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AN EXPERIMENTAL INVESTIGATION ON SELF -HEALING CONCRETE BY USING BACTERIAL SUBTILIS

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ABSTRACT

This project uses bacillus subtilis in an experimental investigation of self-healing concrete. Microorganisms from the genus Bacillus subtilis are capable of effectively mending both structural and non-structural cracks. The main obstacle regarding the survivability of such bacteria in a concrete mixed atmosphere has been overcome by developing an efficient immobilisation method in a cogent manner. Calcium and Bacillus subtilis combined to create calcium carbonate crystals, which stop concrete cracks from forming. The concrete cubes were crushed to determine the varied compressive strengths of the concrete at different curing days using the bacillus subtilis at weight percentages of 0%, 5%, 10%, and 15%.Calcium chloride (CaCl2) is a chemical admixture that acts as an accelerator and is produced as a by-product. Accelerators speed up the initial rate of chemical reaction between cement and water to speed up the stiffening, hardening, and strength development of concrete. calcium chloride such as 0%,0.5%,1.0%,1.5%,2%,2.5% respectively is undergone compressive, and split tensile strength test. The test results will obtain at the age of 7 and 28 days.

Keywords: Bacteria subtilis, calcium chloride, Compressive strtength and split tensile strength,

1. INTRODUCTION

The most widely used construction material is concrete. It is recognised to have a variety of downsides despite its structural versatility. It cracks easily, is deficient in ductility, and is fragile under stress. On the basis of continuing research carried out all over the world, various adjustments have occasionally been made to address the drawbacks of cement concrete. The development of special concrete that takes into account the speed of construction, the strength of concrete, the durability of concrete, and the environmental friendliness of concrete has been made possible by ongoing research in the field of concrete technology using industrial materials like fly ash, blast furnace slag, silica fume, and metakaolin. It's possible that the process happens inside the concrete itself, outside the microbial cell, or maybe both. Oversaturation and mineral precipitation are frequently the results of bacterial activity changing the chemistry of a solution. The incorporation of these biological ideas into concrete may result in the creation of a brand-new substance called "Bacterial Concrete." With the chemical symbol Ca and atomic number 20, calcium is a member of the calcium family. Calcium is a reactive metal and an alkaline earth metal that, when exposed to air, develops a shady oxide-nitride layer. Its heavier homogeneous counterparts share the most of its physical and chemical characteristics. stronium and barium. After iron and aluminium, it is the third most common metal on Earth and the fifth most common element in the crust.

2. OBJECTIVES

1. Growth of Bacteria Subtilis.
2. To optimize the calcium chloride in cement.
3. To determine compressive and split tensile strength of concrete.

3. MATERIALS

Cement: Locally available OPC 53 grade of cement is used.

Fine Aggregate: River sand that is readily available in the area and is in Zone II was used.

Coarse Aggregate: The aggregate was obtainable locally and had a nominal size of 20mm..

Water: For mixing and curing, fresh, potable water is used.

Bacteria: A bacterium that has been produced in a lab is called Bacillus subtilis JC3.

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Calcium Chloride: Concrete hardens quickly and has a high initial strength because to the usage of calcium chlorides as a cement hydration process accelerator.

4. RESULTS

Compressive strength: The 150 mm x 150 mm x 150 mm cube specimens are tested, and the results have been given.

Table 1: Compressive strength of concrete with calcium chloride as partial replacement of cement in concrete**.**

S. No.	Calcium chloride	Compressive Strength (N/mm^2)	
		7 days	28 days
1	0%	34.33	49.13
2	0.5%	34.36	49.20
3	1.0%	35.04	50.15
4	1.5%	35.77	51.17
5	2%	36.76	52.53
6	2.5%	37.42	53.74

Table 2: Compressive strength of concrete with bacillus subtilis as a partial replacement in concrete.

S. No.	Bacillus ubtilis	Compressive Strength (N/mm^2)	
		7 days	28 days
1	0%	34.33	49.13
2	5%	39.17	56.03
3	10%	40.88	58.42
4	15%	36.64	52.62

Table 3: Combined replacement of Compressive strength of concrete with 2.5% calcium chloride+10% Bacteria subtilis.

S.No	Combined replacements	CompressiveStrength, (N/mm^2)	
		7 days	28 days
1	0%	34.33	49.13
2	10%BS+2.5%CC	42.49	60.72

Split tensile strength:A conventional cylindrical specimen is placed horizontally in this test, and a force is exerted radially on its surface until a vertical crack forms along the specimen's diameter.

Table 4: Split tensile strength of concrete with calcium chloride as partial replacement of cement in concrete.

S. No.	Calcium chloride	Split tensile Strength N/mm^2)	
		7 days	28 days
1	0%	3.36	4.81
2	0.5%	3.38	4.82
3	1.0%	3.45	4.94

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4	1.5%	3.53	5.06
5	2%	3.64	5.21
6	2.5%	3.73	5.36

Table 5: Split tensile strength of concrete with bacillus subtilis as a partial replacement in concrete.

S. No.	Bacillus subtilis	Split tensileStrength (N/mm^2)	
		7 days	28 days
1	0%	3.36	4.81
2	5%	3.86	5.53
3	10%	4.06	5.81
4	15%	3.65	5.25

Table 6: Combined replacement of Split tensile strength of concrete with 2.5% calcium chloride+10% Bacteria subtilis.

S.No	Combined replacements	Splittensile Strength, (N/mm^2)	
		7 days	28 days
1	0%	3.36	4.81
2	10%BS+2.5%CC	.43	6.35

5. CONCLUSIONS

1. The Normal concrete compressive strength is for 7 and 28 days is 34.33N/mm^2 and 49.13N/mm^2.
2. At 2.5% calcium chloride partial replaced with cement then the compressive strength is for 7 and 26 days is 37.42N/mm^2 and 53.74N/mm^2 .
3. At 10% of Bacteria subtilis concrete the compressive strength is for 7 and 28 days is 40.88N/mm^2 and 58.42N/mm^2.
4. The optimum combined replacements are noted at 10% of Bacillus subtilis and 2.5% Calcium chloride at 7 and 28 days are 42.49N/mm^{2}and 60.72 N/mm^2 ,
5. The Normal c oncrete split tensile strength is for 7 and 28 days is 3.36N/mm^2 and 4.81N/mm^2.
6. At 2.5% calcium chloride partial replaced with cement then the compressive strength is for 7 and 28 days is 3.73N/mm^2 and 5.36N/mm^2 .
7. At 10% of Bacteria subtilis concrete the split tensile strength is for 7 and 28 days is 4.06N/mm^2 and 5.81N/mm^2.
8. The optimum combined replacements are noted at 10% of Bacillus subtilis and 2.5% Calcium chloride at 7 and 28 days are 4.43N/mm^{2}and 6.35 N/mm^2 ,

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