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An Experimental Study of Self-Healing Concrete by Adding Pseudomonas Fluorescens Bacteria

Mrinmayee Devgire[1], Aniket Kapile[2], Ankitraj Bhavsar[3], Shantanu Bhosle[4], Prof. Rajkumar Vade[5]
[1, 2, 3, 4]*Department of Civil Engineering, The ShetkariShikshan Mandal's Pd. Vasantdada Patil Institute of Technology Bavdhan, Pune 411021*

Abstract: ***Now-a-days concrete is most commonly used material in construction industry. To form a crack in concrete it's a big problem those days. Which is affect on the life of building or any structure.***
In a concrete structure cracks is produced there are many reasons to a failure of structural cracks and this is due to various reasons i.e shrinkage, compressive, and tensile force which are acts on concert. The present study is obtain the performing of concert by adding of various bacteria in it.
Where the bacteria is introduce in concert introduced in concert by healing the cracks which they develops in concert. The present study is about the 'pseudomonas fluorescens bacteria.' Which is capable to healing the developed cracks in concert.
For bacteria growth required optimal dosage and also required optimal
Keyword: Pseudomonas fluorescens bacteria concrete, Microbial concrete, self-healing concrete by adding of non-pathogenic bacteria.

I. INTRODUCTION

A. General

Concrete is play vital role in construction industry. There is no project and construction work is doesn't exist without using concrete. The impovent factor of concrete is to resist the various type of load i.e. compressive load upto 50-100 years, but it has negative impact also concrete is weak in tensile stress condition ok strut.The positive impact of using concrete in construction is its ability to resist the compression load or stress of structure up to 50-100 years but it has negative impact too. Concrete is weak in resisting the tensile stress of structure. So when this tensile stress exceeds its limit, cracks are developed in concrete structure. Due to these cracks, strength of concrete reduces and it results in failure of structure. To counteract this phenomenon, various methods were adopted by the researchers in whole world. From that, some methods are very useful for the future development in concrete i.e. self-healing of concrete, the concrete which heals automatically by its own. To make this self-healing concrete different materials are used which were never used before.

Recently it has been found that, to make self-healing concrete the various types of bacteria can be used. Our study is about bio concrete in which the pseudomonas fluorescens is mixed in concrete to heal the cracks developed in concrete.

B. Introduction of Bacteria

To made this concrete self-heal we need to add the bacteria such as Pseudomonas fluorescens, bacillus subtilis and E-coli which are non-pathogenic bacteria. This bacteria are non-host based bacteria and they are capable of multiplying and recharged to be refilled within concrete. Pseudomonas fluorescens are rod shaped bacilli and gram negative bacteria. The temperature required for their growth is 30-37oC. For this bacterium growth, the strains of bacteria should keep in agar solution for 72 hours.

Group	Species
Pseudomonas Group	Pseudomonas azotoformance
	Pseudomonas brenneri
	Pseudomonas cedrina
	Pseudomonas fluorescens
	Pseudomonas fragi
	Pseudomonas poae
	Pseudomonas gesardii

Family of pseudomonas fluorescens bacteria

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The bacteria are available in solid as well as liquid state too. For making solid bacteria, organic matter should mix with liquid bacteria and make small balls of them and add it in concrete during casting.



Fig. 1 Pseudomonas Fluorescens

C. Objectives

1) To reduce the cracks and its widening
2) To increasing the strength of concrete
3) To reduce the cost of maintainanc
4) To increase the serviceability and also durability of concrete

II. MATERIALS AND METHODOLOGY

A. Material

1) *Cement:* As per standard requirement, OPC53 grade is adopted for mix design of concrete
2) *Water:* Locally available potable water is used for mixing of concrete.
3) *Fine Aggregate:* Natural sand is used as fine aggregate for mixing throughout completion of mixing
4) *Coarse Aggregate:* Crushed granite stone of size 20 mm are used as per std.
5) *Bacteria:* It is used for self-healing of concrete are pseudomonas fluorescens. Addition of bacteria in concrete with different percentage such as 10%, 20% and 30%of water mass

B. Methodology

1) *Culturing of Bacteria:* The pure culture is maintained on nutrient agar slant. The strains of bacteria are kept in liquid solution for the growth of bacteria. The bacteria kept for 72 hours in laboratory and then it stored in seal packed bottles. These bottles prevent the bacteria from direct contact with sunlight. The bacteria are kept in 30-37oC temperature to survive easily.



