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An Experimental Study on Compressive Strength and Sorptivity Of M25 Grade Concrete

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ABSTRACT
Concrete is a porous material which interacts with the surrounding environment. Sorptivity is materials ability to absorb and transmit water through it by capillary suction .When excess water in concrete evaporates, it leaves voids inside the concrete element creating capillaries which are directly related to concrete porosity and permeability . In this paper the mix design was carried out for M25 grade concrete as per IS: 10262-2009. The cement replacement by flyash was varied as 10%, 15% and 20%.Compressive strength and sorptivity tests were conducted on each of the mixes. The results of both the tests of concrete were compared with that of the control concrete. The results indicated that higher volume of cement replacement have lower values of sorptivity. There was a small reduction in 28 days compressive strength also happened.
Keywords - capillary suction, compressive strength, fly ash , porosity ,sorptivity

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I. INTRODUCTION

Fly ash or flue ash also known as pulverized fuel ash is a coal combustion product that is composed of the particulates that are driven out of coal fired boilers together with the flue gases. The use of small percentages of fly ash in a variety of civil engineering works is being carried out mainly for economical reasons. Fly ash, being available used in a costly construction raw material with the aim to solve the problem of disposal of fly ash in environment and cost reduction in construction.

In 1957 John Philip introduced the term **sorptivity** and defined it as a measure of the capacity of the medium to absorb or desorbs liquid by capillarity.[12]

According to C Hall and W D Hoff, the sorptivity expresses the tendency of a material to absorb and transmit water and other liquids by capillarity.[10] The test method is used to determine the rate of absorption (sorptivity) of water by hydraulic cement concrete by measuring the increase in the mass of a specimen resulting from absorption of water as a function of time when only one surface of the specimen is exposed to water.

II. OBJECTIVES OF STUDY

The objectives of the experimental investigation are

- To achieve good compressive strength at optimum usage of flyash in concrete with affordable sorptivity
- To attain relation between sorptivity and compressive strength
- To evaluate sorptivity with accordance of time.

III. METHODOLOGY

In this study the materials were collected locally and the laboratory tests conducted on cement fine aggregate and coarse aggregate. After completion of laboratory tests on the materials the mix design was prepared for M25 grade concrete using the referential codes of IS 10262-2009 and IS 456-2000.Based on the mix design the cube and cylindrical specimens for determining compressive strength and sorptivity were prepared for 7 and 28 days of curing period. The sizes of cube specimens were 150mmX150mmX150mm and cylindrical specimens of 150mmx100mm. Fly ash is used in different percentages as a partial replacement to cement. The measurement of workability carried out by slump test and compaction factor test and the strength tests are conducted on hardened concrete after 7and 28days curing period. The average strength of three cube specimen results was taken in each mix for strength and sorptivity evaluation. From the final results we had done discussions and finally concluded this work.

IV. EXPERIMENTAL PROGRAM

The materials were procured from locally available sources and laboratory experiments were

conducted for determination of their properties. The OPC 53 grade cement (RAMCO), locally available sand having specific gravity of 2.76, coarse aggregate of size 20mm and 16mm were used in this work. Flyash collected from nearby Boyapalem, Visakhapatnam used as partial replacement material in place of cement for preparation of concrete. Water cement ratio 0.46 maintained throughout the work and hand mixing done in the preparation of concrete.

Cement was partially replaced by flyash as 10%, 15% and 20% in different mixes. The cube and cylindrical specimens were casted of size 150mm×150mm×150mm and 100mm diameter 150mm height respectively. After demoulding the cylindrical specimens ,each specimen cut into three pieces (each one 50mm thickness) and the specimens are put into water for curing period of 7 and 28 days. After curing period the cube and cylindrical specimens were tested for compressive strength and sorptivity. Compressive strength conducted as per IS 516 and sorptivity test was conducted with reference to ASTM C1585-13.

$$S = I/t^{1/2.}$$

Here S= sorptivity in mm,

t = elapsed time in mintues

$I = \Delta w/Ad$

Δw = change in weight = W2-W1

W1 = Oven dry weight of cylinder in grams

W2 = Weight of cylinder after30 minutes capillary suction of water in grams

A = surface area of the specimen through which water penetrated.

