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EXPERIMENTAL ANALYSIS OF FLY ASH IN ORDINARY PORTLAND CEMENT CONCRETE

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ABSTRACT

Fly ash is an advantageous mineral admixture for concrete. Hence it is emphasized to the reuse of waste material like fly ash. Over a period of last ten years, the image of fly ash has completely been changed from a "Polluting Waste" to "Resource Material. In this system, fly fiery remains from Electrostatic Precipitators (ESP) is emptied through pneumatic framework and put away in storehouses. This work describes the use of Non-conventional artifact (Fly ash) that is definitely our there.

During this work cement and fine aggregate has been partially replaced by fly ash consequently within the range of 0% (without fly ash), 10%, 20%, 30%, 40% and 50% by weight of cement for M-20 Mix Concrete mixtures were moulded, tested and compared in terms of compressive and split strength.

Keywords: flyash, concrete, creep, shrinkage, reinforced concrete, deformations.

INTRODUCTION

Fly ash is used as a supplementary cementitious material (SCM) in the production of portland cement concrete. A supplementary cementitious material, when used in conjunction with portland cement, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity, or both. Accordingly, SCM's incorporate both pozzolans and water driven materials. A pozzolan is characterized as a siliceous or siliceous and aluminous material that in itself has next to zero cementitious esteem, however that will, in finely partitioned frame and within the sight of dampness, synthetically respond with calcium hydroxide at common temperatures to shape mixes having cementitious properties. Pozzolans that are ordinarily utilized as a part of cement incorporate fly slag, silica smolder and an assortment of common pozzolans, for example, calcined dirt and shale, and volcanic fiery remains. SCM's that are water powered in conduct incorporate ground granulated impact heater slag and fly fiery remains with high calcium substance (such fly cinders show both pozzolanic and pressure driven conduct). The potential for utilizing fly fiery remains as a supplementary cementitious material in concrete has been known nearly since the beginning of the most recent century (Anon 1914), despite the fact that it wasn't until the mid-1900s that noteworthy use of fly cinder in concrete started (for instance, USBR 1948) after the spearheading research led at the University of California, Berkeley (Davis 1937). The most recent 50 years has seen the utilization of fly fiery debris in concrete develop drastically with near 15 million tons utilized as a part of solid, solid items and grouts in the U.S.

MATERIALS AND METHOD

In order to study the effect of fly ash as partial cement replacement on the strength of concrete, 108 cubes and 54 cylinders for a mix have been cast in the laboratory. Cubes (150mm×150mm×150mm) and cylinders (dia. 150mm and height 300mm) were cast using a design mix of (1:1.6:3.2, where 3.2 is the proportion of 10mm and 20mm aggregate), an effort has been made here to get the strength of cubes made up with different percentage of fly ash to the respective strength of conventional concrete at the end of 7, 28 and 56 days of moist curing and to have an idea about the optimum percentage of fly ash which does not affect the strength of non-conventional concrete considerably. There is also check the workability before filling the cubes, for workability there is so many test for find such as slump, compacting factor etc. shown in fig. 1 given below:

CEMENT

In this work, Ordinary Portland Cement (OPC) of prism brand obtained from single batches throughout the investigation was used. The Portland cement content mainly two basic ingredients namely argillaceous and calcareous. The physical properties of OPC as determined are given in table 1. The cement satisfies the requirement of IS: 1489:1991.

Table 1: The Physical Properties of OPC

S.No.	Properties	Experimental	Codal requirement (IS 1489 (Pt-1)-1991)
1	Normal consistency%	27 %	26-33%
2	Initial setting time	95 minute	(Not less than 30 minute)
3	Final setting time	260 minute	(Not more than 600 minute)
4	Fineness Of cement (Le-chatelier expansion)	0.80mm	(Not more than 10 mm)
5	Fineness Of cement (%age retained on 90 micron IS sieve)	5.4%	10%
6	Specific gravity of cement	2.8	3.15

FLY ASH

In the present work the fly ash is obtained from Panipat thermal power plant I (Haryana). The Physical and Chemical Properties of fly ash along with OPC (Ordinary Portland Cement) are given in Table 2.

