

Self Healing Concrete

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ABSTRACT:

Concrete is the first choice for the construction of any structure. Concrete is weak in tension. One of the major problem due to which concrete members fails is cracking. Cracks are generally occurred in each grade of concrete. If crack width is more then it requires repair or extra reinforcement in the design already. These cracks will allow the air, water and chemicals in the concrete ingredients. These lead to failure of structure. So repairing of the cracks is very essential for the durability of the concrete. Repairing of these cracks will increase the cost of maintenance. In this paper the description about self - healing concrete is given. Bacteria are mix in concrete which to improve the behaviour of concrete.

KEYWORD: Cracks in concrete, methods of addition of bacteria, self-healing techniques, types of bacteria

1. INTRODUCTION:

We can also define bacterial concrete as self-healing concrete. It can be defined as "The process can occur inside or outside the microbial cell or even some distance away within the concrete. Often bacterial activities simply trigger a change in solution chemistry that leads to over saturation and mineral precipitation. Use of these Bio mineralogy concepts in concrete leads to potential invention of new material called —Bacterial Concrete" Self-healing concrete is a product that will biologically produce limestone to heal cracks that appear on the surface of concrete structures. Human interventions are not required to cure the cracks. The process of self-healing can be carried out by adding specially selected types of bacteria which are added to the ingredients of the concrete when it is being mixed [1]. The "Bacterial Concrete" can be made by embedding bacteria in the concrete that are able to constantly precipitate calcite. Bacillus Sphaericus is a type of soil bacterium which can continuously precipitate a new highly impermeable calcite layer over the surface of an already existing concrete layer.

Various methods of self-healing are:

1. Bacteria based self-Healing.
2. Vascular Self-Healing
3. Capsule-Based Self-Healing
4. Cementations composites self-Healing
5. Bio-concrete method of self-Healing
6. Autogenously Self-Healing

2. METHODS OF ADDING BACTERIA IN CONCRETE :

According to the previous studies the different approaches for the addition of bacteria in concrete are;

1. In fresh concrete- direct addition of microbial broth or in form of spores.
2. Immobilized form onto activated carbon or silica gel
3. By encapsulation.
4. By using the vascular network .

Direct addition of microbial broth in fresh concrete: this type of addition of bacteria in concrete is a simple method and also economically good and also shows higher biological concrete workability. But the most important thing is it shows very less increase in compressive strength, and durability. In this approach of addition of bacteria in concrete, the lifetime of micro- organisms is less. This is the main reason for the less increase in different characteristics of concrete. Immobilized form onto activated carbon or silica gel: in this approach the addition of attached micro- organisms or their spores to the activated carbon or silica gel is done. In this case the micro-organisms shows higher lifetime, bacteria shows less effect on durability, strength and permeation, it also shows higher biological workability [2]. One more disadvantage of this method is there is very less protection for the micro- organisms in concrete.

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By encapsulation: in this method encapsulated micro-organisms are added directly in concrete. This approach shows high lifetime of micro-organisms, less effect of durability, less strength and permeability, and shows high biological concrete workability. The disadvantage of this method is, this method is expensive and complex. By using the vascular network, in this method there is circulation of micro-organisms in the micro-vessels throughout the concrete. This method is highly effective for the repair of crack and also makes the concrete more durable. But this method is very costly, complex, shows less biological workability and also there is no full information about this method in the previous studies.

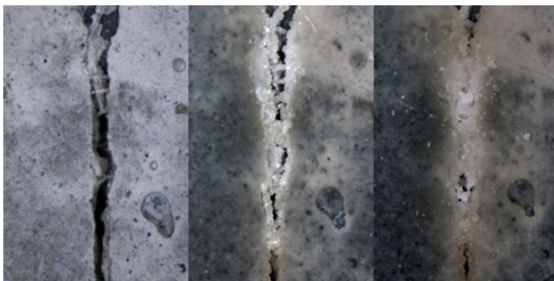


Fig: 1 Working of self-Healing concrete

3. REVIEW OF LITERATURE:

H.M. Jonkers et al concluded that the two component bio-chemical healing agent, composed of bacterial spores and a suitable organic bio-cement precursor compound, using porous expanded clay particles as a reservoir is a promising bio-based and thus sustainable alternative to strictly chemical or cement-based healing agents, particularly in situations where concrete parts of a construction are not accessible for manual inspection or repair [3].

Dr. Geetha Jayaraj et al conclude that the microcapsule proved to be effective way of encapsulating the healing agent for the targeted release. With this Self healing of concrete method relatively large cracks in reinforced concrete can be filled. Methods doesnot leads to strength improvements of the structure but by filling cracks the path of the reinforcement is blocked. Cracks can be filled in this way such that leakage can be stopped. Especially in underground structure where repair is difficult and impossible self healing concrete has great future [4].

Abhijit Mandlik et.al. conclude that the microcapsule proved to be effective way of encapsulating the healing agent for the targeted release.

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M. Kishore, Dr. S. Thenmolzime et.al. studied red soil binds well than clay or sand. Sand having large pores takes a long time to be bonded. Whereas the clay soil, the molecules are densely packed, thus it became hard for the solution to seep in. The urease activity of bacillus megaterium is found to be more than that of bacillus pasteurii, which in turn refers that the B.megaterium produces more calcite than B.pasteurii [6].

Harshali J., Mitali S., Neha A., Pragati B., studied and conclude that Increase in compressive and flexural strength of bio concrete cubes compared to conventional cubes. From his project it is concluded that use of bacteria in concrete increases the percentage strength and reduces its water absorption and sorptivity. By using the bio concrete the compressive strength of concrete and durability of structure can be better than the conventional concrete. The impermeability of bio concrete will be increased than the conventional concrete [7].

Shivam pandey et al concluded that different self-healing techniques are discussed. The first is using bacteria to precipitate calcite in cracks. With this method, large cracks in reinforced cement can be filled. The Bacterial self-healing concrete technology is better than the other technologies because it is eco-friendly. According to many research groups, the cost of bacterial concrete is increases by 30% to conventional concrete [8].

H. Jonkers, E. schlangen, S Qian, A. Garcia Studied different techniques were discussed. The first technique is for healing concrete cracks. The second technique is used for SHCC materials. The third technique is for asphalt application. For first technique the cracks are filled with the help of bacteria. For second technique healing is done with the help of SAP and microfibers. For third technique the use of steel fibres and encapsulated oil is used .

CONCLUSION:

In this paper, methods various bacteria used for self-Healing concrete are mentioned. The methods with which we can add bacteria to concrete are also discussed. Among all the methods direct addition of bacteria to concrete is simple and cost-effective method. But it doesn't affect the properties of concrete significantly. Addition of bacteria will help to block the entry of air and water inside the concrete and protect the reinforcement. Bacterial concrete is a complex concept. But its advantages reduce cost and human efforts. The designing of bacterial concrete is the most popular research topic for the researchers. Till now it is found that maximum compressive strength is increased by addition of *Bacillus cereus*. The failure of concrete is occurred mainly due to cracks. Therefore the repair of cracks is most essential process in maintenance. Some of the bacteria are dangerous for human health. While *Bacillus Sphaericus*, *Bacillus pasteurii*, *Bacillus subtilis*, and *Bacillus flexus* does not impose any bad effect on human health and also shows higher ability of calcite precipitation

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