d= density of water

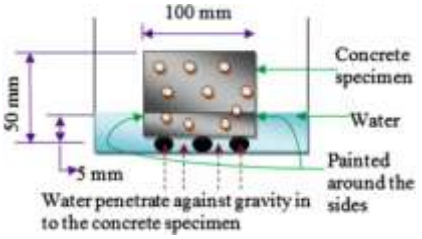


Figure 1 Schematic diagram for sorptivity test

Source: https://www.google.com/search?q=sorptivity+test&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiTz8zj3rvhAhX6#imgrc=IFY0EuQl-Y0I7M:

Figure 2 sorptivity test

Figure 3 weighing of specimens

V. RESULTS AND DISCUSSION

A. RESULTS

From the laboratory tests the following results were obtained

S.No	Name of property	Result	Standard limits
1	Specific gravity of Coarse aggregate	3.10	2.5-2.9 (IS:383-Table 2)
2	Water absorption of coarse aggregate	1.11%	0-2% (IS:383-2016)

Table 1 Tests results of Coarse aggregate

S.No.	Name of property	Result	Standard limits
1	Fineness modulus of fine aggregate	2.75	2.6-2.9 (IS:383-Table 4)
2	water absorption of fine aggregate	0.917 %	0.3-2.5% (IS:383-2016)
3	Specific gravity of fine aggregate	2.765	2.5-2.9 (IS:383-2016)

Table 2 Tests results of Fine aggregate

		Time in minutes					
S.No	Mix	60	240	360	480	600	740
1	Mix-P10	0.333	0.994	0.994	0.994	0.995	0.995
2	Mix-P15	1.050	1.050	1.050	1.051	1.051	1.051
3	Mix-P20	1.029	1.029	1.030	1.030	1.030	1.030

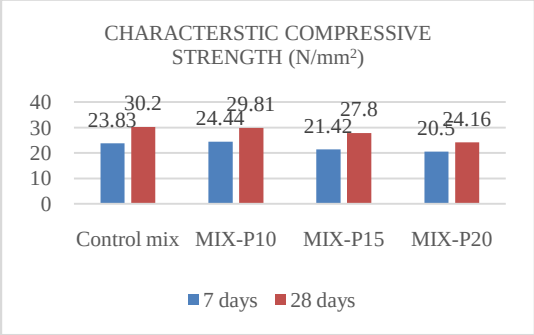
Table 3 sorptivity test results

S.No.	MIX	Workability	
		Slump Value (mm)	Compaction Factor
1.	Control Mix	42	0.92
2.	MIX-P10	30	0.89
3.	MIX-P15	27	0.88
4.	MIX-P20	25	0.83

Table 3 workability test results

S.No.	Mix	Characteristic Compressive strength(N/mm^2) Curing period (days)	
		7	28
1	Control mix	23.83	30.2
2	MIX-P10	24.44	29.81
3	MIX-P15	21.42	27.8
4	MIX-P20	20.5	24.16

Ta**ble4** Compressive strength test results



B. DISCUSSION

1. The 28 days compressive strength of control specimen is 30.2 N/mm^2.In this attempt the strength difference between obtained value and target mean strength is not exceeded 5% hence good strength is achieved. After replacement of cement by 10% fly ash the compressive strength reached its target strength but for further increment in replacement of cement the strength decreased gradually.
2. Upto 20% replacement of cement with fly ash gave good compressive strength results that is nearly its target strength but not up to mark. These strengths were considerable
3. When fly ash is added in concrete, the reactive silica present in fly ash reacts with calcium hydroxide liberated during cement hydration and forms calcium silicate hydrate (C-S-H) gel. Compact C-S-H gel gives higher strength.
4. The sorptivity value increased with cumulative time period at 10% replacement of cement with fly ash. In MIX-P10, the rate of capillarity of water is increased 0.33% when compared with the initial value at 30 minutes time period.
5. There is no increment in sorptivity after 9 hours of time in MIX-P10 and the values are almost same for further time increment. Compact C-S-H gel gives higher strength and lower permeability and absorption characteristics
6. In MIX-P15 and MIX-P20 the sorptivity values are gradually decreased with minimum cumulative time period when compared to MIX-P10.Because of fineness of flyash ,it occupies remaining pores in the mixes and cause to low permeability and absorbing capacity.

