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EFFECT OF INDUCED CARBONATION ON HAREDEN PROPERTIES OF M30 AND M35GRADE CONCRETE USING ORDINARY PORTLAND CEMENT

Poonam Kumari[1] ,Dr. Hemant Sood[2]

[1]*NITTTR CHANDIGARH,*
[2]*NITTTR CHANDIGARH, s*

Abstract*— *An experimental investigation was carried out to find harden properties of M30 and M35 grade of concrete using Ordinary Portland cement with water cement ratio 0.42 for M30 and 0.40 for M35 grade concrete were used in this study. In this experimental study carbonation is assessed using a solution of 0.2% phenolphthalein indicator. Normal concrete is indicated in pink colouration. Where as no change in colour indicates that concrete is affected by carbonation. The Mix design is carried out as per BIS (10262-2009).Compressive strength test, split tensile strength test and the flexural strength test were carried out to find effect of carbonation on hardened properties of carbonated concrete and normal concrete. A comparative study is carried out in between normal concrete and carbonated concrete for 3rd day, 7thday and 28th day test samples. The result shows that carbonation concrete has a higher compressive strength as compared to non carbonated concrete cubes. The result shows that the split tensile strength and flexural strength of carbonated concrete increase as compared to noncarbonated concrete of 3rd day,7thday and 28th day test samples.

Keywords*—*Odinary Portland cement (O.P.C) , Grade M30 ,Grade M35, Compressive strength, Split tensile strength , Flexural strength.

I. INTRODUCTION

Carbonation is a one of the major factors of deterioration and destruction of concrete structure. Carbonation is the reaction of the hydration strength products dissolved in the pore water with concrete pore solution from 12.6 to less than 9 [4]. The carbonation is found to have tremendous impact on some of the engineering properties of concrete. Mostly its influence is predominant on compressive strength, split tensile strength, flexural strength. The depth of carbonation can be measured by spraying phenolphthalein indicator on the scratched point of concrete the solution is a colourless indicator which turns purple when pH is higher than 13. In this paper Compressive strength, Split tensile strength, Flexural strength test was performed to study the effect of carbonation on hardened properties of concrete.

II. MATERIALS AND METHODOLOGY

A. Cement

Utra-Tech OPC 43 grade conforming to BIS:8112 was used for this project.

B. Water

The water samples used in this investigation was obtained from NITTTR Chandigarh campus.

C. Coarse aggregate

Aggregate conforming to IS:383- 2016 was used in this project. Maximum size of aggregate limited to 20mm was mixed with 10mm sized aggregate in proportion of (1:1) in order to make a well graded mix.

D. Fine aggregate

Locally available clean river sand having specific gravity 2.68 conforming to zones II was used.

E. Mix Design

Mix. design for M30 and M35 grade concrete was carried out conforming to BIS: 10262- 2009.

F. Mixing, Casting and Curing

Materials were mixed in a pan mixer. All cubes, beams and cylinders were cast in the standard metallic moulds and vibrated to obtain required sample size. The moulds were cleaned of dust and oil was applied on all sides of moulds before concreting the sample. Thoroughly mixed concrete was poured into the moulds in three equal layers and the moulds were placed on vibrating table for a small period. Excess concrete is removed with a trowel and the top surface in finished with a smooth surface. After 24 hours protection in mould the samples were demoulded and put in curing tank for the respective periods of 3, 7, and 28 days. A set of 3 samples was prepared for each stage curing. The temperature of curing tank was kept at 25° ± 2° c for 28 days.

III. TESTING

The following test procedures were conducted in order to study the effect of induced carbonation on hareden properties of m30 and m35 grade concrete

A. Compressive strength test

The compressive strength of different samples was tested with and without carbonation after 3rd, 7th, and 28th day of curing. The 150mm cubes were tested on compressive testing machine. Load was applied @ 14Mpa/min. The ultimate compressive load of the cubes obtained from different days below.

