WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Analysis of Bio-Concrete and Conventional Concrete

Shivendra Singh[1], Dr. Umesh Pendharkar[2]

[1]M.Tech Student- Department of Civil Engineering, Ujjain Engineering College, Ujjain (M.P.), India
[2]Professer - Department of Civil Engineering, Ujjain Engineering College, Ujjain (M.P.), India

ABSTRACT:

The flaw in conventional concrete is that it is vulnerable to breaking under stress. The liquids can enter concrete buildings through surface fractures, causing concrete structures to deteriorate. While remodeling and restoring concrete structures is a time-consuming, expensive, and difficult problem, individuals By filling up the surface fractures of the concrete, healing concrete solves the problem. This concrete fills the inside area of cracks by releasing calcium carbonate and is environmentally beneficial. In order to improve the impermeable properties of concrete, the major goal of this work is to quantify the rate of crack healing utilizing biological agents. For the purpose of calculating the rate of self-healing in concrete, mechanical and durability tests are performed. Ultrasonic pulse velocity measurements have been used to analyze the density of concrete. Conductivity and water absorption tests were used to evaluate the durability characteristics of concrete samples made from both conventional and bacterial materials. The inclusion of bacteria enhanced the durability characteristics of the bacterial-based concrete specimens.

Keywords :- Calcium Carbonate, Ultrasonic pulse velocity, Compressive Strength, and Water Absorption etc.

I. INTRODUCTION

Cement, fine aggregate, coarse aggregate, and water are the components of concrete, the most common building material. Almost 30 million tonnes of concrete are produced and used annually, according to calculations . Throughout the lifespan of a structure, cracks develop in concrete both in its fresh state—due to shrinkage effects of curing—and its hardened state—due to mechanical loading. The decay process then begins to affect the service life of concrete structures through corrosion of reinforcement and freeze-thaw action . A hydraulic structure's primary need is to prevent leaking for an extended length of time. By reducing the concrete stresses, these structures are made of thick portions to avoid cracking. Furthermore, fractures develop in these thick portions as a result of changes in temperature and humidity. Although controlled cracking can be used to enhance water tightness, it is exceedingly difficult to prevent cracks in concrete buildings.

The fracture may be sealed by using epoxy gel and cement, but it needs ongoing care. It is preferable to utilise biological treatments to repair fractures in concrete surfaces since they are organic and pollution-free. The use of bioconcrete lengthens the useful life of concrete structures, lowers the cost of repair and maintenance, and ultimately results in fewer new construction projects and a more efficient use of resources and energy. This ultimately slows the cement plant's emissions of carbon dioxide into the atmosphere.

II. COMPONENTS OF SELF HEALING BACTERIAL CONCRETE

- Grade of concrete- M40
- Cement- OPC 43
- sand
- aggregate
- water
- bacteria- In the current research work, a Bacillus subtilis rod-shaped ureolytic type bacteria is used. The bacteria were sterilised for 20 minutes at 121^{0}C after being cultured in nutrient broth medium. The culture was added to the medium, inoculated, and then incubated at 37^0 C in a shaker incubator at a speed of 85 rpm. The medium has a pH that is neutral. Regular growth monitoring was done using UV-Spectrophotometer absorbance values.

