

STUDY OF COMPRESSIVE STRENGTH OF SELF HEALING CONCRETE

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Abstract - Concrete is the most widely used man made material in construction industry. Generally, It possesses good compressive strength and flexibility to mould in any shape. In this research, Change in compressive strength and durability of concrete is studied out when preparation of mix is done by using fraction of bacteria solution with replacement of water. In this work, bacteria solution is taken as 0%, 30%, 50%, 70%, and 100% of water use for preparation of mix. The bacteria solution is prepared by incubating growth of bacteria in nutrient broth solution.

Result shows that compressive strength of concrete is increase, when bacteria solution is added up to 70% and compressive strength decreases at 100%.

Key Words: compressive strength, bacteria solution, media.

1. INTRODUCTION

Concrete which forms major components in the construction industry as it is easily available and convenient to cast. But drawback of this is, It is weak in tension, it cracks under sustained loading conditions and presence of aggressive environmental agents leads to reduction in the life of the structure. This process of damage occurs in the early life of the building structure and also during its life time.

In this research work, Bacteria solution is used as replacement of water and Compressive strength of concrete is studied out under various percentage of water.

Bacteria solution is prepare in lab by mixing ingredients like pepton, beef extract, NaCL with distilled water and bacillus species.

2. Literature review

a). Dr. Subhav, Meera C. M. - The present paper described the effect of bacillus subtillus bacteria on the strength of concrete. The researcher found that the use of bacteria (bacillus subtillus) in concrete enhances its strength and durability hence using this type of bacteriafor self –healing mechanism in concrete can produce cost effective, strong and durable structures.

B). Kunal. R. patil, B.P.Waghhere, R.R.Salve, B.K. Ahire, K.S. Patel – In this paper the outhere use the concrete cube which are subjected to bacteria precipitation by different bacteria strain (bacillus pasturii and bacillus sphericus). It means calcium carbonate precipitation bacteria is investigated in this paper. The authors found that the 7, 28 days bacteria treatment they improve the compressive strength of concrete comparison to general concrete.

3. Materials and method

In Concrete, The cement, sand and coarse aggregate are the common materials which are used to mix with water but in this research bacteria solution is used as a replacement of water. These are some material use in this research

3.1 Cement

For this work, cement has purchased from supplier heaving following properties

- a. Manufactured by Reliance.
- b. Initial setting time 90 min.
- c. Final setting time 360 min.

3.2 Sand /fine aggregate

The sand is purchased from the supplier which is brought from river Narmada, having following properties-

- a. Specific gravity= 2.60
- b. The grade of fine aggregate is zone II as per IS 387-1970 specification

3.3 Course aggregate

For this work, Course aggregate of 20 mm size is used. Having specific gravity of aggregate is 2.70.

3.4 Water

The potable water is use for mixing of material and curing of cubes.

3.5 Bacteria solution

The bacteria solution is the solution in which the bacteria harvesting. It is prepared with media and bacteria in lab by using biological protocol.

3.6 Media

Culture media contains nutrient and physical growth parameters necessary for microbial growth. All microorganisms can't grow in a single culture media and in fact many can't grow in any known culture media.

There are two major types of growth media

1. Cell culture, which use specific cell types derived from plants or animals.
2. Microbiological culture, which are used for growing microorganisms, such as bacteria or fungi.

For this study, nutrient broth as a specific type of liquid media is use. Which is prepared by pepton, Beef extract, NaCl, distilled water and NaOH by used the microbiological lab protocol.

3.7 Bacteria

Bacteria are single celled microorganism that does not have nucleus or other membrane-bound organelles. Some time they called prokaryotes. Bacteria are classified into five groups according to their basic shapes, Spherical (cocci), Rod (bacillus), spiral (spirilla), comma (vibriosis) or corkscrew (spirochaetes). They can exist as single cell, in pairs, chain, or clusters.

In this study use the bacillus types of bacteria.

Preparation of bacterial solution

- For this solution take 0.5% NaCl, 1.00% pepton, 1.00%beef extract of distilled water are dissolved in a flask and NaOH mix is used ph=7.4 is maintained at room temperature.
- Flask is kept air tight by using the cotton plug.
- The flask has sterilized for 12-20min at by autoclave @ 121°C. Now the solution is free from any contamination and the solution is clear orange in color before the addition of the bacteria.
- Lets the flasks are opened up and some colony of the bacteria is added to the sterilized flask and is kept in a incubators for inoculated at 37 °C for 24 hours.
- After 24 hours the bacteria solution was found to be whitish yellow turbid solution.

Procedure for compression test of concrete

The IS 10262-2009 code are fallow to prepare the specimen and to the test of compressive strength of concrete.

The cubical moulds of size 150mm × 150mm× 150mm is taken and checked the joint movement. Coating of oil has been applied on the inner surface of moulds and prepared for concreting operation.

The ratio of cement, sand, and coarse aggregate at 1:1.8:3 has taken mixed with hand mixture and rotated till uniformly dry mixture is obtained.

The water cement ratio is taken as 0.5 and the quantity of water is mixed as per w/C ratio. After that the quantity of water are replaced by bacteria solution with different percentage and mixing has been continued to get a uniformly mix.