Table – 2: Physical Properties of fly ash along with OPC

Physical Properties		
	OPC	**Fly Ash**
Specific gravity	2.80	2.30
Mean grain size (µm)	21.5	20
Specific area (cm^2/gm)	3770	2680
Colour	Grey	Grey to black

Table – 3: Chemical Composition (%)of fly ash along with OPC

	OPC	**Fly Ash**
Silicon dioxide (SiO_2)+ Aluminium oxide (Al_2O_3) + Iron Oxide (Fe_2O_3)	-	94.25
Silicon dioxide (SiO_2)	-	60.5
Sulphur trioxide (SO_3)	2.20 (3% max.)	0.2
Reactive Silica (SiO_2)	-	33.4
Chlorides (C_1)	0.011 (0.1% Max.)	0.01
Magnesium oxide (MgO)	2.0 (6% max.)	0.6
Loss on Ignition	1.55 (5% max.)	1.1
Sodium oxide (Na_2O)	-	0.1
Insoluble Residue	22.50	-

WATER

Potable water is used for mixing and curing. The water cement ratio (w/c) of 0.43 has been used.

CONCRETE

The concrete mix design is done in accordance with IS 10262(2009). The cement content used in the mix design is taken as 370 kg/m3 which satisfies minimum requirement of 300 kg./m3 in order to avoid the balling affect. Good stone aggregate and Natural River sand of Zone-Ⅳ were used as coarse and fine aggregate respectively. Size of coarse aggregate was 20mm and 10mm. A sieve analysis conforming to IS 383-1970 was carried out for both the fine and coarse aggregates.

RESULTS AND DISCUSSIONS

The view aspect of cubes after casting shown in Fig.1. The compressive strength of referral concrete at 7, 28 and 56 days are given in Table 4.1. It is evident from this table that the strength increases with the addition of fly ash. Strength increases up to 20% fly ash content and after that it decreases. However increase in strength is more prominent at 20% replacement level. The variation of compressive strength with different percentage of fly ash is shown in fig 1. These figure shows that the compressive strength of concrete with and without as function of curing time. The compressive strength of OPC is 22.8 N/mm^2, 32.3 N/mm^2 and 36.2 N/mm^2, when water/cement ratio is 0.43 at 7, 28 and 56 days respectively.

Fig.1: Casting of mould on vibration machine

Table-3: Compressive strength of fly ash concrete when cement replaced

S.No.	Cube Designation	Compressive strength (N/mm^2)			%age of fly ash
		7 days	28 days	56 days	
1	A1	22.8	32.3	36.2	0
2	A2	23	34.5	39.2	10
3	A3	23.1	34.7	39.4	20
4	A4	17.3	28.3	37.1	30
5	A5	14.2	20.4	28.1	40
6	A6	11.3	18.2	23.6	50

