An Experimental Study of Mechanical Properties of Concrete with Partial Replacement of Cement by Flyash

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Abstract- *Concrete is a composite material made from the cement, water, fine aggregate and coarse aggregate. The main aim of this project deals with partial replacement of cement with waste flyash powder. The properties of fly ash and cement are nearly same, that's why we prefer the fly- ash as partial replacement of cement and also object of decreasing the cost of construction. Fly ash is used as the replacement of concrete ingredients to decrease the cost of disposal. This project deals with an experimental study on the properties and on the durability of concrete containing flyash wastes. Five concrete mixes, i.e. A control mix, and a 10%, 20%, 30% mix of ceramic waste as cement replacement for concrete were prepared with a mix design by calculating the weight of cement, sand and aggregate. The experimental study examines the compressive strength, slump cone test, flexural strength. The main ingredients consist of Portland cement , flyash, river sand, coarse aggregate and water.*

The present study is aimed at utilizing flyash as cement replacing and also the compressive strength of the water cured specimens is measured on the 3, 7, 14, 28 days using M20 concrete mix. We compared mechanical properties and durability properties those of concrete made with natural cement.

Keywords- Cement, Concrete, FlyAsh, Compressive strength, Slump Cone Test, Flexural Strength.

I. INTRODUCTION

Every year millions of tones of ash are generated from thermal power plants. In addition to this a large quantity of agriculture waste like rice husk ash, flyash is also produced. The problem gets compounded with million tones of waste being generated world wide inform of demolished waste from natural and technological disasters. There is a growing concern to limit the amount of waste by recycling which will provide opportunities for saving energy, time and resources.

The utilization of by-products in the production of concrete has gained considerable interest among concrete technologists in the recent years. Mineral admixtures like flyash are the most common type of by-product. That are usually incorporated into concrete mixes to produce concrete with exception properties. The conventional concrete used cement, fine aggregate, coarse aggregate and water. The cost of the convention materials like cement is increasing spirally, hence they can be reduced flyash, which is industrial wastes available at low cost. As not much of literature is available for this aspect of utilization, the trail and error procedure has been adopted for selection of water cement ratio.

NEED FOR STUDY:

The present study is taken up aim to utilize more flyash as replacement in cement. This procedure uses more flyash than it is utilized in cement only, as replacement on which aspect maximum literature is available. Hence there is a need for this study to find the optimum percentage of flyash.

Currently, there has been an attempt to utilize the large amount of flyash, the residue from an in-line sugar industry and the bagasse-biomass fuel in electric generation industry. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement.

II. LITERATURE REVIEW

Fly ash

Alvin Harison et.al (2014) The following conclusions were made based on the findings of the study: Compressive strength of fly ash concrete up to 30% replacement level is more or equal to referral concrete at 28 and 56 days. Optimum replacement level of fly ash is 20%. It was observed that at 28 and 56 days in 20% replacement of PPC by fly ash, the strength marginally increased from 1.9% to 3.28%. It was also observed that up to 30% replacement of PPC by fly ash, the

strength is almost equal to referral concrete at 56 days. PPC gains strength after the 56 days curing because of slow hydration process.

C.Marthong et.al (2010) Normal consistency increases with increase in the grade of cement and fly ash content. Setting time and soundness decreases with the increase in grade of cement. Use of fly ash improves the workability of concrete and workability increases with the decreases in the grade of cement. Bleeding in fly ash concrete is significantly reduced and other properties like cohesiveness, pumping characteristics and surface finish are improved. Compressive strength of concrete increases with grade of cement. As the fly ash contents increases in all grades of OPC there is reduction in the strength of concrete. This is expected, as the secondary hydration due to pozzolanic action is slower at initial stage for fly ash concrete. The reduction is more at earlier ages as compared to later ages. The rate of strength gain of concrete with age is almost similar in all the three grades OPC. Concrete with 20% fly ash content closer to that of ordinary concrete at the age of 90 days. In all grades OPC, fly ash concrete is more durable as compared to OPC concrete and fly ash upto 40% replacement increase with grade of cement.

Mineral admixtures such as flyash are being extensively used in concrete for reasons of strength, durability and economy. They are used in the form of blended cements or as additives, in concrete. Fly ash is a finely divided waste product obtained from the combustion of pulverized coal may be a less preferred admixtures for high performance concrete in situations where early strength requirements is one of the important parameters as its rate of hydration and hence the rate of strength gain is rather very slow.

fly ash concretes (FAC), 7 days strengths were lower than that of cement concretes (CC) for water cement ratio of 0.32 and 0.40 but at water cement ratio of 0.50, FAC had higher strength, however at 28 and 56 days. FAC had stronger than the cement concretes, for lower water cement ratio of 0.32 and 0.40 Fly ash particles size varies between 0.06-1mm. The strength differences between FAC and CC were in the range of 6.10% to 9%. In case of SFC and CC, the difference where always positive and ranged from 16.50 to 53.5%. the above points are suggested by J.K.Dattatreya, M.Neelamegam, N.Prajamane.

