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Review Report on "Self-Healing Concrete"

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Abstract – The most common material used in construction to withstand compression is concrete, but cracks are certain to occur due to the low tensile strength of concrete which results in reduction in strength and durability of a structure. These cracks allow seepage of water as well as other chemicals in the atmosphere which leads to corrosion of reinforcement bars. The repair these cracks is a tedious job and in turn is expensive so to avoid these a special bacteria is induced in concrete which reacts with calcium to form calcium carbonate crystals which blocks the cracks formed in the concrete. This biochemical method results in sealing of micro cracks of size up to 0.15mm we expect to find better results in the near future which will help in sealing even bigger cracks.

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1. INTRODUCTION

Cracking in concrete is very common in spite of utmost care taken cracks tend to occur due to the tensile forces,these cracks tend to expand further due to various atmospheric conditions and increase the repair cost. Adding bacteria along with its calcium heals cracks by calcite precipitation which in turn restores the compressive strength and durability.

Bacterial concrete also known as bio concrete is a science of precipitation of minerals, these bacteria precipitate calcites, carbonates etc. the bacteria's such as Escherichia coli, Bacillus pasteurii, Bacillus sphaericus react with calcium lactate to form calcium carbonates which results in reduction of permeability which improves strength and durability.

2. LITERATURE REVIEW

"Abhishek Thakur P.G. Student, Department of Civil Engineering and AkshayPhogat U.G. Student, Department of Bio-Technology, Khushpreet Singh Assistant Professor, Department of Civil Engineering, Chandigarh University, Gharaun, Punjab, India. In this paper author has given the various strengths of concrete when different bacteria's were used and also the various water absorption with the addition of bacteria the conclusion of this paper was Bacillus cereus gave maximum compressive strength andS. Pasteurii gave maximum decrease in water absorption.

"S.Soundharya in her paper Study on the Effect of Calcite-Precipitating Bacteria on Self-Healing Mechanism of Concrete has explained about the classification and the various bacterias that can be used in concrete she has explained the mechanism of how the bacteria work and also on the advantages and dis advantages of using these bacterias in concrete."

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In this paper Bacteria-based self-healing concrete has introduced how spores are made and inplanted and the details of how bacterias react with CO2 and $Ca(OH)_2$ to form $CaCO_3$ and water he has also given Composition of concrete specimens. LWA refers to Liapor Sand R 1/4 expanded clay particles.

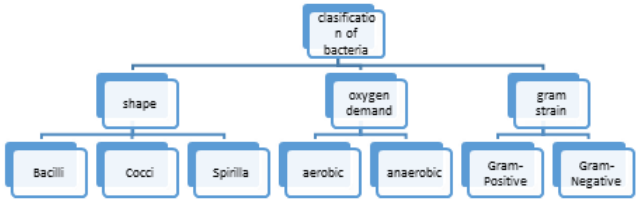
M.Monishaa1, Mrs.S.Nishanthi. in their paper have discussed about the materials and methods in detail and about the changes in both compressive and tensile strength from conventional concrete.

Meera C. M.1, Dr. Subha V in this paper has explained about the methods of placing self healing agents in concrete and also about the changes in strength due to addition of self healing agents they have also assessed the durability of this concrete and concluded that this concrete is more durable as well as the strength is more than the conventional concrete.

3. BACTERIA

3.1 Classifications of bacteria's

Bacteria are simple single cell organisms and are classified according to its shape, gram strain and oxygen demand.



3.2 Various types of bacteria used in concrete are [2]

- Bacillus pasteurii
- Bacillus sphaericus
- Escherichia colli
- Bacillus Subtilis
- Bacillus cohnii
- Bacillus pseodofirrius
- Bacillus balodurais

3.3 Working of bacteria

The bacteria along with calcium lactate, nitrogen and phosphorous are added with the ingredients of the concrete when it is being mixed. These agents lie active up to 200 years in concrete. However as the structure is damaged water starts to seep through the cracks the bacteria starts to germinate on contact with water and nutrients. Once it's activated it feeds on calcium lactate as the bacteria feeds oxygen and calcium lactate is converted into insoluble limestone which fills these cracks and seals it up.

