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Enhancement of Properties of Recycled Coarse Aggregate Concrete using Ureolytic Bacteria

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ABSTRACT: Most of the buildings engineering are not environmentally friendly. construction uses concrete portland on which is known to be a strong contribution to the emissions of CO₂ and environmental damage. In India, the amount of construction has increased rapidly since the last two decades. The use of various types of additional cementation materials (MSC), replacing the concrete could result in a substantial reduction in overall CO₂ footprint product concrete end. The lower the amount of Portland cement used in the production of concrete, the lower the impact of the concrete industry on the environment.

KEYWORDS : bacteria, compressive strength, RCA, NCA

I. INTRODUCTION

Research on the application of bacteria in concrete began almost two decades ago. Here we briefly discuss various types of bacteria, calcite precipitation mechanism, previous studies on the application of bacteria. Subsequently, it was discovered that a bacterium that precipitates calcite, *Bacillus pasteurii*, was responsible for producing the binder for this conversion. This mineral deposition technique can respond with the natural method to seal the pores and cracks of concrete and mortar. Biomineralization is defined as a biologically induced precipitation in which an organism creates a local microenvironment with conditions that allow optimal extracellular chemical precipitation of the mineral phases. This can be seen in many biological species living in different natural environments such as soil, geological formations, biofilms of fresh water, thermal waters, salt lakes and oceans. The exact mechanism underlying the microbial precipitation of calcium carbonate does not have been found up to date.

There are about 5×10^{30} bacteria on Earth, forming a biomass that exceeds that of all plants and animals. Bacteria play an important role in the recycling of nutrients, as in fixing the nitrogen in the atmosphere and putrefaction in the cycles of nutrients biological communities around hydrothermal vents and leaks cold, bacteria that provide nutrients needed for life's sustain by converting compounds dissolved as hydrogen sulfide and methane energy for biological communities about hydrothermal vents and cold emissions. All the bacteria living on earth have not been characterized. Bacteria that can be grown in laboratories that are only half the edges of bacteria of bacterial species. The branch of microbiology that studied bacteria called bacteriology.

II. REVISION OF LITERATURE

The review of the literature for this study is carried out extensively in the direction of concrete made from recycled materials for sustainability. The present study uses bacteria for the improvement of RCA concrete. The investigations are carried out in the presented study to evaluate the mechanical properties of RCA concrete. For the purposes of presentation, the review of the literature is divided into three segments, as for example (i) specifically RCA studies, (ii)

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studies on the application of bacteria to improve the properties of RCA concrete, (iii) review of the experimental methods used in the present study

The crushed concrete resulting from the demolition of old structures is today generated in large quantities. The current annual rate of production of construction waste is 145 million tonnes worldwide [Revathi *et al.* 2013]. The area required to fill this amount of waste is enormous. Therefore, recycling of construction waste is vital, both to reduce the amount of open land needed for land filling and preserving the environment through conservation of resources [Revathi *et al.* 2013, Pacheco-Torgal *et al.* 2013]. It was widely reported that recycling reduces energy consumption, pollution, warming overall, the emission of greenhouse gases and cost [Khalaf and Venny 2004; Pacheco-Torgal and Said 2011; Ameri and Behnood 2012; Vázquez 2013; Behnood *et al.* 2015; Pepe 2015 and Behnood *et al.* 2015]. This in turn is beneficial and effective for the environment

Several researchers have examined the physical and mechanical properties of RCA and its influence when the natural aggregate is partially or totally replaced by the RCA to produce concrete. It was found that the mechanical strength of the RCA concrete is inferior to that of traditional concrete. This is because of the highly porous nature of RCA compared to natural aggregates and the amount of replacement compared to the natural aggregate [Rahal 2007, Brito and Saikia 2013]. The physical properties of the RCA depend mainly on the attached mortar and, in general, the RCA shows more porosity, greater water absorption, low density and low resistance compared to added natural cement. It was reported that there was a reduction of up to 25% of the compressive strength due to the above reasons [Amnon 2003; Tabsh and Abdelfatah 2009; Elhakam *et al.* 2012; McNeil and Kang 2013].

III. MATERIALS USED

In the present investigation materials are used

1. Ordinary portland cement
2. River sand of size >12.5mm
3. Water material

IV. MATERIAL PROPERTIES

It must be chemically inert.

