BACTERIA AS A BIOLOGICAL ADMIXTURE IN CONCRETE

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Abstract

The main objective of the present study deals with the execution of the concrete by the microbiologically prompted unique growth/filler. One such thought has prompted the advancement of an extremely special concrete known as Bacterial Concrete where microscopic organisms is incited in the mortars and concrete to heal up the issues with various bacterium proposed at various bacterial concrete. Here a study was made by utilizing the microscopic organisms "Escherichia coli". Calcite arrangement by Escherichia coli is a model research facility bacterium, which can create calcite precipitates on suitable media supplemented with a Calcium source.Concrete cubes with and without addition of bacteria are studied and it is observed that there is an improvement in the compressive strength for the cubes with the addition of bacteria. Concrete cylinders with and without addition of bacteria was considered and it is observed that there is an improvement in the Split tensile strength for the cylinders with the addition of bacteria.

Keywords: *Escherichia Coli, Compressive Strength, Split Tensile Strength.*

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1. INTRODUCTION

Concrete is a homogenous mixture of cement, fine aggregate, coarse aggregate and water. Concrete has a high load bearing capacity in compression, yet the material is weak in tension. Hence, to take up these tension, steel reinforcement bars are embedded in concrete of any structural element. When the concrete cracks under tension, the steel bars take up these loads. The concrete also acts as a barrier which protects the steel bars from the environment attack and prevents corrosion. Here the entrance of water and other moisture particles take place and deterioration of the structure begins with the corrosion of the steel.For increasing the durability of the concrete structure, either the cracks that are framed must be repaired later on or in the configuration stage additional reinforcement must be put in the structure to guarantee that the crack width stay within a specific least utmost. This extra reinforcement may be only needed for durability reasons and not for structural capability. Particularly with current steel costs this additional steel is uneconomical. Durability is one such reason to avoid cracks or reduce crack widths. However, if a reliable technique could be developed which repairs cracks in concrete automatically, this would increase and ensure durability and functionality developed that repair cracks in concrete extremely and also the extra steel that is used to limit the widths of cracks could most likely be saved to a huge amount.

Crack widths in concrete ought to be restricted, mostly for durability reasons. In case, if crack widths are too wide, the cracks should be repaired or an extra reinforcement is required in the design. If a method could be developed for repairing cracks in concrete automatically, this would save a large amount of money, both on the expenses of injection fluids on cracks and also on the additional steel that is placed in structures only to prevent crack widths. A dependable self-healing technique for concrete would prompt another method for planning durable concrete structures, which is beneficial for national and global economy.

2. MATERIALS

2.1 Cement

Ordinary Portland cement of evaluation accessible in nearby market is utilized as a part of the study. The bond utilized has been tried for different properties and found to be adjusting to particulars of IS: 8112-1989.

2.2 Coarse aggregate

The aggregates of 20mm and below size are general used. The particular gravity of the coarse aggregates of totals of 2.6-2.8 is utilized. The physical attributes are tried according to IS 383:1970 procurements.

2.3 Fine Aggregate

The sand which is accessible provincially and is all around passing through 4.75mm sieve is utilized as fine aggregate, affirming according to IS 383:1970 procurements. The examinations of the fine and coarse totals are affirmed to IS: 10262-2009.

2.4 Water

Water utilized for blending and curing is crisp convenient water, insisting according to IS: 456 – 2000.

2.5 Bacteria

A thermophilic, anaerobic microorganism isolated from the hot spring of Bakreshwar, India, belonging to the Shewanella species [2] was used in this study. This iron-reducing microorganism was cultured anaerobically in a modified medium (pH 7.5) before adding to the cement–sand mortar mixture. E. coli microorganisms grown in standard Luria Broth (LB) medium having pH of 7.2 were used to study their effect on mortar.

3. METHODOLOGY

The methodology for producing a self-healing bacterial concrete involves the following steps:

3.1 Selection and Cultivation of Bacteria

Pure cultures are maintained on nutrient agar slants and on nutrient agar plates. It forms irregular dry white colonies on nutrient agar plate. Whenever required, few colonies of the pure culture is added into nutrient broth of 25ml in 100ml conical flask. The growth conditions are maintained at 37°C temperature and placed in 125 rpm orbital shaker. The growth medium used with the composition of nutrient agar is given below

Table 1: Quantity of growth medium extraction

Nutrients	Amount
Beef extract	1.0g
Yeast extract	2.0g
Peptone	5.0g
Nacl	5.0g
Agar	15.0g
Distilled water	1.01g

3.2 Preparation of Test Specimens

Bacterial concrete are casted by using ordinary Portland cement mixed with bacterial concentration 10^6 cells/ml of water. Conventional concrete samples are also casted in parallel for comparing results with bacterial concrete. The specimens are cured under tap water at room temperature and tested at 7 and 28 days.