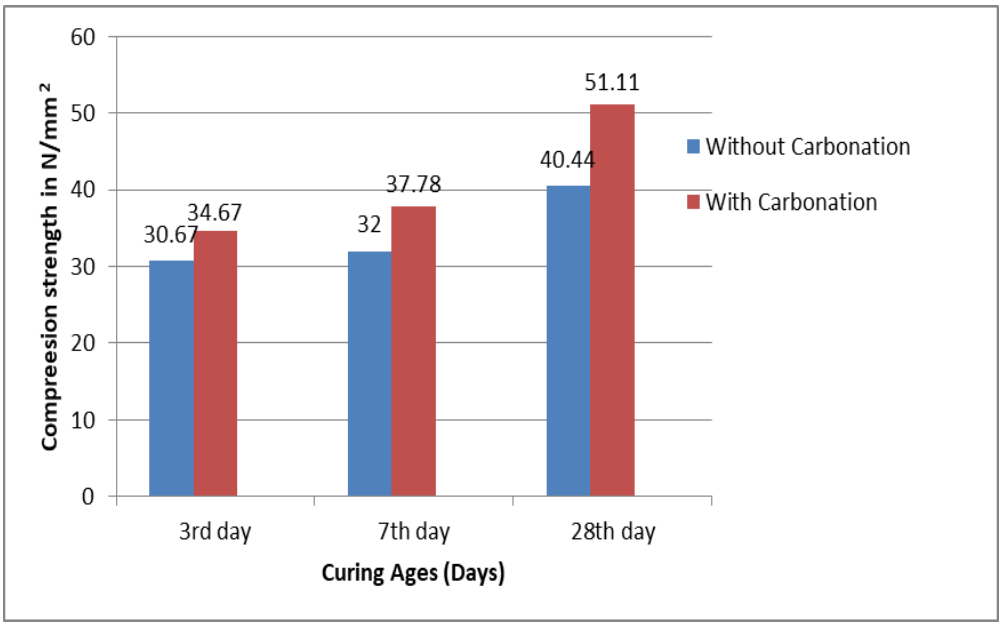

Fig. 1 Compressive strength of M30 grade concrete

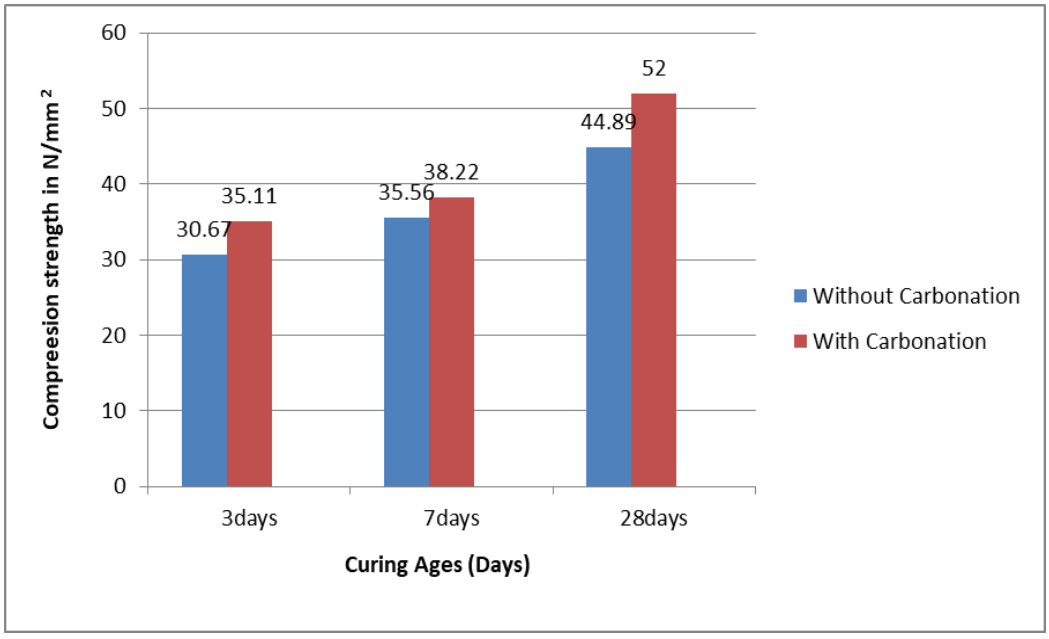

Fig. 2. Compressive strength of M35 grade concrete

B. Split tensile strength test

The split tensile strength of different cylinders was tested after curing and carbonation in 3rd , 7th and 28th were tested as per BIS: 5816 using