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Self Healing Concrete

Harsh Mehta[1], Daivik Patel[2], Gopika Pillai[3], Saket Sorathiya[4], Adil Haji[5], Sandeep Khorasiya[6]
[1-5]Student, Department of Civil Engineering ,Sigma Institute of Engineering, Vadodara, Gujarat, India
[6]Assistant Professor , Department of Civil Engineering ,Sigma Institute of Engineering, Vadodara, Gujarat, India

ABSTRACT

The concrete is the most commonly use material all over the world. Concrete has the drawback of minor cracks due to certain factors like temperature, saline effect, high tensile strength etc. The concrete micro cracking leads to the failure of structure and reduces its durability and strength when steel exposed to air. To overcome the carbon release in environment by reducing the use of cement in cracking and also reducing the harmful chemicals which are injurious to health would be reduced to great extent. The filling of cracks by bacterial action induced calcium carbonate precipitation as a preventive measure for micro cracking. This method is now well developed with advance laboratory research in combination of bacteria and concrete. The scour (calcium Lactate) are added with mortar on which the bacteria use to react and forms limestone is calcium carbonate (CaCO3) so the by-product which form has a calcium compound. The bacteria used are 'bacillus pseudofirmus' scientifically called 'sporosarcina pasteurii' mixed with sand and cement. Other benefits of microbiologically induced bacteria are that it works on different organic matter like birds excreta found on concrete buildings. The strength of concrete do not get affected by it. This review paper deals the application & merits for concrete for increasing life span of concrete. The micro-cracks get filled by itself hence this type of concrete is called 'self-healing concrete.

Keywords: Self healing concrete, bacterial concrete, innovation in concrete technology

I. INTRODUCTION

Concrete is main material for the building and now a day widely used in all type of structures. It has better durability and strength. It can resist compressive load to its elastic limit. If load exceeds the limit then cracks are formed. If CO_2, O_2 and Harmful chemical penetrates the concrete cover, getting to reinforcement and cause corrosion. Which decrease the tensile stress of concrete. Due which it can cause irreparable damage in structure. So, it is important to fill these cracks.

Until now, some compound is applied to fill the crack or to prevent for formation of crack, such as plastic polymer applied on the surface of concrete. This are the common way to increase the life of concrete structure. In this method human involvement is required. Also, it is very expensive to treat. Furthermore, sometime it is difficult to repair the damage are because of their location and environmental condition example underground structure, radioactive west storage tank among other.

Due this fact, self-healing concrete is popular among researcher for some years. In fact, concrete has self -

healing ability. Hydration of unhydrated cement in the prance of water cause the fill small cracks (<200μm). It can be related to self- heling phenomena of biosphere and automatic healing of small cut in plant and animal by biological mechanism. Hence the curies question come in mind "can we achieve to bring similar process in concrete" There are various studies going on to bring an effective answer. However, cost is too high to consider

It is our purpose to show different research going on biological self -healing concrete and development in research from 2007 by different scientise

II. CRITICAL LITERATURE REVIEW

Dr. Henk Jonker et. al. used bacillus bacteria as self-healing component. Its life span is above 200 years so it can be employed for filling crack for longer period. They are commonly found in Lake of Russia and Egypt. The bacillus is well based with calcium lactate, nitrogen, & phosphorus, so they are used in concrete mix. During his experiment, he observed that oxygen is composed by bacteria and during the process the soluble calcium lactate converts into insoluble limestone. This insoluble limestone produces by bacteria help in filling cracks. The other advantages are that oxygen which is responsible for corrosion of reinforcement is used by bacteria, so it reduces the rate of corrosion of reinforcement. But there is some disadvantage like there is more compression in softer part of concrete (sand) as compare to harder part of concrete (aggregate), other drawback is that concrete is very expensive to make.

J.Y Wang et. al. presented a paper on self-healing concrete by use of microencapsulation bacterial spores. In this study they used microcapsules in the bacteria spores for self-healing. Their unitability and influence on mortar specimen were investigated. Breakage of micro capsules upon cracking was verified using scanning electron microscopy. Its self-healing was evaluated by crack healing ratio and water permeability. The result indicated that the healing ratio of specimen with bio microcapsule was higher about 48%- 80%, in specimen without bacteria about 18%-50%. The specimen with bacteria series healed crack of width about 970 micrometers and the water permeability was about 10 times lower than non-bacteria series. By using wet-dry cycle it stimulated the self-healing with bacteria but no self-healing was observed in all specimen stored at 95% RH which started that liquid water is an essential component for self-healing.[4]

