Performance Evaluation of Bacterial Concrete

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Abstract:- **Bacterial Concrete can be defined as the concrete which is able to repair its own cracks .By addition of using some healing agents .In this paper we have given an overview on the performance evaluation of bacterial concrete basically the micro cracks are common problem in the concrete construction .The available crack tend to failure of the structure. Specially selected types of bacteria ,called GENUS BACILLUS ,Along with a Calcium based nutrient known as calcium lactate. Nitrogen and phosphorous are mixed with Manufacturer sand ,coarse aggregate and cement are mixed together which results in bacterial concrete .M-Sand is a substitute of river sand it will produced by crushing of granite stone When the cracks are formed in the concrete, it will allow to moisture through seepage into that the presence of moisture will activate the bacteria and that will heal the cracked concrete surface.**

Keywords-Component-Genus,Bacillus,Calcium Lactate,Special Concrete.

I. INTRODUCTION

Cracking in concrete is a main phenomenon is related to durability. In recent years bacteria based on bacterial concrete is being developed to extend the service life. These can be used for the strength and regaining capacity of concrete with different bacteria. These bacterial concrete has been very limited worldwide. The concept is still developing stage and on the way top large scale. These concrete is forms out by group of microbiological researchers .The Concrete is alkaline material some time bacteria is easy to survive in the alkali environment The bacteria with calcium nutrients added into the concrete at the time of mixing. If any cracks formed bacteria precipitation calcium carbonate is produce to seal the crack .The inactive bacteria should able to survive 200 years in dry condition in the concrete. Crack developed in concrete allows water and oxygen with inactives the bacteria and it starts the calcium precipitation process of concrete and heals the crack developed in concrete.

II.MATERIALS REQUIRED

A. *Cement*

Ordinary Portland cement of grade 53 of specific gravity 3.125.

B. Coarse aggregates

According to IS 383:1970 and specific gravity of 2.2.

C. Fine Aggregates

Fine aggregate has the specific gravity of 2.6 and confirming to the specification of IS 10262:2009 –Zone II.

D. Water

Natural Potable Water was used for in this concrete. It is specified under IS 456:2000.

E. M Sand

Manufactured sand has the specific gravity of 2.73 and confirming the specific gravity of IS 383:1970 and 30% of M Sand should be added in total amount of fine aggregate.

F.Bacteria Used

Bacillus Pasturii , Bacillus Subtiles ,Bacillus Sphaericus , Bacillus Cohnii , Bacillus Filla.

III.METHODOLOGY

1.Purchasing of bacteria

The Bacteria of concentration of 10^5cells/ml was purchasing from Dr. Rajan Laboratories , Tambaram ,Chennai. The viability of the bacteria was checked in the micro biology department Sastra Deemed University, Thanjavur.

2.Accuracy And precision with Serial Dilution of Bacteria

Obtained Bacteria will be serially diluted with water to the required concentration of 10^5
Cells/ml, Under the Guidance of Microbiology department of Sastra Deemed University , Thanjavur.

3. Casting

Casting will be done on M20 Grade concrete and the cubes and cylinders were cast with and without bacteria.

For bacterial Concrete specimen the concentration 10^5 Cells/ml will be added.

The total amount of 12 cubes and 6 cylinders will be casted.

And 6 Cubes and 3 cylinder will be casted for concentrated and other 6 cubes and 3 cylinders will be casted for bacterial concrete.

4.Curing

For potable water the curing is done with 7/14/28 days.

5.Testing

For Testing UTM should be used for (150*150*150 mm) and for split tensile strength test (300*150 mm) and the ultrasonic pulse velocity test was conducted on concrete cubes 7^{th},14^{th},28^{th} day at K.S.K CET Darasuram.

6. How does bacteria remediate cracks

The cell surface is negative in charge.and it draws cations including Ca^{2+} from the atmosphere to deposits on the surface.and produce the chemical reactions:

i. Ca^{2+}+ cell = cell- Ca^{2+}
ii. Cell- Ca^{2+} Co_3^{2-}=cell- $CaCo_3\downarrow$

Thus the calcite is precipitated and eventually plug in the pores of the concrete.

7.Working Process

Cracks less than 0.2mm can be auto fill by concrete .But if cracks are more than 0.2mm then concrete itself fail to heal itself thus opening passage to chemicals and other materials .**In bio – concrete if water is in the contact with the concrete through the cracks the bacteria get activated** from its stage

IV.TESTSAND OBSERVATIONS

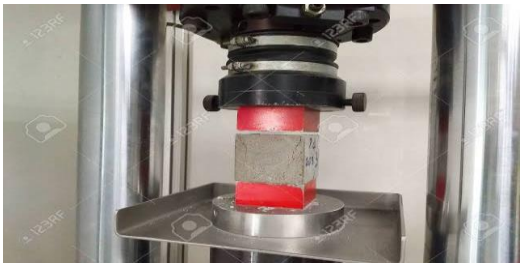
1. Compressive strength test

The test was conducted on concrete cube of size 150 x 150 x 150 mm.[3].This test depends upon many factors such as water cement ratio, cement strength, quality control during production of concrete.

Table 1. compressive strength test results for M20 grade concrete

	Convention-al concrete N/mm^2	**Bacterial concrete of** 10^5 cells/ml
28 days Age	28.8	35.84

Diagram of Compressive testing machine



2. Ultrasonic pulse velocity test

This type of test will be conducted on the normal & bacterial concrete specimens under direct method of testing .

The type of ultrasonic pulse velocity was RTUL UX4600 of accuracy 0.1 µs & frequency of 60KHZ

These Test results are a direct indication of the density and hence the quality of the concrete specimens.

High values of pulse velocities were expected from bacterial concrete specimens due to the filling of micro cracks in them owing to the calcium precipitation.