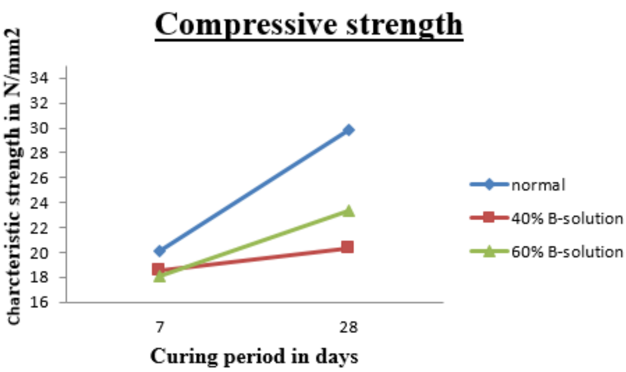
3.3 Testing Procedure

After the obliged time of curing, the samples are expelled from the curing tank and tested for compressive quality. The compressive quality of the samples at 7 days and 28 days is determined. The reported results are the normal of three trials.

4. RESULTS AND DISCUSSION

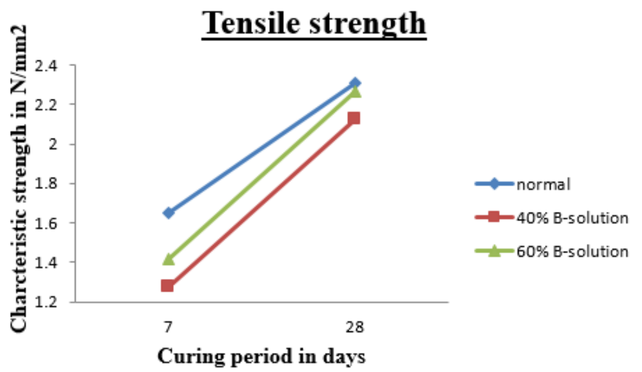
The primary goal of this examination is to contemplate the impact of expansion of the microorganism on the compressive quality of concrete. The results of the compressive quality at 7 days and 28 days for control specimens without micro-organism and for bond with microorganisms of suitable cell concentration of e.coli (105, 106 and 107 cells for each ml of mixing water) is given underneath.

Compressive strength(N/mm^2)				
Sl. No	**Curing period (days)**	**Normal concrete (N/mm^2)**	**Bacterial Concrete (N/mm^2)**	
			40%	**60%**
1	7	20.1433	18.5166	18.07
2	28	29.85	27.4	28.75



The test results revealed 8% and 3.6% decrease in Bacterial Concentrations at 28 days curing when compared to conventional concrete. The slump achieved Compressive Strength of concrete for 40% and 60% was 125mm for 40% bacterial concrete and 135mm for 60% bacterial concrete. This indicates that as the concentration of bacterial solution increases, workability also increases.

Split tensile strength(N/mm^2)				
Sl. No	Curing period (days)	Normal concrete (N/mm^2)	Bacterial Concrete (N/mm^2)	
			40%	60%
1	7	1.6503	1.273	1.4143
2	28	2.3103	2.1216	2.263



The results also revealed that there is 8% and 2% decrement in tensile strength of concrete for 40% and 60% Bacterial Concentrations at 28 days curing when compared to conventional concrete

5. CONCLUSIONS

It is concluded that the bacterial concrete will higher life span when compared to that of conventional concrete because calcite precipitate crystals impermeable the concrete specimen and resists the harmful solutions entering the concrete specimen there by reducing the deleterious effect which they may cause. However, there is no much improvement in strength of mortar with the addition of E. coli. This concrete can be used to prevent cracks and hence saving the structure from corrosion of steel.

ACKNOWLEDGEMENT

The financial assistance to this experimental study received from Karnataka State Council for Science and Technology (KSCST), Bangalore, India is gratefully acknowledged. We would also acknowledge the help rendered by Mr Likhit m.l., Assistant Professor, Department of civil engineering, SCEM Mangalore.

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