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An Experimental Investigation On Mineral Admixture For High Performance Of Concrete

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ABSTRACT

Concrete is the most commonly used construction material. Now a day's high performance concrete is globally used in the infrastructure industry for strong and durable structure, to produced high performance concrete various supplementary cementitious material are used as mineral admixture. In our project involves the use of Fly ash and Silica fume at various proportions to enhance the compressive strength of high performance concrete. The investigation was carried out by replacing 20% and 40% fly ash along with 15% of silica fume by weight of cementitious material. To cover a wide range of compressive strength of concrete various water binder ratios. The study mainly consisted of establishing relation between these parameters graphically. Investigation demonstrates that silica fume along with fly ash in fresh and hardens state of concrete. These, in turn improve the resistance of concrete to the penetration of harmful substances such as chloride and sulphate ions, carbon dioxide, water and oxygen, and hence enhance durability performance. In our study M30 grade of concrete used. The improved pore structure of HPC is mainly achieved by the use of chemical and mineral admixtures. In the present study the effect of mineral admixtures on the durability properties of HPC is investigated. The strength tests were carried out on the hardened concrete. Durability properties were determined by conducting sulphate attack test.

Key words: Concrete, Fly ash, Silica fume, mineral admixture

1. INTRODUCTION

Use of waste and by products in concrete will lead to green environment and such concrete can be called as "Green Concrete". There are various types of waste materials that can be considered for usage in concrete. The disposal of fly ash will be a big challenge to environment, especially when the quantum increases from the present level. Hence worldwide research work was focused to find alternative use of this waste material and its use in concrete industry is one of the effective methods of utilization. Increase in demand and decrease in natural resource of fine aggregate for the production of concrete has resulted in the need of identifying a new source of fine aggregate. The possibility of utilization of thermal power plant byproduct bottom ash as replacement to fine aggregate in concrete is taken into consideration.

Presently about 105 million tons flyash is generated every year in India as a by-product of coal consumed in the thermal power plants. The thermal power plant is only the source to produce 65% of the total electricity produced in our country. Investigation on utilization of flyash in cement mortar is carried out by many authors reported in the literature. Several million tons of coal for generating the electricity is being consumed in India out of which 40% of coal is accounted for generating of flyash as a bye product. Waste glass is a major component of the solid waste stream in many countries. It can be found in many forms, including container glass, flat glass such as windows, bulb glass and cathode ray tube glass. At present, although a small proportion of the post consumer glass has been recycled and reused, a significant proportion, which is about 84% of the waste glass generated in India, is sent to landfill. Glass is a 100% recyclable material with high performances and unique aesthetic properties which make it suitable for wide-spread uses.

2.METHODOLOGY

Figure.1 shows the methodology adopted in this study

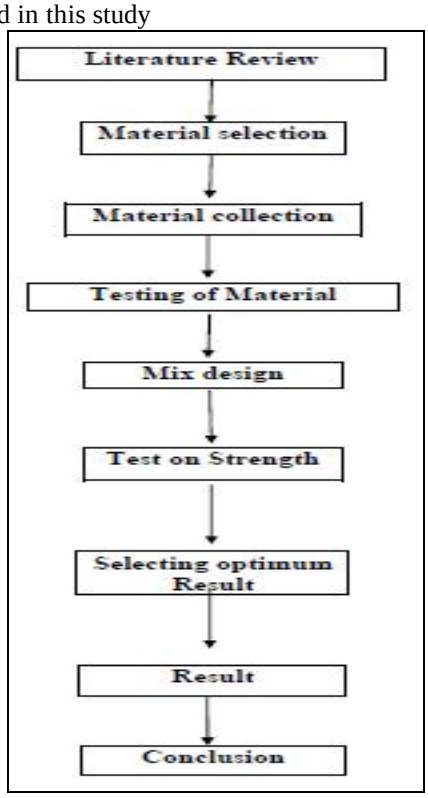

Figure. 1 Methodology

3. MATERIALS AND METHODS

3.1 Cement

The cement used was ordinary Portland cement 53 (OPC 53).All properties of cement were determined by referring IS 12269 - 1987. The specific gravity of cement is 3.15. The initial and final setting times were found as 55 minutes and 258 minutes respectively. Standard consistency of cement was 30%.

3.2 Fine Aggregate

The sand which was locally available and passing through 4.75mm IS sieve is used. The specific gravity of fine aggregate was 2.60.

