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UTILIZATION OF FLY ASH AS A CEMENTATIOUS MATERIAL IN CONCRETE

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ABSTRACT: Fly ash utilization in concrete as partial replacement of cement is gaining importance day by day. Technological improvements in thermal power plant operations as well as collection systems of fly ash improved the quality of fly ash. To study the use of fly ash in concrete, cement is replaced partially by fly ash in concrete. In this experimental work concrete mix was prepared with replacement of fly ash by 0%, 25%, 50%, 75% and 100%. Effect of fly ash on workability, setting time, compressive strength and water content are studied. To study the impact of partial replacement of cement by fly ash on the properties of concrete, experiments were conducted on different concrete mixes.

1. INTRODUCTION

Pozzolanic materials containing silica and alumina compounds with a low degree of Crystallization present in their composition. These materials are rich in siliceous or alumino-siliceous compounds that in the presence of moisture chemically react with calcium hydroxide to form products that have cementatious properties.

Fly ash (FA) is a by-product of the combustion of pulverized coal in thermal power plants. It has been widely used to attain sustainability in the cement and concrete industry for many years .In addition to its environmental benefits, the proven technical benefits of using FA to replace cement in concrete include improvement in workability, reduction of bleeding, reduction in the temperature rise in hardening concrete, reduction of drying shrinkage, reduction of reinforcement corrosion in reinforced concrete and overall Improvement In durability.

Fly Ash addition is assessed based on the mechanical properties (compressive strength and modulus of elasticity) and physical properties fineness, specific gravity.

The components of the concrete are fine aggregate, coarse aggregate, cement and water. The vital environmental problems related with cement production is releasing of CO2, one of the major greenhouse gas which causes Global Warming. Keeping this ill effect of cement, various replacements include fly ash, ground granulated blast furnace slag, rice husk and silica fume is used. Fly ash is a much cheaper material than Portland cement, so that large replacements can result in significant economic savings.

2. METHODOLOGY

1. PHYSICAL CHARACTERISTICS

The physical characteristics of fly ash like fineness, particle shape and size, density and colour mainly depend on the type of collection system and the combustion temperature of the pulverized coal. The physical properties of fly ash have a greater influence on the performance of fresh concrete such as workability, bleeding, segregation etc. The fineness of the fly ash influences pozzolanic activity and workability of concrete.

2. PARTICLE SIZE DISTRIBUTION OF FLY ASH

Sieve analysis is done to determine the particle size distribution. 1 kg of dry fly ash sample is taken and placed on the topmost sieve of the sieve shaker having different sizes of brass sieves. Place the pan on the bottom and cover on the top of the sieve shaker. Start it for shaking for 10 to 15 minutes. After complete shaking stop the sieve shaker and weight the material retained on each sieve.

3. SPECIFIC GRAVITY

The test is useful to know how much heavy the material relative to water. After receiving the Fly Ash sample, it is dried in an oven at a temperature of 105 to 115℃ for a period of 16 to 24 hours.

$$G = \frac{M_2 - M_1}{(M_2 - M_1) - (M_3 - M_4)}$$

Where,
M1 = mass of empty pycnometer,
M2 = Mass of the Pycnometer with dry soil
M3 = Mass of the Pycnometer and soil and water
M4 = Mass of Pycnometer filled with water only

4. COMPRESSIVE STRENGTH DETERMINATION:

In this test sample of concrete is filled in the mould of size 15cm x 15cm x 15cm and top of mould is strike off. A total number of 18 cubes were casted. Fly ash is added in place of cement in concrete in 6 different percentages starting from 0%, and raised themixing of fly ash upto 25%, at an interval of 5%. The specimens are covered with the wet gunny bags for 24 hours. Then after sample is removed and kept for curing in curing tank. At the end of curing period sample is removed and tested immediately. The testing is done under Universal Testing Machine.