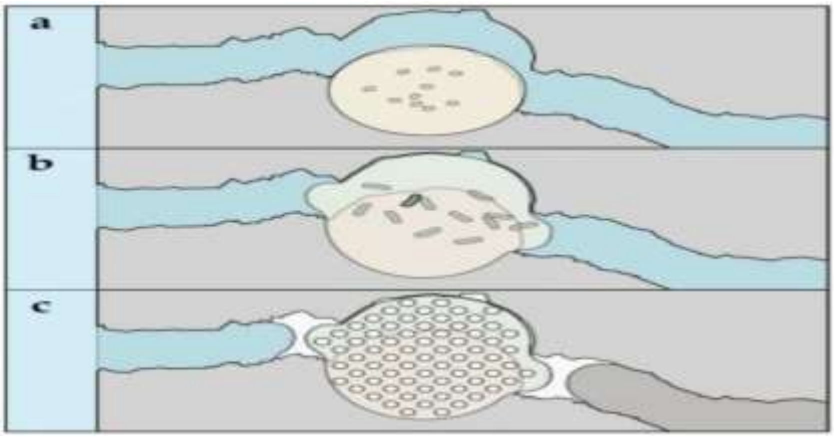

Figure 1 Process of self healing bacterial concrete

III. PREPARATION OF BACTERIAL CONCRETE

In this experiment, concrete samples with a 50 MPa strength were made using bacterial and conventional mixes with a 0.5 water-to-cement ratio. The bacillus subtilis cells in the concrete specimens have a cell density of 110 cells per millilitre of water. For measuring the self-healing rate, mechanical, and durability properties of concrete, various forms and sizes of moulds are constructed.

For testing the mechanical concrete's characteristics, cubic specimens of size 150 x 150 x 150 mm are cast for the compressive strength test, cylindrical specimens of size 150 x 300 mm are ready for the split tensile strength test, and beam samples of size 100 x 100 mm are cast for the flexural strength test.

For the purpose of calculating the ultrasonic pulse velocities of concrete, cubic specimens with a dimension of 150x 150x150 mm are constructed. Cubical specimens of 150 x 150 x 150 mm are cast for the water absorption examination and cylindrical specimens of 100 mm to 200 mm are created for the Sorpitivity test in order to estimate the durability attributes of concrete.

Three layers of concrete are poured into each of the securely fastened, oil-coated moulds. The Sample were spread evenly throughout the mould after being tamped using a rod with a rounded end. After 24 hours, the specimens are demolded and then cured for 7, 14, and 28 days. When reporting the test findings, the average of the five specimens is used.

IV. CONCRETE TESTS

1. Compressive strength test

Both regular and bacterial concrete samples were tested for compressive strength with a load intensity of 160 kg/cm2/min, and the specimen size used was 150 mm x150 mm x150 mm.

2. Split tensile strength test

Both regular and bacterial concrete samples were tested for split tensile strength test and the specimen size used was 150 mm x300 mm.

3. Flexural strength test

Both regular and bacterial concrete samples of 500 mm by 100 mm by 100 mm (length, breadth, and depth) were tested for flexural strength using two points of force. Samples are evaluated for an applied load of 160 kg/cm2/min using a flexural testing equipment with a 120 kN capacity. Every concrete specimen is dried in plain water.

4. Ultrasonic pulse velocity test

To evaluate the calibre of concrete, a non-destructive technique called ultrasonic pulse velocity is employed. Using ultrasonic pulse velocity waves, the strength and homogeneity of concrete may be examined . Moreover, it is used to inspect the interior flaws, fracture depth, and honeycombing of concrete structures.

The breadth of the sample and the amount of time it takes for the pulse to travel through it allow one to calculate the pulse velocity. Lower velocities suggest that the concrete is porous, whereas higher velocities indicate that the quality of the concrete is good.

5. Water absorption test

The controlled and bacterial concrete samples underwent a water absorption test to determine how much water was absorbed. Calculations are made to determine how watertight samples are before, during, and after sealing.

V. RESULT AND DISCUSSION

There was results discussion in tabulation and graph form.

A. Compressive strength comparison

Here the comparison of Compressive strength results for normal and bacterial Concrete for 7 and 28 days is discussed. The Compressive strength values are shown below .

Table 1 Compressive strength comparison

Concrete type	Compressive strength (MPa)	
	7 days	28 days
Normal concrete	36	54
Bacterial concrete	48	69

