Getnet Meharie et al. (2017) In this paper discussed factor affecting self healing efficiency of cracked concrete structure. Factor affecting such as size of the crack, age of concrete and its cracks, healing time, temperature, pressure, presence of concrete material. It is concluded to this paper this bacteria concrete is reliable for use.

6. Ms. T. Viduthalai et al. (2018) In this paper M25 concrete was use for self healing concrete. The major test are done for this bacteria concrete such as compressive strength test, water absorption test. Compressive strength carried out in 7, 14, 28 days and check the test between conventional concrete and compare both concrete, compressive strength found more in self healing concrete. Water absorption test carried in 28 days it found that, Water absorption more in conventional concrete than self healing concrete.

7. Kusuma K et al. (2018) In this paper important aspect of self healing concrete were discussed. The bacteria is used for the experiment was bacillus Magneterium and found the compressive strength test to use this bacteria which are more than the conventional concrete. The paper concluded that bio concrete is eco friendly and cost effective way when compared to conventional concrete.

### 3. Methodology

In this experiment we compare the conventional concrete and bacteria concrete strength and also see the bacteria concrete whether it is heal or not. First we do sieve analysis and collect the aggregate (coarse and fine), sand, cement to make M10 grade concrete it ratio is 1:3:6. Where 1 is part of cement, 3 is part of sand and 6 is part of aggregate. We take 2.5 kg of cement by taking this ratio we calculate amount of sand 7.5kg and coarse aggregate 15 kg and taking water cement ratio 0.6 means 1.5 Liter. Taking the mould size 70.6mm cube having same length breadth and height cast the concrete into it and leave it to 24 hours then curing started for 7,14,28 days.

3.1 Material required: Cement, Sand, Aggregate and calcium lactate



**Figure 3.1.1.** Calcium lactate compression testing machine.

3.2 Mixing Mix the aggregate, cement, sand and calcium lactate taking chemical 0.5% to cement and mix it properly. It will increase the strength of concrete and fill the cracks to form limestone.

3.3 Casting Take the mould size in the form of cube  $70.6 \times 70.6 \times 70.6$ mm and insert the concrete into it by proper temping in 3 layer and release it to 24 hour.

3.4 Curing and Testing after casting curing is started for 7, 14, 28 days in submerged water and checking the strength in compression testing machine both Normal and bacteria concrete.

#### 4. Result

4.1 Compressive strength test the capacity or capability of structure which can resist the load acting on it known as compressive strength of concrete. When bacteria is added in concrete it improves the quality of concrete by increasing the strength of concrete as compare to conventional concrete. The compressive strength of concrete may increase by 13% by adding bacillus or calcium based bacteria and testing perform in 7, 14, 28 days. It increases 13.12% strength in 7 days, 26.24% in 14 days and 39.50% in 28 days. The table show the strength different of conventional and bacteria concrete as shown in figure 5.

S. No.	No. of days	Compressive strength of conventional concrete cubes n/mm	Compressive strength of bacillus concrete cubes n/mm <sup>2</sup>	% increase in strength
1	7	18.12	24.16	30.76
2	14	22.26	31.28	46.15
3	28	33.32	44.62	32.21

4.1.1 Comparing of compressive strength of conventional concrete and bacterial concrete.

### Conclusion

As compared between conventional concrete or bio concrete

(1) Self healing concrete have ability to increase durability of many building material and it is found that bacterial concrete provide more strength than conventional concrete which is advantage of self healing concrete.

(2) Self healing concrete also have limitation which is discuss above in research paper.

(3) Cementation by bacteria is easy for usage. It provide high quality structure that will cost effective and eco friendly in nature.

(4) Self healing concrete work need to improve the method of this technology from both experiment and economical point of view.

(5) Many cementitious and stone material can increase compressive strength and reduction in the permeability, water absorption, corrosion of reinforcement etc.

(6) It is found that bacterial concentration increases then the calcium carbonate precipitation increase.

(7) Due to consolidation, pores inside the cement mortar help to increases in compressive strength with induce microbiologically in calcite precipitation.

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