special gear for split tensile testing in the compressive testing machine with a load capacity of 3000 kN and loading rate of 140 kg/sq cm/min for obtaining ultimate load of the specimens. The split tensile strength of the beams designed with different days as below.

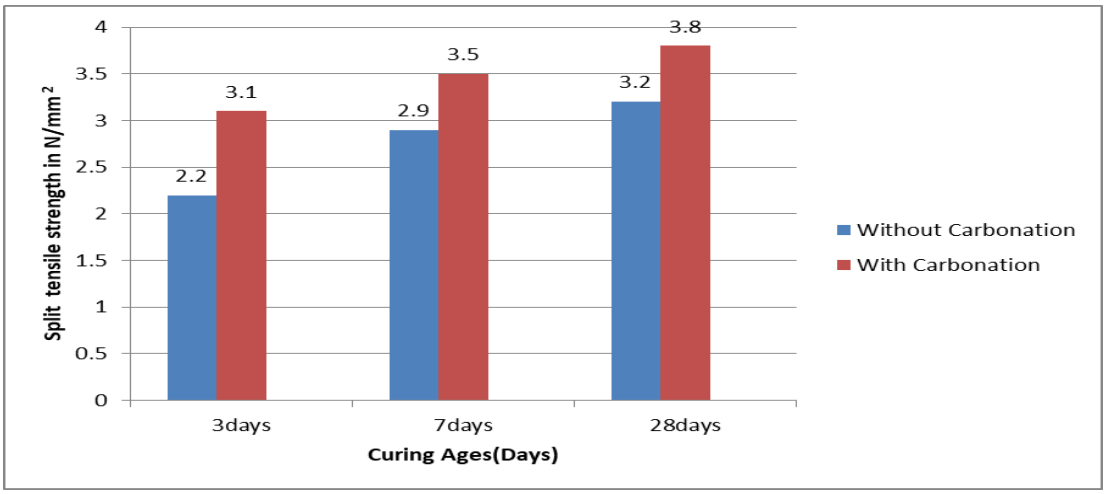

Fig. 3. Split tensile strength of M30 grade concrete.