It must be clean and rough. It must be free of organic matter. It must contain sharp, angular and durable grains.

It must not contain salts, which attract moisture from the atmosphere.

It must be well graduated (i.e.,) must contain particles of various sizes in appropriate proportions

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Bacillus Subtilis

Table 2.2 Properties Of Bacillus Subtilis

TYPE	Gram Postive
Shape	Rod Shaped
Temperature	Room Temperature

V. PREPARATION OF BACTERIAL CONCRETE: BACTERIA CULTURE

The pure culture is constantly maintained on nutrient agar slopes. Irregular dry white colonies are formed on nutrient agar. Once necessary a single colony of the crop has been inoculated under flask conditions and growth 200ml nutrients both in 500ml are kept at 37 degrees and placed in 125rpm average orbital shaker. The composition required for crop growth of peptone, NaCl, meat extract. Mainly 12.5 g of nourishing broth (soil) were added to a 1000 ml flask containing conical distilled water. It is then covered with a thick cotton stopper and is made of tight air with paper and elastic. Subsequently it is sterilized, using a pot for about 10-20 minutes. Now the solution is free of any contaminant and the solution is clear orange in colour before the addition of bacteria later, the bottles are opened and exactly 1ml of bacteria are added to the flask and sterilized is kept in a stirrer at a speed of 150-200 rpm overnight. After 24 hours, the bacterial



solution was found to be cloudy, yellow solution biancastro. Dopo the completion of the presence of Bacillus subtilis, the media preparation liquids must be mixed in the concrete

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VI. EXPERIMENTAL INVESTIGATIONS

DETERMINATION OF THE SPECIFIC CEMENT GRAVITY

- Weigh a Le Chatelier bottle or a specific gravity bottle, clean and dry, with its cap (W1).
- Put a cement sample in the center of the flask (about 50 g) and weigh with its stopper (W2).
- Add kerosene (polar liquid) to the concrete in the flask up to when it is about half full.
- Mix well with glass rod to remove trapped air. Continue to mix and add more kerosene until it is flush with the graduated mark.
- Dry the outside and weigh (W3). Trapped air can be removed from the vacuum pump .
- Clean is filled with clean kerosene flush with the dry graded mark on the outside is weigh (W4).

SIEVE ANALYSIS OF THIN TOTAL

Table.No-4.1: Seive analysis of observations of fine aggregates

Sieve size (Mm)	Sieve weight (Grams)	Sieve weight + sand	Weight of the sand (Grams)	Cumulative weight of convict	% weight retained Sieved	% weight of the expense in Sieve
4.75	370	0,390	20	20	2.17	97.82
2	310	0.420	110	130	14.13	85.87
1	330	0.570	240	370	40.2	59.8
600	310	0.540	230	600	65.21	34.79
425	300	0,550	250	850	92.39	7.61
300	280	0,340	60	910	98.91	1.09
150	280	0,290	10	920	100	-
75	280	0,280	0	920	100	-
bread	280	0,280	0	920	100	-
Total =				5640		

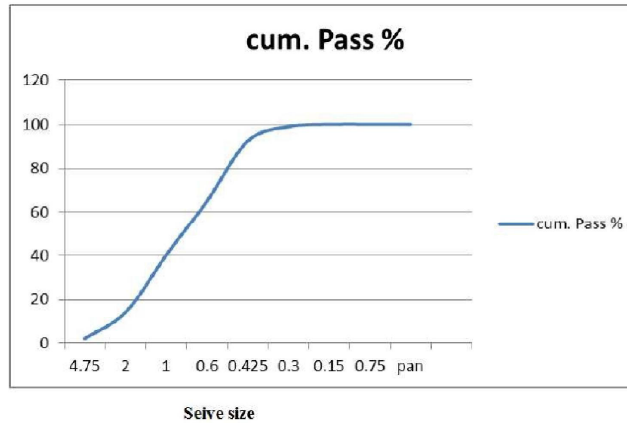
$$\text{Finesse} = 5640/1000 = 5.64$$

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GRAPH No.-4.1: Graph for sieve size and cum. Percentage of approval

