Experimental Investigation on Structural Behavior of Blended Cement Concrete

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ABSTRACT

Blended cement is obtained by mixing OPC with mineral admixtures or additives like fly-ash, slag or silica fume. Blended cements are now being considered superior as compared to conventional OPC category of cements. Portland cement is environmentally very unfriendly material. As good Engineer, one must reduce its use in concrete. Replacing 15% of cement worldwide by Supplementary Cementing Materials (SCM) will reduce CO_2 emissions by 227 million tonnes. Replacing 50% of cement worldwide by SCM will reduce CO_2 emissions by 750 million tonnes. This is equal to removing ¼ of all automobiles in the world. An experimental study on Flyash concrete in which the cement is replaced by fly ash in varying percentages (40% &60%) to make it as a double blended cement concrete. Then the silica fume is added in varying proportion (5% & 10%) to make it as a treble blended cement concrete.

INTRODUCTION

Concrete is a mixture of cement, sand, coarse aggregate and water. Its success lies in its versatility as can be designed to withstand harshest environments while taking on the most inspirational forms. Engineers and scientists are further trying to increase its limits with the help of innovative chemical admixtures and various supplementary cementitious materials (SCM).

BLENDED CEMENTS

Blended cements are produced by the addition of fly ash / slag / silica fume / metakaolin etc. to ordinary Portland cement, the quantity recommended for replacement of OPC is limited to produces blended cements with an ensured quality standards and globally established technology.

BLENDING MATERIALS (SCMs)

More recently, strict environmental – pollution controls and regulations have produced an increase in the industrial wastes and sub graded byproducts which can be used as SCMs such as fly ash, silica fume, ground granulated blast furnace slag etc.

EXPERIMENTAL INVESTIGATION

CEMENT

OPC 53 grade cement was used for this investigation and the specific gravity of cement was 3.12.

FINE AGGREGATE

The fine aggregate used for this investigation was clean river sand passing through 4.75 mm sieve with the fineness modulus of 3.4 and specific gravity of 2.56. The particle size distribution is given in Table 4.1 and this sample falls in zone II as per IS 383 – 1970

COARSE AGGREGATE

The size of crushed granite angular aggregate used in this test was between 20 mm and 4.75 mm with the specific gravity of 2.78. The properties were determined as per IS specifications. Fineness modulus of coarse aggregate is 7.00.

WATER

Water used for this experimental investigation was fit for concreting and the same water was used for curing purpose also. pH value of water = 7.5

FLY ASH

The difference between fly ash and Portland cement becomes apparent under a microscope. Fly ash particles are almost totally spherical in shape, allowing them to flow and blend freely in mixtures. This capability is one of the

properties making fly ash a desirable admixture for concrete.