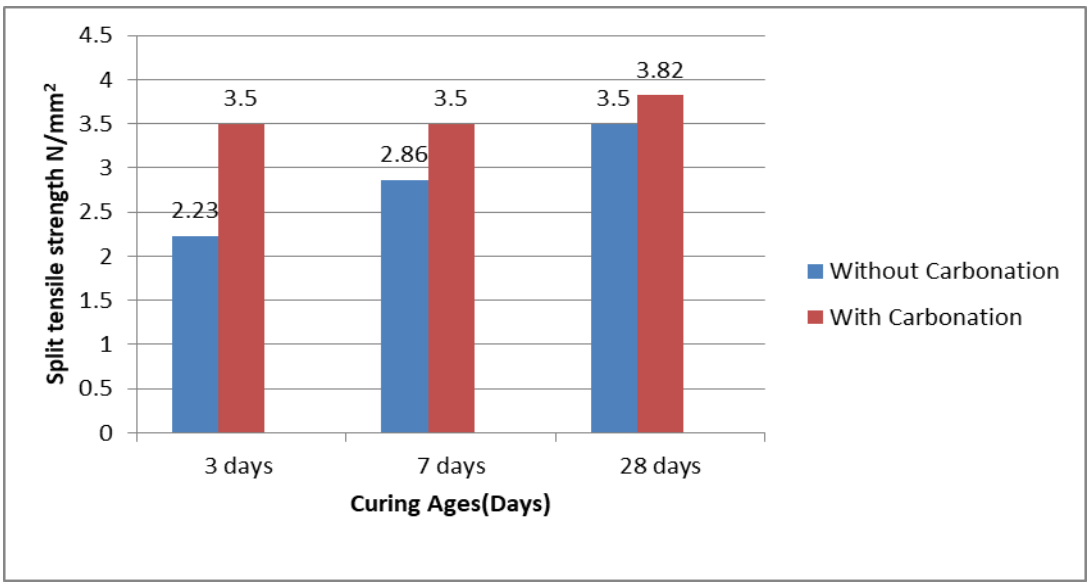

Fig. 4. Split tensile strength of M35 grade concrete.

C. Flexural strength test

The flexural strength of carbonation beam samples was tested after 3rd, 7th and 28th day curing. The beams were tested on a flexural testing machine as per BIS:516 under symmetrical two-point loading with a loading rate7 KN/min. The Ultimate flexure strength of carbonated and non carbonated beams were given below.

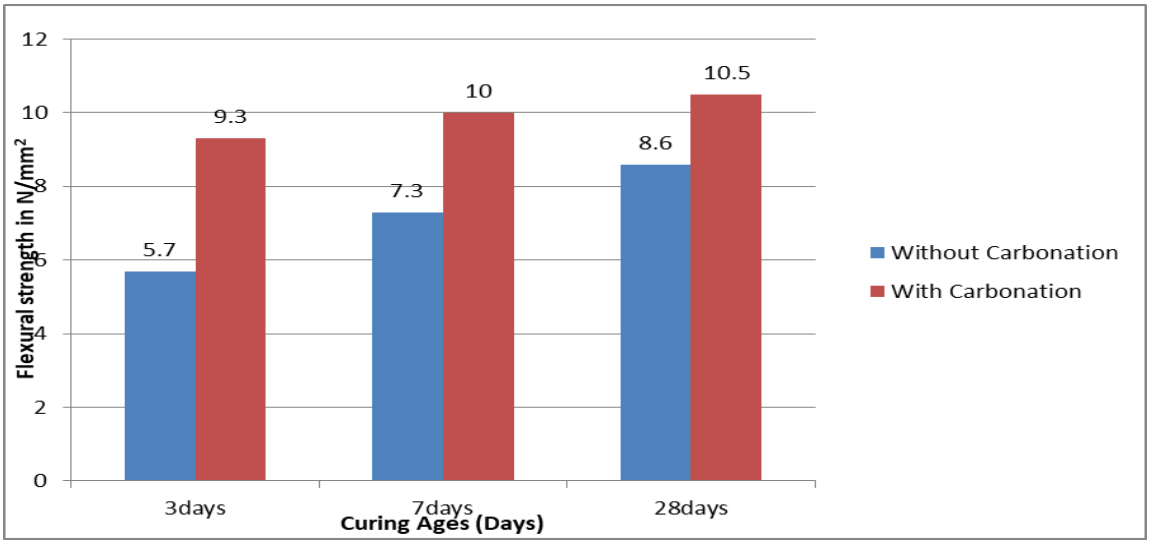

Fig. 5. Flexure strength of M30 grade concrete.