Calcium Carbonate will be formed due to the reaction of CO2 present with Calcium Hydroxide present in the concrete matrix according to the following reaction:

$CO2 + Ca(OH)2 \rightarrow CaCO3 + H2O$ (1) As Ca(OH)2 is a soluble mineral, it gets dissolved in entering water and diffuse out of the crack in the form of leaching. The self-healing process in bacteria incorporated concrete is much more efficient due to the active metabolic conversion of Calcium nutrients by the bacteria present in concrete:

$Ca(C_3H_5O_2)_2 + 7O_2 \rightarrow CaCO_3 + 5CO_2 + 5H_2O$ (2) Here Calcium Carbonate is produced directly due to microbial metabolic process and also indirectly due to autogenesis healing. This process results in efficient bacteria-based crack sealing mechanism.

4. APPLICATION OF BACTERIA IN CONSTRUCTION INDUSTRY [2]

This can be used in

1. Repair of limestone monuments
2. Sealing of cracks
3. High strength durable roads

5. ADVANTAGES

1. Due to sealing of joints reduction in permeability of concrete.
2. It increases the durability of concrete.
3. It is pollution free, eco-friendly and natural.
4. Decreased production of concrete.
5. Repair & maintenance cost is reduced.
6. Applicable to existing buildings in form of spray.
7. Reduces CO_2 Emission by concrete production.
8. Increase in compressive strength.
9. Better resistance to freeze-thaw action.
10. Due to sealing of joints saves reinforcement from corrosion

6. DISADVANTAGES

1. Increase in cost
2. Bacteria's used are harmful to health.
3. No standards or codes for making these concrete are available.

7. REFERENCE

BACTERIAL CONCRETE AND EFFECT OF DIFFERENT BACTERIA ON THE STRENGTH AND WATER ABSORPTION. CHARACTERISTICS OF CONCRETE: A REVIEW -Abhishek Thakur P.G. Student, Department of Civil Engineering, Chandigarh University, Gharaun, Punjab, India. AkshayPhogat U.G. Student, Department of Bio-Technology,Chandigarh

University, Gharaun, Punjab, India. Khushpreet Singh Assistant Professor, Department of Civil Engineering, Chandigarh University, Gharaun, Punjab, India. BACTERIAL CONCRETE: A REVIEW

EXPERIMENTAL STUDY ON STRENGTH OF SELF-HEALING CONCRETE M.Monishaa1, Mrs.S. Nishanthi. 2 1 Student of final year M.E. in Structural Enigneering&Dr.SivanthiAditanarCollegeof Engineering, Tiruchendur.Tamilnadu,India.mmonishaa9894 @gmail.com 2Assistant Professor Department of Civil Engineering Dr. SivanthiAditanar College of Engineering, Tiruchendur.Tamilnadu, India.

Pappupreethi K, RajishaVelluvaAmmakunnoth U.G Student, Department of Civil Engineering Sri Ramakrishna Institute of Technology, Coimbatore, Tamil Nadu, India P. Magudeaswaran Assistant Professor, Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamil Nadu, India

Strength AndDurabilityassessment Of Bacteria Based SelfHealing Concrete Meera C. M.,(Department of Civil Engineering, SreeNarayanaGurukulam College of Engineering, India)Dr. Subha V.,(Department of Civil Engineering, SOE, Cochin University of Science and Technology, India)

Study on the Effect of Calcite-Precipitating Bacteria on Self-Healing Mechanism of Concrete (Review Paper) S.SoundharyaStudent M.E. Structural Engineering,Dr.K.Nirmalkumar Professor, KonguEngineering CollegePerundurai Erode, Tamil Nadu Bacteria-based self-healing concrete H. M. Jonkers Delft University of Technology, Faculty of Civil Engineering and Geosciences, Department of Materials and Environment – Microlab, Delft, the Netherlands

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