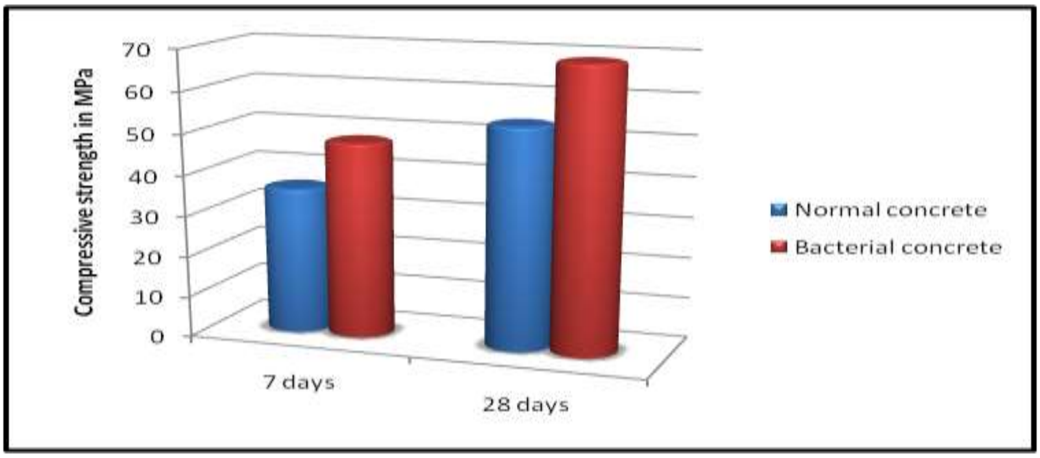

Figure 2 Compressive strength comparison

B. Split tensile strength comparison

Here the comparison of Split tensile strength results for normal and bacterial Concrete for 7 and 28 days is discussed. The Split tensile strength values are shown below .

Table 2 Split tensile strength comparison

Concrete type	Split tensile strength (MPa)	
	7 days	28 days
Normal concrete	25	40
Bacterial concrete	32	46

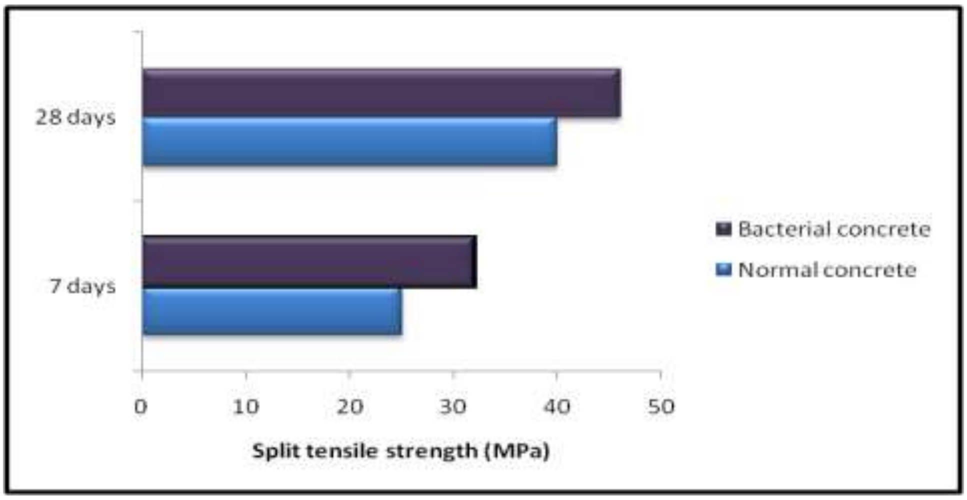

Figure 3 Split tensile strength comparison

C. Flexural strength comparison

Here the comparison of Flexural strength results for normal and bacterial Concrete for 7 and 28 days is discussed. The Flexural strength values are shown below.

Table 3 Flexural strength comparison

Concrete type	Flexural strength (MPa)	
	7 days	28 days
Normal concrete	3.2	4.1
Bacterial concrete	3.5	4.7