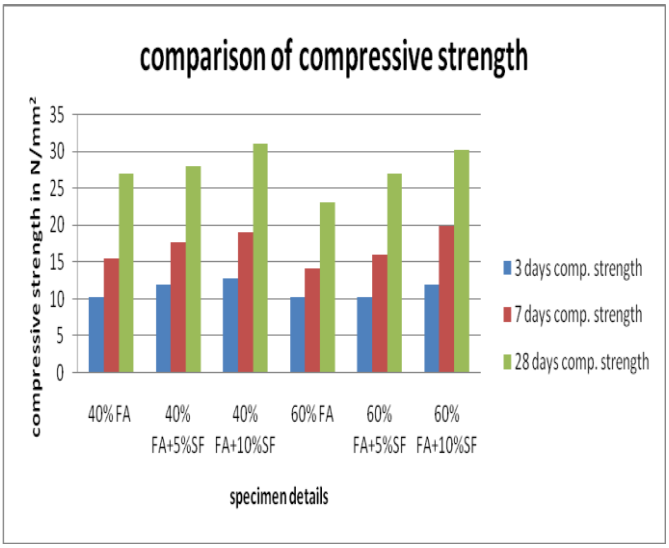
MIX PROPORTIONING

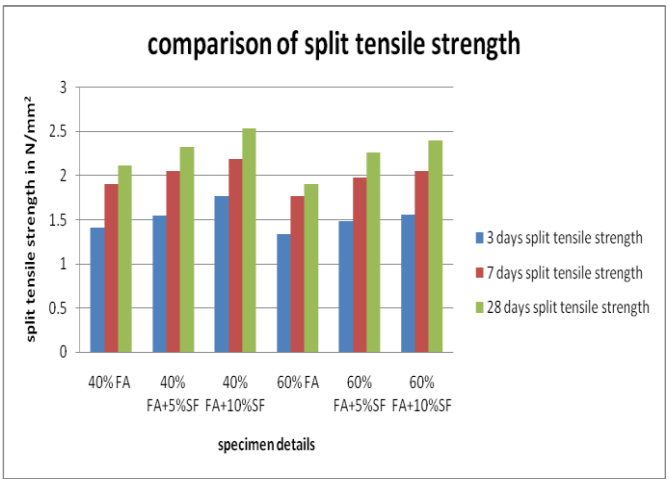
The mix proportions for the controlled concrete of M30 and blended cement concrete of M30 were arrived from the trial mixes. M30 grade mix was prepared and mix ratio of concrete is **0.37: 1: 0.85: 2.49 by** weight of water, cement, fine and coarse aggregate.

PREPARATION OF TEST SPECIMENS

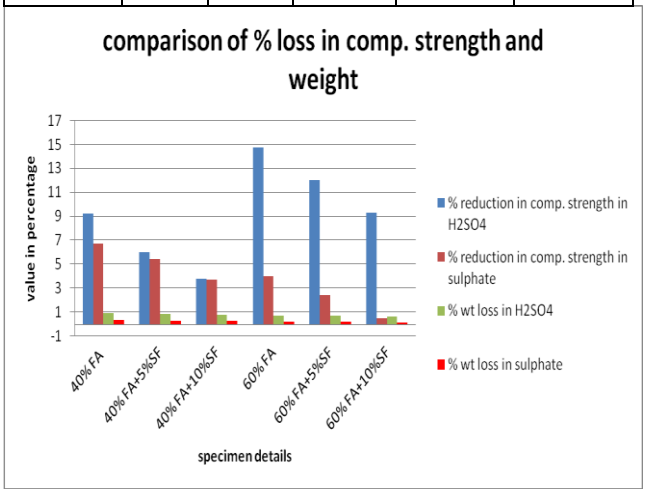
RESULTS

COMPARISON OF TEST RESULTS





Details	3 days	7 days	28 days	Chloride attack	Sulphate attack
	Cubes and cylinders			cubes	
Control specimens					
40% FA	3+3	3+3	3+3	3	3
60% FA	3+3	3+3	3+3	3	3
Replaced concrete specimens					
40%FA+ 5%SF	3+3	3+3	3+3	3	3
40%FA+ 10%SF	3+3	3+3	3+3	3	3
60%FA+ 5%SF	3+3	3+3	3+3	3	3
60%FA+ 10%SF	3+3	3+3	3+3	3	3



CONCLUSIONS

Based on the test results, the following conclusions were derived

- The replacement of cement with two different percentages of fly ash content reduced the compressive strength of concrete at the age of 3, 7, 28 days, but there was a continuous and significant improvement of strength properties beyond 28 days.
- In this triple blend, the silica fume takes care of properties in the early age, while fly ash adds its contribution at later ages.
- The addition of silica fume did not affect the workability of the fresh fly ash concrete.
- The initial age (3&7 days) strength of flyash concrete has been improved upto 10% with the addition of silica fume.
- The 28 days strength of 40% and 60% fly ash concrete has increased from 5 to 10%

of strength with the addition of 5% silica fume.

- The strength has increased from 10 to 20% with the addition of 10% silica fume.
- The deterioration rate of blended cement concrete subjected to sulphuric acid attack and chloride attack was same as flyash concrete.
- When immersed in acid and sulphate, weight loss of cube decreases with increase in replacement of fly ash, then the addition of silica fume also reduces the weight loss.
- More addition of silica fume can increase the initial age strength and decrease the deterioration rate of flyash concrete.

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