Table 2. Specification as per IS 13311 –part 1(1992)

S.no	**Pulse velocity by cross probing(km/s)**	**Concrete Quality Grading**
1.	Above 4.5	Excellent
2.	3.5 to 4.5	Good
3.	3.0 to 3.5	Medium
4.	Below 3.0	Doubtful

Table.3 Results of ultrasonic pulse velocity test on concrete

Concrete Type	**Cross probing**
Normal	4.43
10^5cells/ml	4.97

3.Splitting tensile strength test

Splitting tensile strength test in concrete cylinder (height-300 mm,diameter-150 mm) is a method to determine the tensile strength of concrete which is one of its basic and important properties .Concrete due to its brittle nature is not expected to resist to direct tension and hence develop cracks when subjected to tensile forces .Thus this test directly indicate the load at which concrete members tend to crack.

Type of Test	Normal Concrete	Bacterial Concrete of 10^5 cells/ml
Splitting tensile strength N/mm^2	2.01	2.966

Diagram for split tensile test

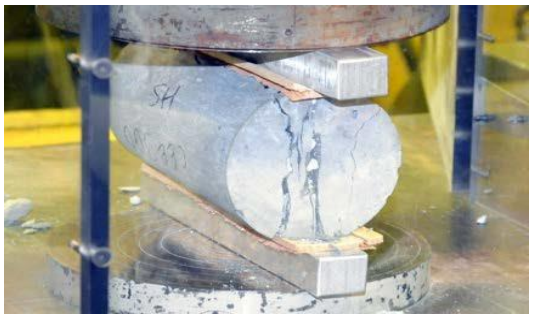


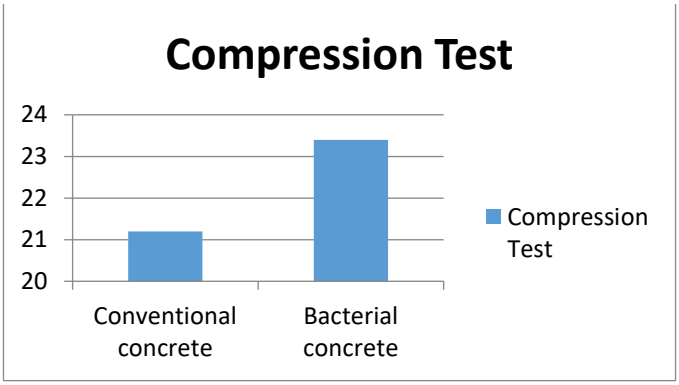
Table.4 Results of split tensile test of cylinder

M20 grade

V.COMPARISIONS OF RESULTS

1.Compressive strength of concrete specimens

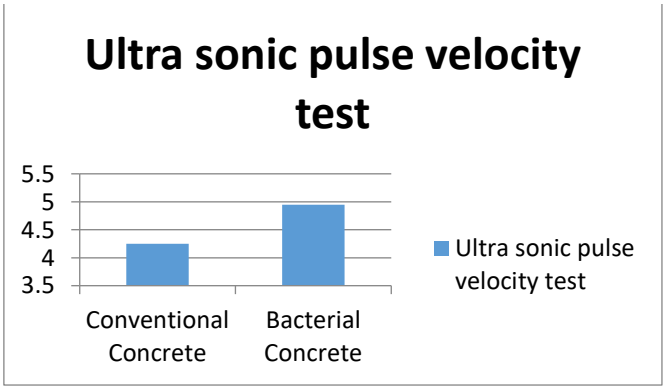
The graph gives an idea about the variation of compressive strengths of M20 grade concrete specimen for 7 , 14 , 28 days of curing. The distinction between conventional concrete & bacterial concrete specimen is well plotted.



Graph 1 : Compressive strength test results for 7,14,28 day of curing on M20 grade specimens.

2.Ultrasonic pulse velocities of concrete specimens

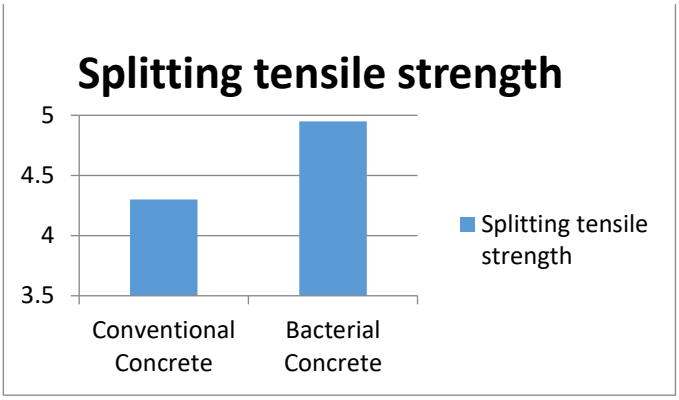
The ultrasonic pulse velocity results for normal and bacterial concrete specimens on 7,14,28 days were plotted.



Graph 2 : Split tensile test results for 7,14,28 day of curing on M20 grade specimens.

3.Splitting Tensile strengths of concrete specimens

The results of splitting tensile test on M20 grade concrete specimens on 28th day of curing was plotted to obtain the graph below



Graph 3. Splitting tensile test on 28th day of curing for M20 grade of concrete specimens

VI.CONCLUSION

All These experiments are conducted for both bacterial and conventional concrete In these two type of concrete bacterial concrete should get more strength than conventional concrete and bacterial concrete are also fill the micro cracks in concrete and also making it denser Using of Manufacturer sand should be more effective and less expensive than river sand and the minor problem should be water absorption in the sand particles .and the optimum concentration of cell 10^5 cells/ml should be preferred.

VII.REFERENCES

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