Fig. 2 Storage Bottles

2) *Methods of Mixing Bacteria in Concrete:* There are different types of method which can be used for adding bacteria in concrete i.e. i) The bacteria is directly added in concrete ii) Bacteria mixed with organic matter and then small balls of organic matter which are mixed with bacteria, they are added in concrete iii) The encapsulation method in which the bacteria are fill in capsules and then capsules are mixed with concrete iv) The bacteria is injected or directly sprayed in the crack or surface of the crack after crack develops in concrete structure.

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3) *Casting Of Cube:* The concrete used for this work is M25 grade concrete. The concrete cubes having size 150mmX150mmX150mm are casted as per bacteria proportion in it and then they are compared with conventional concrete in which no bacteria were added.
4) *Curing of Cubes:* After one days cubes are demoded and they can put the distilled water tank for a curing purpose and then they can tested for 7 and 28 days



Fig. 4 Curing of Cubes

5) *Testing of Cubes:* The cubes are tested on 7, 14 and 28 days for the compressive strength. After that the cubes in which bacteria are introduced they are again submerged in water for curing and to check the formation of calcite precipitation on surface of cubes after some period of time.
6) *Proces Of Healing The Concrete By Adding Bacteria:* After testing a block they are put in water again and then observed it bacteria is an active state and they are healed the cracks . this process is obtain in 2 to 3 weeks after cracks is developed.



Fig. 5 (while developing crack) 1 week



Fig. 6 (2nd week)



Fig. 7 (3rd week)

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Fig. 8 (4th week)

Results On A Concrete Block

III. LITERATURE REVIEW

Pradeepkumar A., Akila Devi, Anestraj S., Santoshkumar A. have studied the bacillus subtilis bacteria which is added in M20 grade concrete. The experiment results in increase of compressive strength of concrete when 30 ml of bacteria is added in concrete. The strength of M20 grade concrete results came equals to M25 grade concrete. In this study, the main focus was on how right condition can be created for bacteria not only to survive in concrete but to produce as much calcite as needed to repairs cracks.

S. kavitha and A. Aswin kumar have found that the selfhealing can only occur for cracks smaller than 0.2 mm. In their study, they use pseudomonas fluorescens, bacillus subtilis and E-coli with 1 % to 5% in M30 grade of concrete. A significant increase in strength was observed due to addition of bacteria in this study.

E. Tziviloglou V., Wikator, H. M. Jonker, E. Schlangen

Bacteria-based self-healing concrete has shown promising results regarding the improvement of crack sealing performance.In this study, the bacteria based healing agent is incorporated into light weight aggregate and mixed with fresh mortar. By this means autogenous healing of concrete is enhanced and upon cracking material is capable to recover water tightness. From this study it was focused that compressive strength mortar containing lightweight aggregate is not affected by presence of healing agent. Oxygen concentration measurement and bacterial traces on calcite formation confirmed the bacterial activity on specimen containing healing agent. VirginieWikator, Henk M. Jonkers**,** The aim of this study was quantify the cracks healing potential of specific and novel two component bio chemical self-healing agent embedded in porous expanded clay particles, which acts as reservoir particles and replace part of regular concrete aggregate. That the observed doubling of crack-healing potential was indeed due to An Experimental Study on Self-Healing Concrete By Adding Pseudomonas fluorescens Bacteria 12 metabolic activity of bacteria was supported by oxygen profile measurements which revealed O2 consumption by bacteria-based but not by control specimens. We therefore conclude that this novel bio-chemical self-healing agent shows potential for particularly increasing durability aspects of concrete constructions in wet environments

IV. CONCLUSION

From the above study which is done by researchers we conclude the self healing concrete is done by using ‘pscudomonos fluroscens bacteria. Due to the adding bacteria it help to increase durability of the concrete. It also increase the small percentage of compression strength of concrete due to bacteria adding. Hence psudomonuas flurosence bacteria are preferable.