3.3 Coarse Aggregate

20mm size aggregates-The coarse aggregates with size of 20mm were tested and the specific gravity value of 2.78 and fineness modulus of 7 was found out. Aggregates were available from local sources.

3.4 Fly Ash

Fly Ash is a by-product of the combustion of pulverized coal in electric power generation plants. When the pulverized coal is ignited in the combustion chamber, the carbon and volatile materials are burned off. However, some of the mineral impurities of clay, shale, feldspars, etc., are fused in suspension and carried out of the combustion chamber in the exhaust gases. As the exhaust gases cool, the fused materials solidify into spherical glassy particles called Fly Ash. Fly Ash is economical. The cost of Fly Ash is generally less than Portland cement depending on transportation. Significant quantities may be substituted for 18 Portland cement in concrete mixtures and yet increase the long term strength and durability. Thus, the use of Fly Ash may impart considerable benefits to the concrete mixture over a plain concrete for less cost.

3.5 Silica Fume

Figure.2 Silica Fume

Silica fume is also known as micro silica, volatilized silica, or condensed silica fume. It is a by-product from silicon metal and ferrosilicon alloy production. The material is a very fine powder with spherical particles about 100 times smaller in size than Portland cement or fly ash. The diameters range from 0.02 to 0.5 m with an average of 0.1 m. Silica fume contains 85 to 95% no crystalline silicon dioxide.

4.TESTING PROCEDURE

Within the experimental research program concerning the development of mechanical properties of a partially replacement of cement by flyash, partially replacement of sand by bottom ash and glass is used reference concrete of grade M25 (REF) was considered with the following composition, accordingly. The w/c-ratio is 0.43. Coarse aggregates were chosen, having a particle size mainly varying between 2 mm and 20 mm.

4.1 Compressive Strength Test

At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block will be noted. From the noted values, the compressive strength may calculated by using below formula.
Compressive Strength = Load / Area
Size of the test specimen =150mm x 150mm x 150mm

4.2 Split Tensile Test

The size of cylinders 300 mm length and 150 mm diameter are placed in the machine such that load is applied on the opposite side of the cubes are casted. Align carefully and load is applied, till the specimen breaks. The formula used for calculation.
Split tensile strength = 2P/ dl

4.3 Flexural Strength Test

During the testing, the beam specimens of size 7000mmx150mmx150mm were used. Specimens were dried in open air after 7 days of curing and subjected to flexural strength test under flexural testing assembly. Apply the load at a rate that constantly increases the maximum stress until rupture occurs. The fracture indicates in the tension surface within the middle third of span length. The flexural strength was obtained using the formula (R)
$R = Pl/bd2$
Where,

R = Modulus of rupture (N/mm2)
P = Maximum applied load (N/mm2)
l = Length of specimen (mm)
b = Width of specimen (mm)
d = depth of specimen (mm)

5. TEST RESULT

5.1 Various Percentange Of Flyash

Ratio –I
Fly ash – 20% by replacement of cement
Silica Fume – 15% by replacement of sand
Ratio – II

Fly ash – 40% by replacement of cement
Silica Fume – 15% by replacement of sand

5.2 Compressive Strength test results For Various Percentange Of Flyash
Compressive Strength test results For Various Percentange Of Flyash given in Table.1 and shown in Figure3.

Table 1 Compressive Strength Of Cube

Control Mix	Best Compressive Strength in N/mm²								
	CC			Various Percentange Of Flyash					
				Ratio I			Ratio II		
	7	14	28	7	14	28	7	14	28
M30	17.8	23.6	28.3	19.5	24.2	27.6	23.4	25.3	28.30

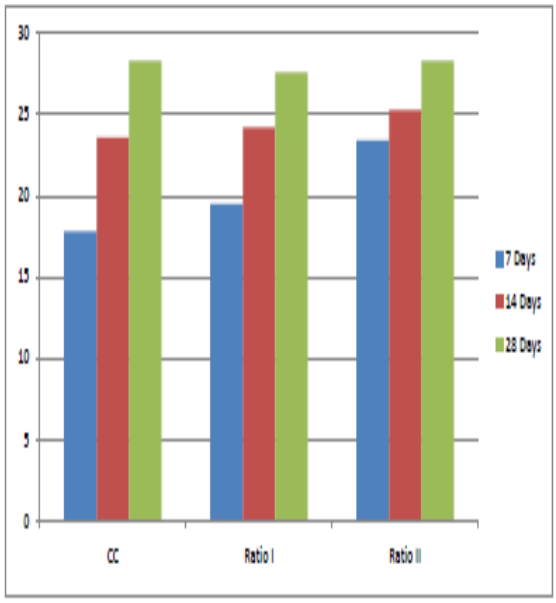

Figure.3. Compressive Strength test results

5.3 Split Tensile Test For cylinder For Various Percentange Of Flyash
Split Tensile Test For Cylinder For Various Percentange Of Flyash given in Table.2 and shown in Figure.4