The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area calculated from the mean dimensions of the section (see also 4.5.1 of IS· 1199-1959) and shall be expressed to the nearest kg per sq-cm

RESULTS:

From the following investigation we have get the results:

Table.1 –Particle Size Distribution

S.No.	Sieve Size (mm)	Weight retained (gm)	% Weight Retained	Cumulative % Weight Retained	% Finer
1	4.75	50	5.0	5.0	95.0
2	2.36	65	6.5	11.5	88.5
3	1.18	80	8.0	19.5	80.5
4	0.600	95	9.5	29.0	71.0
5	0.300	121	12.1	41.1	58.9
6	0.150	209	20.9	62.0	38.0
7	0.075	380	38.0	100	00.0

Table -2: Specific Gravity Using Pycnometer Method

S.No.	Observation Number	1	2	3
1	Weight of Bottle (W1)	593.2	593.2	593.2
2	Weight of Bottle and Soil (W2)	744.2	744.2	744.2
3	Weight of Bottle, Soil and Water (W3)	1552.4	1551.5	1553.7
4	Weight of Bottle and Water (W4)	1480.0	1480.0	1480.0
Specific gravity		1.92	1.89	1.95

Table:3 Compressive Strength of Fly Ash Concrete

S.No.	% of Fly Ash	Compressive Strength(N/mm^2)		
		7 Days	14 Days	28 Days
1	0%	13.7	16.4	20
2	25%	13.4	16.8	19.6
3	50%	12.8	16.2	18.9
4	75%	10.2	13.5	15.8

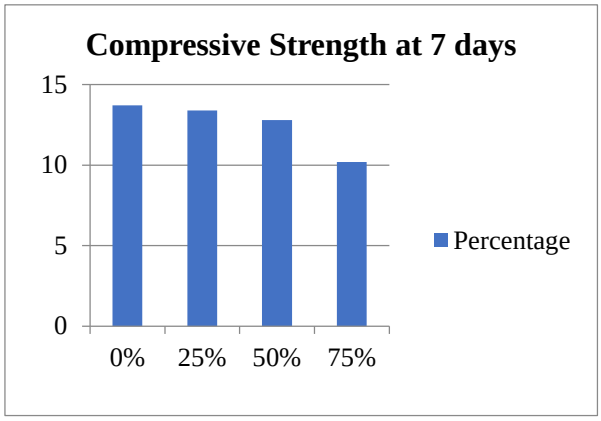

Figure1. Variation of compressive strength at 7 days.

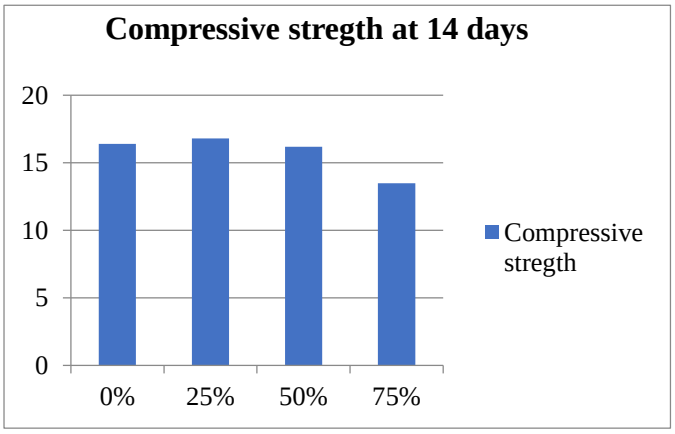

Figure2. Variation of strength at 14 days .

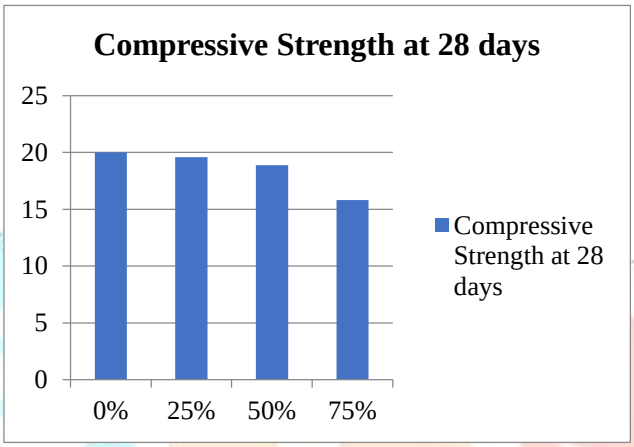

Figure3 Variation of compressive strength at 28 days

CONCLUSIONS

From the result of this study, it can be conclude that cement replacement by fly ash is useful in lower grades of cement such as M20. It can be stated that at 25% of replacement of cement by fly ash there is considerable increase in strength properties.

Incorporation of fly ash in concrete can save the coal and thermal industry disposal cost and produce a "greener" concrete for construction.

With the use of mineral admixture the cost is considerably reduced due to no use of mechanical vibrators plus viscosity modifying admixtures also avoided.

The strength of concrete decreases with increases in percentage of fly ash first and again increases as the percentage of fly ash increases upto a certain limit.

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