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STRENGTH STUDY ON SELF -HEALING CONCRETE BY USING BACTERIAL SUBTILIS

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ABSTRACT

In this study, self-healing concrete is being experimentally investigated using the bacterium Bacillus subtilis. Both structural and non-structural cracks can be efficiently repaired by bacteria of the genus Bacillus subtilis. By ingeniously inventing an effective immobilisation technique, the main challenge surrounding the survival of such bacteria in a concrete mixed atmosphere has been removed. Crystals of calcium carbonate, which prevent concrete cracking, are produced by the combination of calcium and Bacillus subtilis. Using the bacillus subtilis at weight percentages of 0%, 5%, 10%, and 15%, the concrete cubes were crushed to evaluate the various compressive strengths of the concrete at different curing days.As a by-product, calcium chloride (CaCl2) is a chemical admixture that serves as an accelerator. In order to hasten the stiffening, hardening, and strength development of concrete, accelerators increase the initial rate of the chemical interaction between cement and water. Compressive and split tensile strength tests on various concentrations of calcium chloride (0%, 0.5%, 1.0%, 1.5%, 2%, 2.5%, respectively) were performed. The test results will be available at 28,56 and 90 days and Ultra sonic pulse velocity.

KEYWORDS: Calcium chloride, Bacteria subtilis, Compressive strtength and split tensile strength,

1. INTRODUCTION

Concrete is the building material that is most frequently used. Despite its structural adaptability, it is acknowledged to have a number of drawbacks. It lacks ductility, cracks easily, and becomes brittle under pressure. On the basis of ongoing worldwide study, numerous modifications have occasionally been made to overcome the shortcomings of cement concrete. Continuous research in the area of concrete technology using commercial materials like fly ash, blast furnace slag, silica fume, and metakaolin has enabled the development of special concrete that takes into account the speed of construction, the strength of concrete, the durability of concrete, and the friendly to the environment of concrete.It is conceivable that the process takes place inside the concrete itself, outside the microbiological cell, or perhaps both. Bacterial activity frequently modifies a solution's chemistry, leading to oversaturation and mineral precipitation. These biological concepts could be incorporated into concrete to produce "Bacterial Concrete," a brand-new material. Calcium belongs to the calcium family and has the chemical symbol Ca and atomic number 20. Calcium is an alkaline earth metal that is reactive and forms a shady oxide-nitride layer when exposed to air. The majority of its atomic and molecular properties are shared by its heavier homogeneous counterparts.

2. OBJECTIVES

1. Development of Bacillus subtilis.
2. To improve cement's calcium chloride content.
3. To calculate the concrete's split and compressive tensile strengths.

3. MATERIALS

Cement: OPC 53 grade cement that is readily accessible locally is utilised.

Fine Aggregate: River sand from Zone II, which is easily accessible in the area, was used as a fine aggregate.

Coarse Aggregate: The aggregate had a nominal size of 20 mm and could be found nearby.

Water: Fresh, potable water is utilised for both mixing and curing.

Bacteria: Bacillus subtilis JC3 is a bacterium that was created in a laboratory.

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Calcium chloride: Calcium chlorides are used as a cement hydration process accelerator, causing concrete to fast solidify and have a high initial strength.

4. RESULTS

Compressive strength: The test is performed on cube specimens that are 150 mm in height, 150 mm in width, and 150 mm in depth.

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)		
		28 days	56days	90days
1	0%	49.13	53.58	57.24
2	0.5%	49.20	53.62	57.55
3	1.0%	50.15	54.64	58.64
4	1.5%	51.17	55.76	59.81
5	2%	52.53	57.41	61.42
6	2.5%	53.74	58.59	62.79

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

S. No.	Bacillus subtilis	Compressive Strength,(N/mm^2)		
		28 days	56days	90days
1	0%	49.13	53.58	57.24
2	5%	56.03	61.04	65.15
3	10%	58.42	63.17	68.22
4	15%	52.62	57.12	61.23

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)		
		28 days	56days	90days
1	0%	49.13	53.58	57.24
2	10%BS+2.5%CC	60.72	66.06	70.65

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	Compressive Strength (N/mm^2)		
		28 Days	56 days	90days
1	0%	4.81	5.24	5.61
2	0.5%	4.82	5.26	5.63

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3	1.0%	4.94	5.37	5.77
4	1.5%	5.06	5.49	5.88
5	2%	5.21	5.65	6.08
6	2.5%	5.36	5.83	6.26

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

S. No.	Bacillus subtilis	Compressive Strength, (N/mm^2)		
		28 days	56 days	90days
1	0%	4.81	5.24	5.61
2	5%	5.53	6.02	6.43
3	10%	5.81	6.34	6.76
4	15%	5.25	5.69	6.13

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

S.No	Combined replacements	CompressiveStrength, (N/mm^2)		
		28 days	56 days	90days
1	0%	4.81	5.24	5.61
2	10%BS+2.5%CC	6.35	6.86	7.28

5. CONCLUSIONS

1. The Normal concrete compressive strength is for 28,56 and 90 days is 49.13N/mm^2,53.58N/mm^2 and 57.24N/mm^2.
2. At 2.5% calcium chloride partial replaced with cement then the compressive strength is for 28,56 and 90 days is 53.74N/mm^2 ,58.59N/mm^2 and 62.79N/mm$^{2.}$
3. At 10% of Bacteria subtilis concrete the compressive strength is for 7 and 2828,56 and 90 days is 58.42N/mm^2, 63.17N/mm^2 and 68.22N/mm^2.
4. The optimum combined replacements are noted at 10% of Bacillus subtilis and 2.5% Calcium chloride at 28,56 and 90 days are 60.72N/mm^2, 66.06N/mm^2 and 70.65N/mm^2.
5. The Normal concrete split tensile strength is for 28,56 and 90 days is 4.81N/mm^2 , 5.24N/mm^2 and 5.61N/mm^2.
6. At 2.5% calcium chloride partial replaced with cement then the compressive strength is for 28,56 and 90 days is 5.36N/mm^2 , 5.83N/mm^2 and 6.26N/mm^2.
7. At 10% of Bacteria subtilis concrete the split tensile strength is for 28,56 and 90 days is 5.81N/mm^2, 6.34N/mm^2 and 6.76N/mm^2.
8. The optimum combined replacements are noted at 10% of Bacillus subtilis and 2.5% Calcium chloride at 28,56 and 90days are 6.35 N/mm^2 , 6.86N/mm^2 and 7.28N/mm^2 .

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