Table 2 Split Tensile Test For Cylinder

Control Mix	Split Tensile in N/mm²								
	CC			Various Percentange Of Flyash					
				Ratio I			Ratio II		
	7	14	28	7	14	28	7	14	28
M30	1.1	2.2	3.5	1.8	2.6	4.2	2.8	3.8	5.3

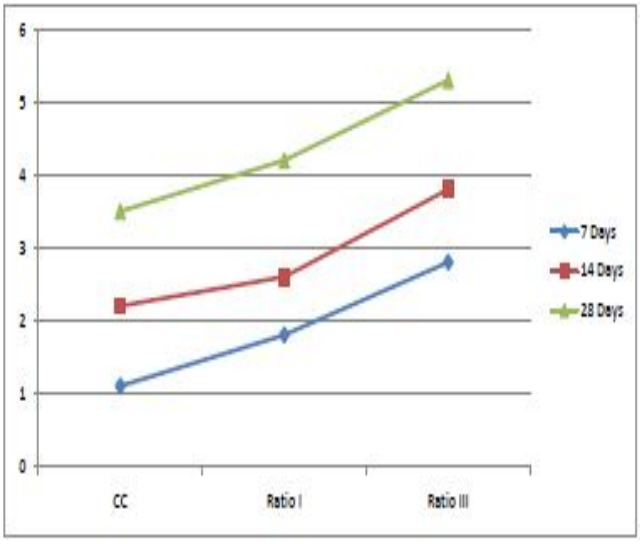

Figure. 4 Split Tensile Test For Cylinder

5.4 Flexural Strength Of Beam For Various Percentage Of Flyash

Flexural Strength Of Beam For Various Percentange of Flyash given in Table.3 and shown in Figure.5

Table 3 Flexural Strength Of Beam

Control Mix	Best Compressive Strength in N/mm²								
	CC			VARIOUS PERCENTANGE OF FLYASH					
				Ratio I			Ratio II		
	7	14	28	7	14	28	7	14	28
M30	2.30	3.30	4.20	2.50	3.35	4.36	3.05	4.20	4.96

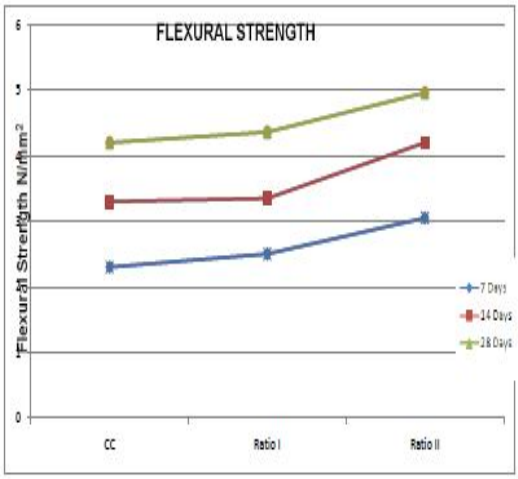

Figure.5 Flexural Strength Of Beam

6.CONCLUSIONS

The study was conducted to evaluate the strength characteristics of concrete with silica fume and fly ash in concrete. The concrete mix design was done for M30 grade concrete. The following points are concluded from this study.

- The 7 days cube compressive strength results showed reduced strength of concrete due to slow action.
- The Strength of concrete containing flyash 40% and 20% of silica fume and was high compared with that of the conventional mix.
- The flexural strength of concrete with 40% fly ash content with 30% of silica fume showed improvement on the mechanical properties of concrete.
- Cement replacement level of 40 % flyash in concrete mixes was found to be the optimum level to obtain higher value of the strength and durability at the age of 28 days.
- By cost analysis it is found that by 40 % replacement of flyash, cost is reduced up to 45 % on Cement. Also by using bottom ash in this concrete to reduced the fine aggregate cost.
- To reduced the weight of concrete making an light weight concrete because here using glass as coarse aggregate.

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