The wet concrete is now poured into the moulds for 2 to 3 layers and compacted manually. After concreting operations, the upper surface is leveled and finished with a mason's trowel.

The wet corresponding identification marks are labeled over the finished surface and they are tested for 7 and 28 day UTM for compression testing.

$$\text{COMPRESSIVE STRENGTH} = \frac{\text{TOTAL FAILURE LOAD}}{\text{AREA OF THE CUBE}}$$

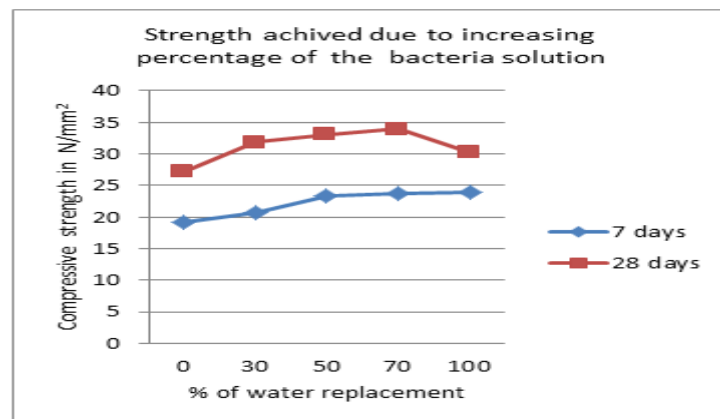
4. Test and Result

Table no. 01 for 7 days compressive strength of concrete

Group name	Water in liter	Bacteria Solution in liter	Water in %	Bacteria solution in %	Total replacement of water in %	Strength achieved In N/mm ²			Change of strength achieved in N/mm ²	Change of strength achieved in %	Average strength achieved In N/mm ²
						samples					
						1	2	3			
G-1	186	0	100	0	0	19.16	19.56	18.84	0	0	19.18
G-2	130	55.8	70	30	30	21.67	20.62	19.84	+1.35	+7.03	20.71
G-3	93	93	50	50	50	24.18	22.34	23.27	+4.08	+21.27	23.26
G-4	56	130	30	70	70	24.34	24.89	22.22	+4.63	+24.14	23.81
G-5	0	186	0	100	100	23.67	25.22	22.88	+4.73	+24.66	23.92

Table no. 02 for 28days compressive strength of concrete

Group name	Water in liter	Bacteria Solution in liter	Water in %	Bacteria solution in %	Total replacement of water in %	Strength achieved In N/mm ²			Change of strength achieved in N/mm ²	Change of strength achieved in %	Average strength achieved In N/mm ²
						samples					
						1	2	3			
G-1	186	0	100	0	0	28.44	25.17	27.11	0	0	27.16
G-2	130	56	70	30	30	32.00	30.66	32.88	+4.68	+17.23	31.84
G-3	93	93	50	50	50	31.77	33.33	34.22	+5.95	+21.90	33.11
G-4	56	130	30	70	70	33.35	32.44	35.95	+6.79	+25.00	33.95
G-5	0	186	0	100	100	29.00	32.00	28.88	+2.96	+10.89	30.12



Graph no. 01

5. Discussion and Conclusions

After 7 and 28 days curing period, the compressive strength of different sets of samples of M20 concrete containing different percentage of bacteria solution and nutrient presented in these table

1. The compressive strength test after 7 days result given in Table no. 01 from this table it is clear that the compressive strength concrete with 100% bacteria solution is 23.98N/mm² which is grater then to conventional concrete.
2. The compressive strength test after 28days result given in Table no. 02 from this table it is clear that the compressive strength concrete with 70% bacteria solution is 33.95 N/mm² which is grater then to conventional concrete.
3. The inclusion of bacteria has increased the compressive strength of concrete. The increase in compressive strength is mainly due to filling of the pores inside the cement concrete cubes with microbiologically induced calcium carbonate precipitation (MICCP). The greatest improvement in compressive strength was obtained for concrete specimens.
4. The enhancement of compressive strength of hardened cement paste was due to the consuming and refinement of Ca(OH)₂ grain, which occurred during the hydration of cement especially at early ages. As a consequence, the hydration of cement was accelerated and many reaction products were formed. Also CaCO₃ filled up the pores of loose net structure around the cement particles making the porosity of hardened cement paste decrease and the density degree increase.

REFERENCES

- (1) Meera C.M., Dr. Subha V. (2016) "strength and durability assessment of bacteria based self-healing concrete" IOSR Journal of Mechanical and Civil engineering (IOSR-JMCE).
- (2) Kunal. R. patil, B.P.Waghere, R.R.Salve, B.K. Ahire, K.S. Patel (2016) "effect of bacteria calcite precipitation on compressive strength of general concrete cubes" IJSET VOL. 3, February 2016
- (3) Jasira Bashir, Ifrahkathwari, Aditya Tiwary and KhushpreetSingh "Bio concrete the self healing concrete" Indian Journal of Science and Technology, vol9(47), December 2016.
- (4) Ravindranatha, N. Kannan, Likhith M. L "self-healing material bacteria concrete" IJRET Vol. 03 May-2014
- (5) IS: 2386 (Part-III)-1963 Methods of Test For Aggregates For Concrete.
- (6) IS 10262:2009 Concrete Mix Proportioning- Guidelines.