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EXPERIMENTAL STUDIES ON PARTIAL REPLACEMENT OF CEMENT WITH FLY ASH IN CONCRETE

[1]K. KRISHNA SAMHITHA, [2]CH.ARUNA,[3]A. ASHOK KUMAR

[1,2]UG Student, [3] Assistant Professor, Department of Civil Engineering, Sree Vahini Institute of Science & Technology,Tiruvuru,Andhrapradesh ,India

I.ABSTRACT:

Fly ash a waste generated by thermal power plants is as such a big environmental concern. In modern decades, the industrialization and urbanization are the two phenomena that are spreading all over the world. Apart from the requirement of these phenomena, there should also be investigation into their negative impacts on the worldwide environment and common life. The experimental studies on mortar containing fly ash as a partial replacement of sand by weight as well as by volume were carried out to quantify its utilization. The use of fly ash in concrete formulations as a supplementary cementitious material was tested as an alternative to traditional concrete. The cement has been replaced by fly ash accordingly in the range of 0% (without fly ash), 10%, 20%, 30% & 40% by weight of cement for M-40 mix.

Key words: Fly Ash, Compressive Strength, Split Strength, Flyash.

II.INTRODUCTION

In India now a days, the concept of smart city is growing very faster. As the main emphasis is on green and sustainable development. Infrastructure is the basic arm and smart material is essential to achieve that feat properly. Smart material is a one which gives better results in low economy. These industrial wastes are dumped in the nearby land and the natural fertility of the soil is spoiled. Fly ash is the finely divided mineral residue resulting from the combustion of ground or powdered coal in electric power generating thermal plant. Fly ash is a beneficial mineral admixture for concrete. Fly ash is a by-product produced from the combustion of coal in an electrical generation station. According to Design and Control of Concrete Mixtures (2010). Fly ash is a natural pozzolan, which means that it is a "siliceous or siliceous-and-aluminous material" which chemically reacts with calcium hydroxide (CH) to form composites having cementitious properties It influences many properties of concrete in both fresh and hardened state. Cement Industry is major in contributor in the emission of CO2 as well as using up high levels of energy resources in the production of cement. By replacing cement with a material of pozzolanic characteristic, such as the fly ash, the cement and the concrete industry together can meet the growing demand in the construction industry as well as help in reducing the environmental pollution. In general mortar is a mixture of cement, fine aggregate and water, in which, coarse aggregate is avoided. Although it is possible to obtain advantages of using fly ash in mortar as in concrete, limited

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research has been done in fly ash mortars. In the present experimental investigation, the fly ash has been used to study the effect on compressive and split strength onM40 grades of concrete.

FLY ASH

Fly ash is composed of the non-combustible mineral portion of coal. Fly ash is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. In some cases, such as the burning of solid waste to create electricity , the fly ash may contain higher levels of contaminants than the bottom ash and mixing the fly and bottom ash together brings the proportional levels of contaminants within the range to qualify as non-hazardous waste in a given state, whereas, unmixed, the fly ash would be within the range to qualify as hazardous waste.

Cement: Ordinary Portland cement (Ultra-Tech Cements of 53 grades) was used having specific gravity: 3.15, 32.5% Consistency and Compressive strength 54 MPa

Sr. No	Physical Properties of Cement	Result	Requirement as Per Is:8112-1989
1	Specific Gravity	3.13	3.10-3.15
2	Standard Consistency (%)	27%	30-35
3	Initial Setting Time (Hours, Min)	37 Min	30 Minimum
4	Final Setting Time (Hours, Min)	185 Min	600 Maximum
5	Compressive Strength-7 Days	38.70 N/Mm^2	43 N/Mm^2
6	Compressive Strength -28 Days	52.90 N/Mm^2	53 N/Mm^2

FINE AGGREGATES

Sand shall be obtained from a reliable supplier and shall comply with ASTM standard C 33 for Fine aggregates. It should be clean, hard, strong and free of organic impurities and deleterious substances. It should be inert with respect to other materials used and of suitable type with regard to strength, density, shrinkage and durability of mortar made with it. Grading of the sand is to be such that a mortar of specified proportions is produced with a uniform distribution of the aggregate, which will have a density and good workability and which will work into position without segregation and without use of high-water content.

- Specific Gravity of fine aggregate is 2.66
- Fully compacted density of fine aggregate is 1670 kg/m3
- Partially compacted density of fine aggregate is 1500 kg/m3
- Fineness Modulus of Fine Aggregate is 3.2

Property	Fine Aggregate
Fineness Modulus	3.32
Specific Gravity	2.35
Water Absorption (%)	1.22
Bulk Density (Gm/Cc)	1750

Properties of fine Aggregates

COARSE AGGREGATES

Machine Crushed granite aggregate confirming to IS 383- 1970 consisting 20 mm maximum size of aggregate has been obtained from the local quarry. It has been tested for Physical and Mechanical Properties such as Specific Gravity, Sieve Analysis, Density values and the results are as follows.