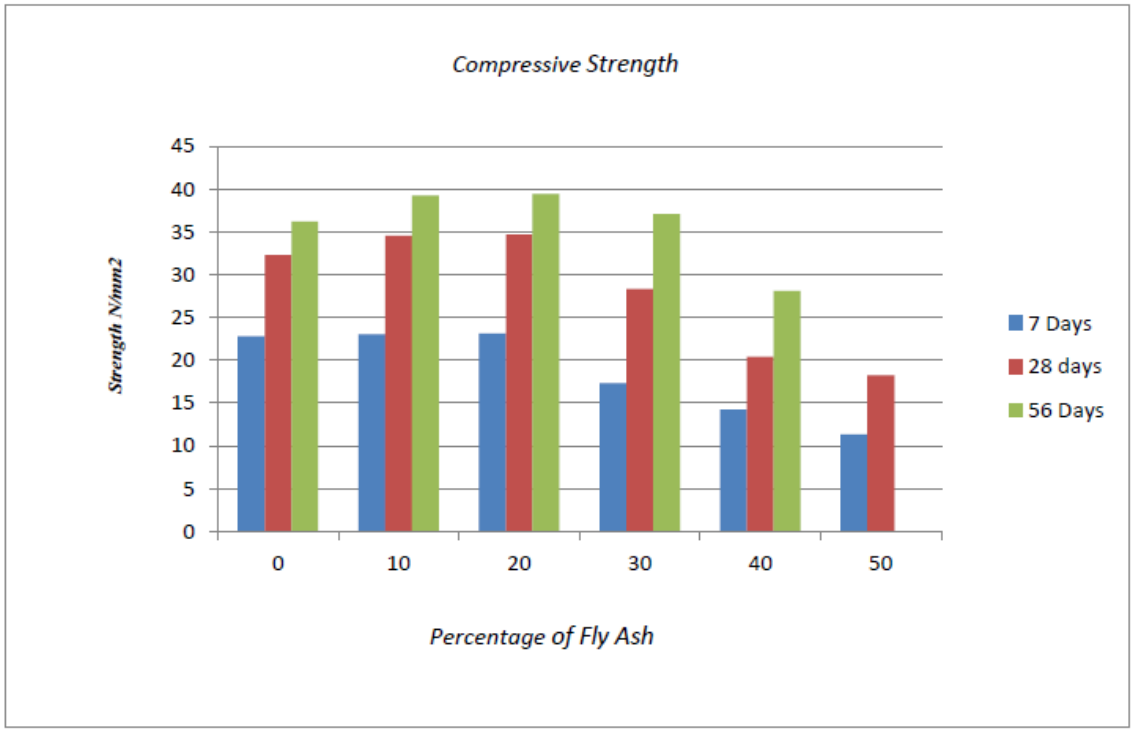

Fig. 2: Compressive strength of Fly Ash Concrete

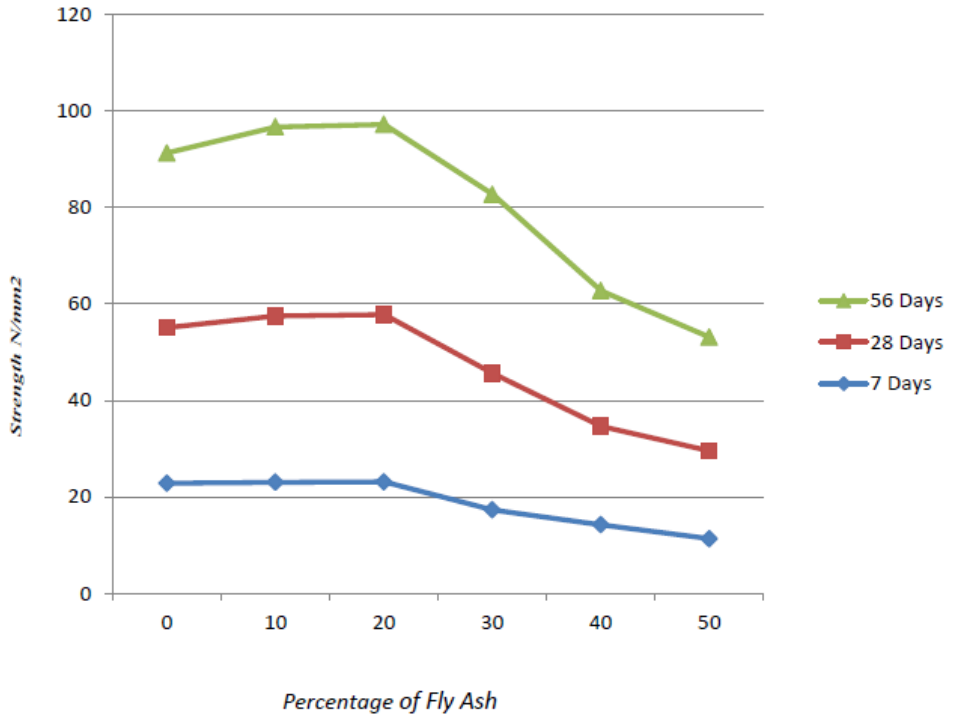

Fig. 3: Compressive Strength of Fly Ash Concrete

CONCLUSIONS

Fly ash increases concrete strength, improves sulfate resistance, decreases permeability, reduces the water ratio required, and improves the workability of the concrete. Partial substitution solid hazardous waste does not strongly affect the strength of concrete and other properties. The compressive strength of referral concrete at 7, 28 and 56 days are given in tables. It is evident from this table that the strength increases with the addition of fly ash. Strength increases continuously increases percentage of fly ash content. The variation of compressive strength with different percentage of fly ash is also shown in figures. The compressive strength of fly ash concrete when fine aggregate partially replaced with fly ash at 50% replacement level increase in strength is 14.55% and 18.78% at 28 and 56 days with the reference of referral concrete cubes.

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