VII. BULKING OF FINE AGGREGATES

Table.No-4.2: Buckling observations of fine aggregates

Yes No	% of water added to the weight of the sand	Height of wet sand in cm (h')	% volume of sand
1.	2	20.5	12.02
2.	4	22.5	22.9
3.	6	23	25.6
4.	8	22	20.2
5.	10	21	14.75
6.	12	19.7	7.65

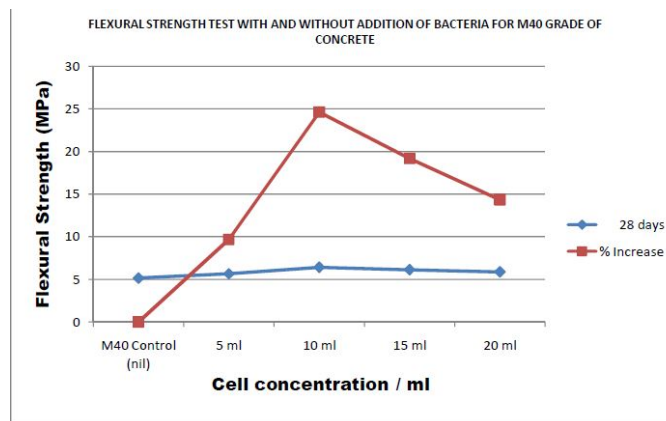
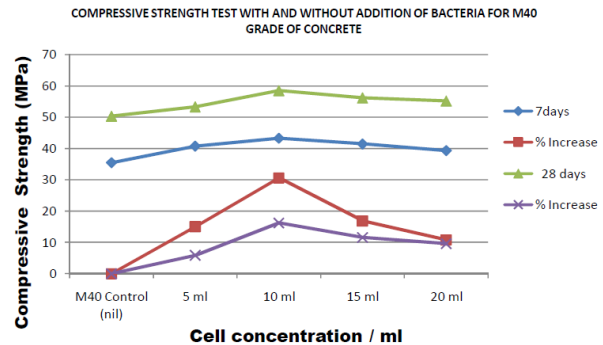
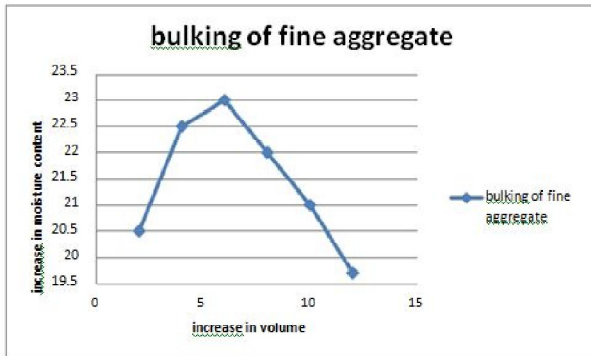
The graph NO. -4.1: increase in the fine aggregate

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VIII. CONCLUSIONS

The experimental research is carried out to study the improvement of properties such as compressive strength, tensile strength to split and the bending strength of RCA concrete with the addition of *B. subtilis*. The main conclusions of the present study are as follows:

- The properties of the RCA concrete as resistance to compression, tensile strength broken and flexural strength are enhanced by the addition of *B. subtilis*.
- Maximum compressive strength of the bacterial RCA is observed at an optimal concentration of 10 cells / ml at 7 and 28 days.
- Due to the inclusion of bacteria in particular we got slight increase in resistance to compression, divided you nsile strength and flexural strength up to 15% compared to traditional concrete.
- Subtiles plays a vital role in increasing the resistance to compression of the concrete RCA through the precipitation of carbonate of calcium in the pores.
- The main advantage of bacterial concrete is that we can improve the useful life of a concrete structure up to 200 years if this technology has been further improved and given special importance.
- This bacterial concrete is a self-regenerating concrete that cures the cracks for an effective duration of 5 initial hours up to the longest possible time and the life of the bacterial cell is 200 years.
- These bacterial uses can save cement and the construction of a building can be made economical, since we know that the production of cement gives rise to the production of carbon dioxide at the highest levels, so that greater control is carried out muyeficaz.

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- These specific bacterial uses may be common made in the next few decades they were heading towards the victory of civil engineering facilities according to the scientific view of the highly authorized laboratories.

From the results it can be concluded that the *Bacillus subtilis* can be grown easily be used safely in improving the performance and characteristics of the concrete. To improve the quality of concrete RCA , calcium carbonate mineralization with the help of .

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