V. FUTURE SCOPE

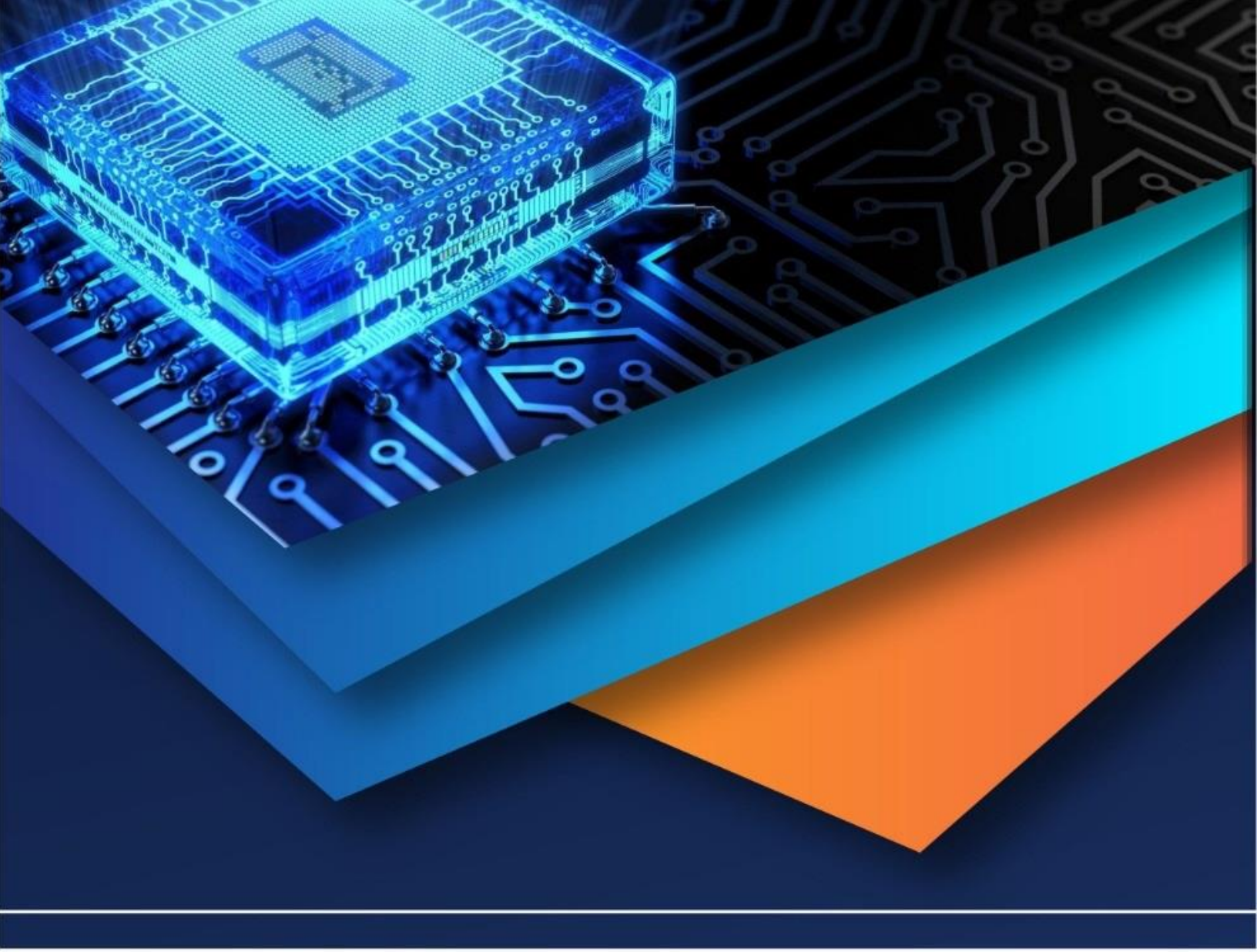
From above conclusion. Due to this initial cost of construction increased but it reduced maintainace cost of structure and also increased durability of concrete.

It’s the main view point which is upcoming construction work.

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