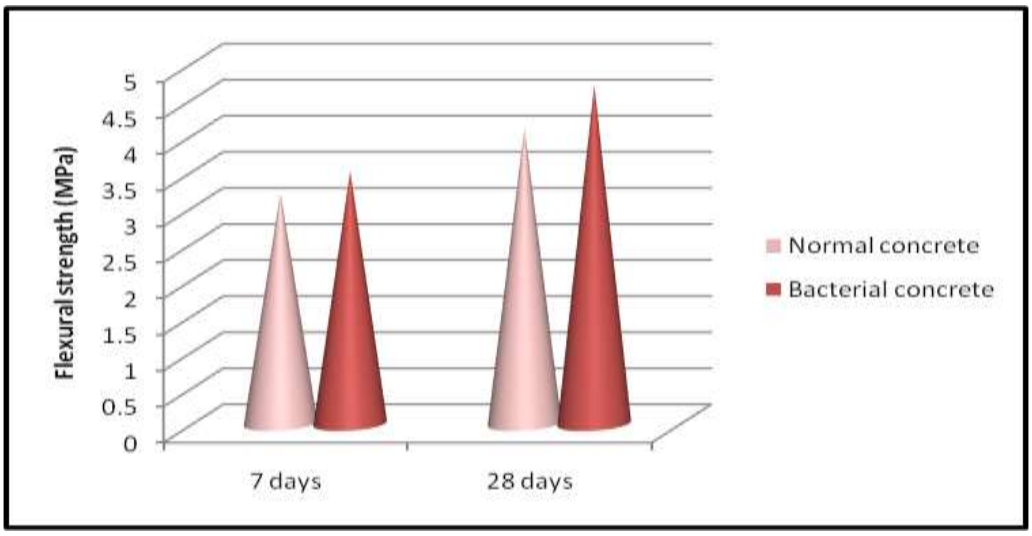

Figure 4 Flexural strength comparison

D. Ultra sonic pulse velocity comparison

Here the comparison of Ultra sonic pulse velocity results for normal and bacterial Concrete for 7 and 28 days is discussed. The Ultra sonic pulse velocity values are shown below.

Table 4 Ultra sonic pulse velocity comparison

Concrete type	Ultra sonic pulse velocity (km/s)	
	7 days	28 days
Normal concrete	4.1	4.6
Bacterial concrete	4.2	4.8

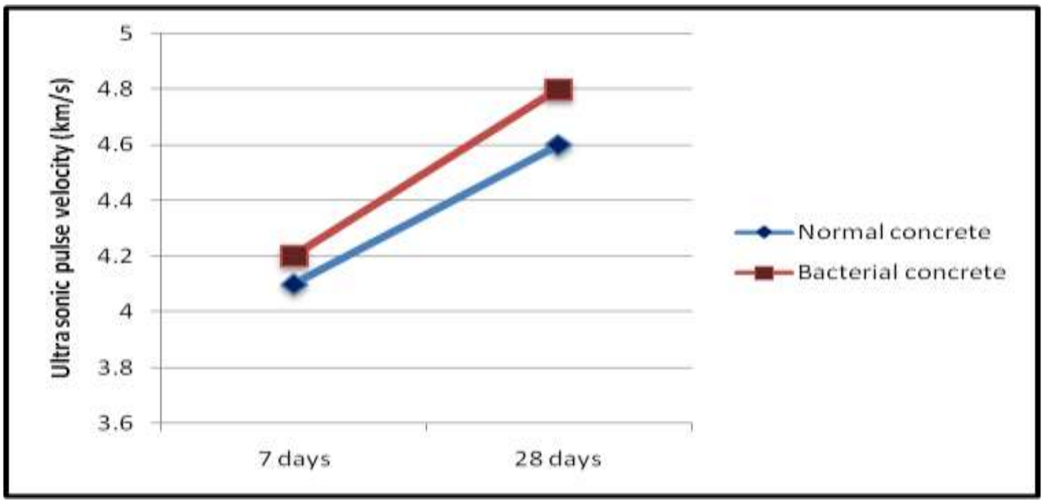

Figure 5 Ultra sonic pulse velocity comparison

E. Water absorption comparison

Here the comparison of Water absorption results for normal and bacterial Concrete for 7 and 28 days is discussed. The Water absorption values are shown below.

Table 5 Water absorption comparison

Concrete type	Water absorption % of wt loss	
	7 days	28 days
Normal concrete	1.5	1.3
Bacterial concrete	0.6	0.3