- Specific Gravity coarse aggregate is 2.61

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- Fully compacted density of coarse aggregate is 1690kg/m3
- Partially compacted density of coarse aggregate is 1466kg/m3
- Fineness Modulus of Coarse Aggregate 9.09

Property	Coarse Aggregate	
	20 Mm	10 Mm
Fineness Modulus	7.52	3.15
Specific Gravity	2.70	2.75
Water Absorption (%)	1.88	1.33
Bulk Density (Gm/Cc)	1745	1714

Properties of coarse Aggregates

Water: Drinking water from VELS UNIVERSITY was used for the preparation of concrete. The water samples are potable and of uniform quality.PH value should be less than 7. Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement.

III. DESIGN MIX METHODOLOGY

Design Mix

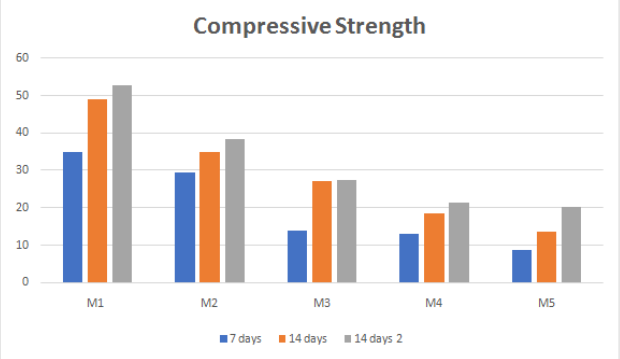
A mixM40 grade was designed as per IS 10262:2009 and the same was used to prepare the test samples.

MIX NAMES	PROPORTIONS
M1	0% FlyAsh + 100% Cement
M2	10% FlyAsh + 90% Cement
M3	20% FlyAsh + 80% Cement
M4	30% FlyAsh + 70% Cement
M5	40% FlyAsh + 60% Cement

IV. RESULTS

Compressive Strength

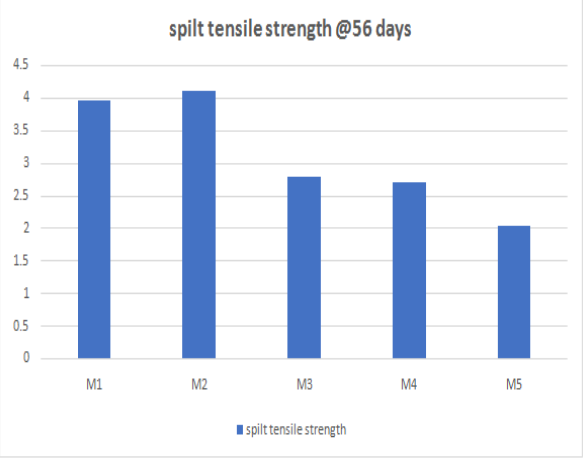
Concrete proportions	Average ultimate compressive strength at		
	7 days (N/mm²)	14 days (N/mm²)	14 days (N/mm²)
0% FlyAsh + 100% Cement	34.85	49.09	52.71
10% FlyAsh + 90% Cement	29.35	34.95	38.26
20% FlyAsh + 80% Cement	13.75	27.22	27.53
30% FlyAsh + 70% Cement	13.05	18.32	21.46
40% FlyAsh + 60% Cement	8.60	13.50	20.10



Split Tensile Strength

Concrete proportions	spilt strength @56 days N/MM²
0% FlyAsh + 100% Cement	3.96
10% FlyAsh + 90% Cement	4.10
20% FlyAsh + 80% Cement	2.78
30% FlyAsh + 70% Cement	2.69
40% FlyAsh + 60% Cement	2.04

Table 2 Split Strength



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V. CONCLUSIONS

Based on limited experimental investigation concerning the compressive & split strength of concrete, the following conclusions are drawn:

- Compressive strength reduces when cement replaced fly ash. As fly ash percentage

increases compressive strength and split strength decreases.

- Use of fly ash in concrete can save the coal & thermal industry disposal costs and

produce a „greener concrete for construction.

- The cost analysis indicates that percent cement reduction decreases cost of concrete,

but at the same time strength also decreases.

- This research concludes that fly ash can be innovative supplementary cementitious

Construction Material but judicious decisions are to be taken by engineers.

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