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A Review Paper on Self-Healing of Concrete by Using Bacteria, Bacillus Subtilis

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ABSTRACT

A Self-Healing Material is described as a material that is capable of repairing itself back to the original state. Self-Healing Concrete is a product that will biologically produce Limestone to heal cracks that appear on the surface of concrete. When a concrete structure is damaged and water seeps through the cracks that appear in the concrete, the spores of the bacteria gets germinated, thus the concrete will be healed. Bacillus Subtilis:- Bacillus Subtilis is also known as Hay Bacillus. It is a Gram Positive, Catalase Positive Bacterium, found in soil. It is in rod shaped and can form a tough, protective endospore, allowing it to tolerate extreme environmental condition. The concentration of the Bacteria is 30 gm. and 60 gm. added while mixing the concrete. The Compressive strength, Flexural strength, durability of concrete will be recorded after 7, 14, and 28 days and also curing will be recorded for conventional cube of size 150 x 150 x 150 mm.

Keywords: Bacillus Subtilis, Ordinary Portland Cement.

I. INTRODUCTION

Concrete is the most commonly used building material, but it has few limitations.It is strong durable, locally available and versatile. Concrete is very good material to resist the compressive load to a limit but if the load applied on the concrete is more than their limit of resisting load, it causes the strength reduction of concrete by producing the cracks in the concrete and the treatment of the cracks is very expensive. Tiny cracks formed on the surface of the concrete make the whole structure vulnerable due to seepage of water into the concrete, promoting less durability of concrete. Self Healing concrete can solve the problem of durability of concrete structures.[1], Self Healing concrete is one that senses the cracks formation and reacts to heal itself without human interference. The cracks are formed on the surface of concrete due to many reasons like shrinkage, indequate water for hydration. Self-Healing concrete is a concrete that will biologically produce Limestone to heal cracks that appear on the surface of concrete structures. However when a concrete structure is damaged and water starts to seep through the cracks that appears in the concrerte, the spores of the bacteria germinate on contact with the water and nutrients. Having being activated, the limestone solidifies on the crack surface, there by sealing it up. The consumption of oxygen during the bacterial conversion, has an additional advantage. [2], Bacillus Subtilis, also known as hay bacillus or grass bacillus.It is a gram positive, catalase positive bacterium, found in soil. It is in rod shaped and can form a tough, protective endospore, allowing it to tolerate extreme environmental condition.

II. METHODS AND MATERIALS

Cement

Ordinary Portland cement of 53 grade is used in concrete. Cement used has been tested as per IS 10262 and 456-2000.

Crushed sand

Crushed sand having specific gravity of 2.65 and confirming to IS-383 II is used.

Course aggregate

The maximum size of coarse aggregate should be 20 mm and minimum size should be 10 mm. The coarse aggregate with angular in shape and the rough surface texture is used.

Bacteria

The bacteria of Bacillus subtilis were obtained from, Florken sciences, Nashik.

Water

Locally available portable water confirming to standard specified in IS 456-2000 is use.

M25 grade of concrete mix design as per IS code 10262 (2009) given below in table no 1

Table 1. M25 grade of concrete mix design

Materials	Quantity	Average specific gravity	Water absorption %
Cement	478.95kg	3.15	-
Sand	794.49kg	2.65	1.0 %
20mm aggregate	1011.17kg	2.67	0.5 %
Water	191.58kg	-	-
Bacteria	30gm & 60gm	-	-

METHODS:

Slump test: The concrete slump test is an imperical test that measure workability of fresh concrete. The slump cone test indicates the behaviour of a compacted concrete cone under the action of gravitional forces.The test was carried out with a Moulds called a slump cone. The decrease in height of concrete to that of moulds is noted with scale which is found to be 75mm for conventional cubes and 45mm for bacterial cubes.

Compressive studies: M25 concrete design mix was made as per I.S 10262:2009.Cubes of size 150mm X 150mm X150mm were casted with and without adding bacteria. Dosage of 30 gm and 60 gm bacteria were added in 2nd mix design. Cubes will be then tested for compressive strength at 7,14 and 28 days.

III. RESULTS AND DISCUSSION

Expected Outcome

Introducing the bacteria into the concrete makes it very beneficial it improves the property of the concrete which is more than the conventional concrete. Bacteria repair the cracks in concrete by producing the calcium carbonate crystal which block the cracks and repair it. The concentration of the Bacteria is 30 gm. and 60 gm. added while mixing theconcrete. The Compressive strength and durability of concrete will be recorded after 7, 14, and 28 days and also curing will be recorded for conventional cube of size 150 x 150 x 150 mm. By introducing Concrete using the bacteria in concrete, the layer of Limestone will be formed on the surface on concrete cubes when the cracks are formed. This research has shown that the development of self healing concrete is Eco friendly and it also increases the service time, durability and reduces the maintenance cost.

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