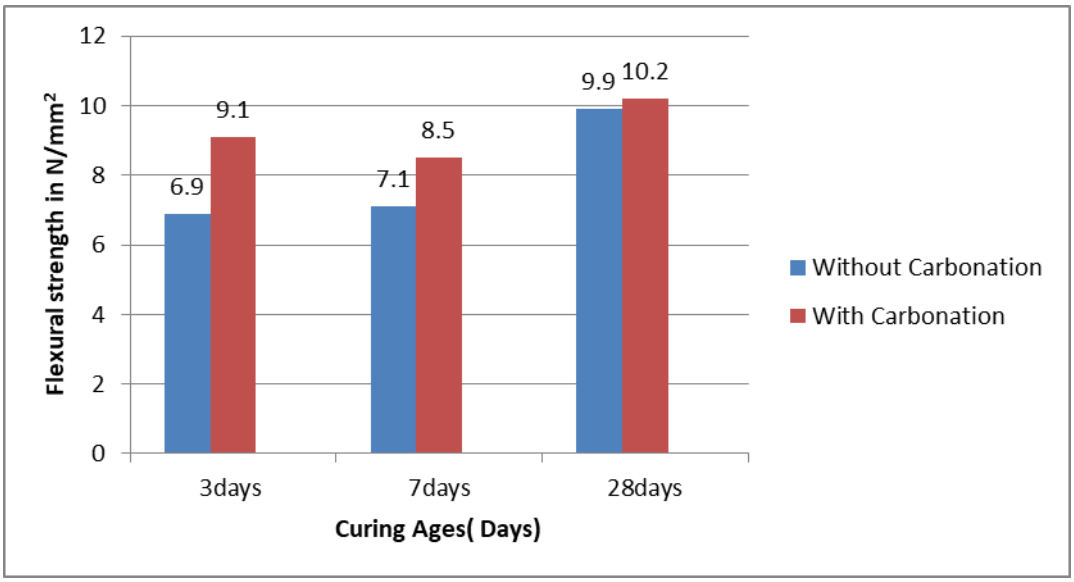

Fig.6.Flexural strength of M35 grade concrete.

D. Carbonation test

This test was carried out to determine the depth of concrete affected due to the combined attack of atmospheric carbon dioxide and moisture causing a reduction in the level of alkalinity of concrete. Carbonation depth is assessed using a solution of 0.2% phenolphthalein indicator. The change of colour of concrete to pink indicates that the concrete is in good health. Whereas no change in colour is suggestive of carbonation -affected concrete. The test was carried out by spraying the indicator on freshly exposed surfaces of fractured concrete cubes. The depth of carbonation was estimated based on the change in colour profile. In order to simulate the effect of atmosphere on the health of concrete in real life, the cubes after curing were placed in carbonation chamber set the Temperature 40˚C, Humidity 60˚, Carbon dioxide 50% to 55% for a period of 3rd,7thand 28th day.

IV. CONCLUSIONS

1. From the result of compression test, it is concluded that the compressive strength value of carbonated concrete on grade M30 increases as compared to normal concrete and carbonated concrete samples had increases of 11.6% for 3rd day samples, 15.3% for 7th day and 20.9%for 28th day test samples with respect to normal concrete samples.

2. From the result of compression test, it is concluded that the compressive strength value of carbonated concrete on grade M35 increases as compared to normal concrete and carbonated concrete samples had increases of 12.6% for 3rd day samples, 6.8% for 7th day and 13.7%for 28th day test samples with respect to normal concrete samples.

3. Split tensile strength test, result concluded that carbonated concrete of grade M30 has higher strength as compared to normal concrete and split tensile strength of carbonated samples had increases by 25.8% for 3rd day samples, 17.1% for 7th day and 15.4%for 28th day test samples with respect to normal concrete samples ofM30.Similarly, split tensile strength value of carbonated concrete of grade M35 is higher than normal concrete and split tensile strength value of carbonated samples had increases by 37% for 3rd day samples, 17.1% for 7th day and 7.1%for 28th day test samples with with respect to normal concrete samples ofM35.

4. The flexural strength test result shows that flexural strength value of carbonated concrete on grade M30 and M 35 increases as compared to normal concrete and flexural strength of carbonated samples had increased by 38.7% for three day samples, 27% for seven days and 18.1%for 28 days test samples with respect to normal concrete samples of grade M30. Similarly, for grade M35 concrete, the flexural strength value had increased by 24.2% for three day samples, 16.5% for seven days and 2.9%for 28th day test samples with respect to normal concrete samples.

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