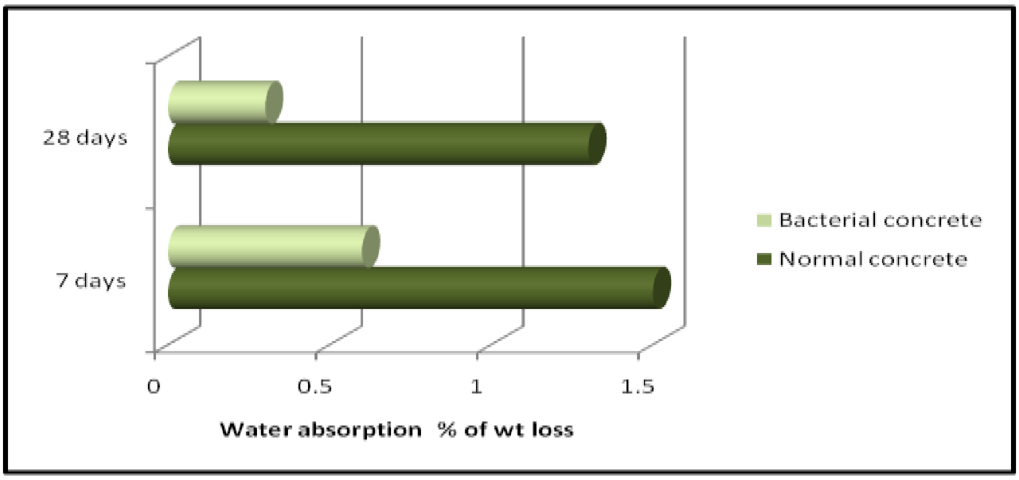

Figure 6 Water absorption comparison

VI. CONCLUSION

- Compressive strength for 7 days and 28 days of bacterial concrete is increased by 33% and 27% respectively, as compare to normal concrete.
- Split tensile strength for 7 days and 28 days of bacterial concrete is increased by 28% and 15% respectively, as compare to normal concrete.
- Flexural strength for 7 days and 28 days of bacterial concrete is increased by 9.3% and 14% respectively, as compare to normal concrete.
- Ultra sonic pulse velocity for 7 days and 28 days of bacterial concrete is increased by 2.4% and 4.34% respectively, as compare to normal concrete.
- Water absorption weight loss percentage for 7 days and 28 days of bacterial concrete is reduce by 60% and 76% respectively, as compare to normal concrete.

REFERENCES

I. Salmabanu Luhar (2015) “A review paper on self-healing concrete” journal of civil engineering research 2015 ,5(3): 53-58

II. Ali Keyvanfar (2014) “a review of self-healing concrete research development” journal of environment treatment techniques ISSN: 2309-1185

III. Ishraq mohammad Ali Khattab (2019) “study on self-healing concrete types” sustainable structure and material, vol. 2, no.1, (2019) 76-87

IV. Er. Chetan Kumar (2020) “A review paper on self-healing concrete” IJARIIE-ISSN-2395-4396

V. M. Monishaa (2017) “experimental study on strength of self-healing concrete” SSRG International journal of civil engineering-(ICRTCETM-2017)

VI. Shubham Ajay Puranik (2019) “bacterial concrete- A sustainable solution for concrete maintenance” International journal of innovative technology and exploring engineering ISSN: 2278-3075

VII. Vidhya Lakshmi. A “Experimental investigation on self-healing bacterial concrete” international journal of research in engineering and technology eISSN: 2319-1163

VIII. S.S. Lucas (2018) "study of self-healing properties in concrete with bacteria encapsulated in expanded clay" science and technology of material 30(2018) 93-98

IX. Dr. K. CHANDRAMOULI (2018) "experimental study on bacterial concrete" SSRG international journal of civil engineering (SSRG-IJCE) special issue ICITSEET Sep. (2018)

X. Ravindranatha "self-healing material bacterial concrete" international journal of research engineering and technology eISSN: 2319-1163

XI. Rajesh Talluri (2015) "A critical review on bacterial concrete" International journal of scientific engineering and research ISSN(Online): 2347-3878

XII. Nataliya Hearn (1998) "self-healing, autogenous healing and continued hydration: what is the difference?" Materials and structure Oct. (1998), PP 563-567

XIII. Waiching Tang (2015) "Rebust evaluation of self-healing efficiency in cementitious materials" construction and building materials 81(2015) 233-247 ELSEVIER

XIV. H.M. Jonkers (2016) "bacterial based self-healing concrete to increase liquid tightness of cracks" construction and building materials 122(2016) 118-125 ELSEVIER

XV. J.Y. Wang (2014) "self-healing concrete by use of microencapsulated bacterial spores" cement and concretes research 56(2014) 139-152 ELSEVIER