E. Tziviloglou et. al. compared water seepage though cracks by replacing material of concrete. In his study he has mixed bacterial base self-healing agent into lightweight aggregate and mixed in fresh mortar. Agent used in bacteria based self-healing concrete was spouse of genus bacillus. Which are commonly found in salty lakes of Egypt and Russia. First, he used the bacteria in normal concrete (NC) then he replaced sand with lightweight aggregate (LWA). Then he conducted different test on fresh concrete and hard prisms. In the fresh concrete flow ability is more and bulk density decreases as compared to conventional concrete. In hard concrete compressive strength of concrete was less compared to normal concrete after three days. At 7th day compressive strength was same. But after 27th day compressive strength was less as compared to conventional concrete. And he found that water seepage was less in lightweight concrete.[2]

Zhengxian yang et. al. used oil core/silica gel in self-healing cementations composite.in this paper it presents work which features the design of microcapsule with oil core and silica gel shell consisting of methyl methacrylate (mma) as a healing agent and an initiator containing triethylborane (TEB) They are micro capsulated through an interfacial self-assembly process and sol-gel reaction. The microcapsules are dispersed in fresh cement mortar along with carbon microfibers and healing occurs through a passive mode for hardened mortar, self-healing can be triggered by cracks propagation through microcapsules. The crack, resistance of the self-healing composites was evaluated by using a fatigue

test under uniaxial compression cyclic loading. The test results revealed that the incorporation of a small dosage of PSMS into carbon micro-fibre reinforced mortar improved the crack, resistance and toughness of specimens under fatigue loading and was further confirmed by field emission scanning electron micro capsuled with energy dispersive X-ray analyzer.it demonstrated the feasibility of self-healing cementations composites using oil core or silica gel shell.[5]

Daisuke Homma et. al. presented a paper on self-healing capability of fibre Reinforced cementations composites [FRCC]. The test was carried out on a FRCC specimen where three types FRCC were prepared namely (1) Polyethylene fibre (PE) (2) Steel core fibres (SC) (3) Hybrid fibres composite [both PE & SF]. In this cracks were introduced by tension and then retained in water for 28 days. Then self-healing was investigated by microscope observation water permeability test, tension & back scattered electron image analysis. It was found that fine fibres of PE were bridging over the cracks. As a result water permeability co-efficient decrease & tensile strength was improved. The self-healing products were calcium carbonate crystals which helped to reducer permeability and increases tensile strength.[4]

V. Wiktor et. al. bacteria- based self-healing concrete to increase liquid tightness of cracks. In these bacteria healing agent is incorporated into light weight aggregate and mixed with fresh mortar. It has shown promising result regarding the improvement of crack sealing performance. By this means autogenously healing of concrete enhanced and upon cracking the material is capable to recover water tightness. It focuses on the healing agent incorporated into the mortar matrix and evaluation of the recovery of liquid tightness after cracking. It is exposed to two different healing regimes.

1) Wet immersion 2) Wet dry cycle. Through water permeability tests. Water tightness increases for specimen containing healing agent compared to the specimen without it when subjected to wet dry cycles. The specimen has calcite formation due to healing agent. Thus this study shows how the addition of the healing agent affects the fresh and hardened state properties of the mortar and to evaluate the RWT after cracking.[6]

III. CONCLUSION

By referring different research paper and review papers by different authors we conclude that cracks in concrete which decrease the durability and strength of structure, due to which there are large numbers of experiments are going on in the field of self-healing concrete. We have discussed about two of self-healing methods (1. bacterial based self-healing concrete & 2. Material based self-healing concrete). By this study we have come to a conclusion that use of bacteria as component of self-healing of concrete is better than material based but it decreases the compressive strength of concrete and due to its high cost it is not popularly used all over the world.

IV. REFERENCES

[1]. DR. Henk Jonkar, self healing concrete, a micro biologist at delft university

[2]. E. Tziviloglous, bacteria based self healing concrete to increase liquid tightness of crack, construction and building material 122 (2016) pg no. 118 -125, Deflt university of technology, the Netherlands

[3]. J. Y. Wang self healing concrete use of microencapsulated bacterial spores, cement and concrete research 56 (2014) Pg no. 139-152, Belgium.

[4]. Daisuke Homma, self healing of fibre reinforced cementations composites, journal of advance concrete technology vol. 7, 217-228, June 2009.

[5]. Zhengxian Yang, A self healing cementations composite using oil core /silica gel shell micro capsule, cement and concrete composite 33 (2011) 506-512, Netherlands.

[6]. V. Wiktor, bacteria based self healing concrete to increase liquid tightness of crack, construction and building material