VI. CONCLUSION

1. The compressive strength increased by 2.5% at 10% replacement of cement with fly ash when compared to control specimen .Hence for obtaining good strength, upto 10% replacement of cement with fly ash in M25 concrete mix is acceptable.
2. In MIX-P10,thesorptivity is high when compared with remaining mixes but it is considerable for ordinary structures.
3. Upto 15% replacement of cement with fly ash the compressive strength and sorptivity values are considerable.

RECOMMENDATION

In the present study the compressive strength and sorptivity tests were done after 28 days of curing period at room temperature and the sorptivity test was conducted at a cumulative time period of 12 hours for each case. The same test will try to do at a long cumulative hours or days with different chemical agents mixing with water for curing at different temperatures and will evaluate the nature of sorptivity.

REFERENCE

[1]. Atis, C. D. (2003). "Accelerated carbonation and testing of concrete made with fly ash." Construction and Building Materials, Vol. 17, No. 3, pp. 147-152.

[2]. Bai j., Wild S, Sabir BB (2002) "Sorptivity and strength of air-cured and water cured PC-PFA-MK concrete and the influence of binder composition and carbonation depth". Cement and concrete research 32:1813-1821.

[3]. Bentz, D., Ehlen, M., Ferraris, C., and Garboczi, E. "Sorptivity-Based Service Life Predictions for Concrete Pavements." 181–193.
[4]. Caliskan, S. (2006). "Influence of curing conditions on the sorptivity and weight change characteristics of self-compacting concrete." The Arabian Journal for Science and Engineering, 31(1), 169-178.
[5]. Claisse, P. A. (1997). "Absorption and Sorptivity of Cover Concrete."Journal of Materials in Civil Engineering, 9(3), 105-110.
[6]. Dias, W. P. S. (2000). "Reduction of concrete sorptivity with age through carbonation."Cement and Concrete Research, 30(8), 1255-1261.
[7]. Deepa A Sinha, Dr.A.K.Verma, Dr.K.B.Prakash (2012) "Sorptivity and waste absorption of steel fibers reinforced ternary blended concrete". International journal: global research analysis (GRA),volume:1,issue:5,oct2012,issn no:2277-8160.
[8]. Gonen, T. and Yazicioglu, S. (2007). "The influence of compactionpores on sorptivity and carbonation of concrete." Construction and Building Materials, Vol. 21, No. 5, pp. 1040-1045.
[9]. Güneyisi, E. and Gesog˘lu, M., (2008). "A study on durability properties ofhigh-performance concretes incorporating high replacement levelsof slag." Materials and Structures, Vol. 41, No. 3, pp. 479-493.
[10]. Hall, C. (1977). "Water movement in porous building materials--I.Unsaturated flow theory and its applications."Building and Environment, 12(2), 117-125.
[11]. Hall, Christopher; Hoff, William D (2012). Water transport in brick, stone and concrete, 2nd edn. London and New York: Taylor and Francis. http://www.routledge.com/books/details/9780415564670/.
[12]. Philip, John R (1957). "The theory of infiltration: 4. Sorptivity and algebraic infiltration equations". Soil Science 84: 257-264.
[13]. Sulapha, P., Wong, S. F., and Wee, T. H., and Swaddiwudhipong, S.(2003). "Carbonation of concrete containing mineral admixtures."Journal of Materials in Civil Engineering, Vol. 15, No. 2, pp. 134-143.
[14]. Song X.J, Marosszeky M, Brungs M, Munn R. 2005. Durability of fly ash based Geopolymer concrete against sulphuric acid attack 10 DBMC International Conference on Durability of Building Materials and Components, Lyon, France, 17- 20 April.

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