Fly ash is one such cement replacing pozzalanic material. The positive effect of using fly ash in concrete is now well known and includes the following.

- Preservation of limestone and coat reserves
- Minimizing green house gas emissions associated with manufacturing of ordinary Portland Cement
- Environment friendly and economical disposal of millions of tones of Fly ash.
- Saving in energy requirements disposal in the production of Ordinary Portland Cement.
- Producing Concrete of better theology, higher strength and enhanced durability.
- Considering the above beneficial effects of using fly ash in concrete, this should be considered as resource material rather than industrial waste.
- Projected availability of fly ash in India ex expected to reach 200 Million Tones in the year 2010.
- Use of fly ash in structural concrete is acceptable as per IS :456

Prabir C.Basu and Subhjit S Sarswathi suggests the above points.

III. METHODOLOGY

Procurement of Materials

The Materials used for the study are:

- Cement
- Fine Aggregate
- Coarse Aggregate
- Fly ash

Cement

Cement is a material that has cohesive and adhesive properties in the presence of water. such cements are called hydraulic cements. these consist primarily of silicates and aluminates of lime obtained from lime stone and clay.

Fly ash

In the present experimental investigation ‘Class F’ Fly ash obtained from a Thermal Power Plant is used. Cement is replaced by 10%, 20% and 30% of fly ash by weight of cement.

IV. RESULTS AND DISCUSSION

The compressive strength test is conducted on concrete specimens on 7^{th}, 28^{th} day results are given.

Test Results:

0% Fly Ash (Cement Concrete)

1.	Identification Mark	:	CC
2.	Dimension of Specimen	:	150 mm x 150 mm
3.	Cross Sectional Area	:	22500 mm²
4.	Compressive Strengths	:	
	@ 7 Days	:	21.72 N/mm²
	@ 28 Days	:	33.36 N/mm²

10% Fly Ash (FCC-1)

1.	Identification Mark	:	FCC-1
2.	Dimension of Specimen	:	150 mm x 150 mm
3.	Cross Sectional Area	:	22500 mm²
4.	Compressive Strengths	:	
	@ 7 Days	:	20.86 N/mm²
	@ 28 Days	:	31.98 N/mm²

20% Fly Ash (FCC-1)

1.	Identification Mark	:	FCC-2
2.	Dimension of Specimen	:	150 mm x 150 mm
3.	Cross Sectional Area	:	22500 mm²
4.	Compressive Strengths	:	
	@ 7 Days	:	18.23 N/mm²
	@ 28 Days	:	25.88 N/mm²

30% Fly Ash (FCC-1)

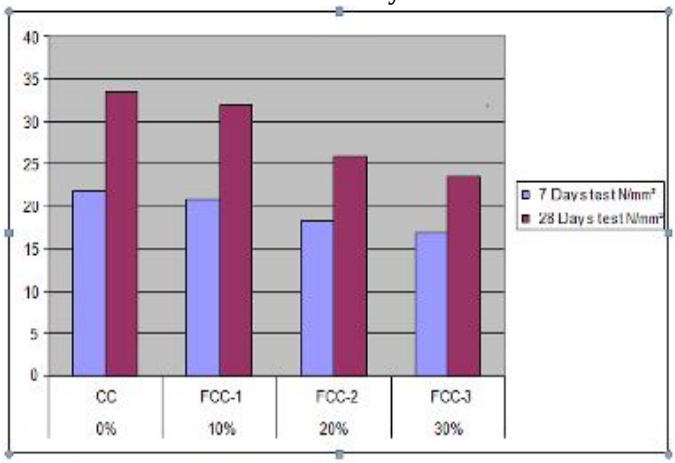
1.	Identification Mark	:	FCC-3
2.	Dimension of Specimen	:	150 mm x 150 mm
3.	Cross Sectional Area	:	22500 mm²
4.	Compressive Strengths	:	
	@ 7 Days	:	16.83 N/mm²
	@ 28 Days	:	23.50 N/mm²

Compressive Strength of Cubes with Addition of Fly Ash

% Addition of Fly Ash	Identification Mark	7 Days test N/mm²	28 Days test N/mm²
0%	CC	21.72	33.36
10%	FCC-1	20.86	31.98
20%	FCC-2	18.23	25.88
30%	FCC-3	16.83	23.50

Mix	**Constituents**
CC	Cement +Fine Agg.+ Coarse Agg.
FCC-1	(0.90% Cement +0.10% Fly Ash)
FCC-2	(0.80% Cement +0.20% Fly Ash)
FCC-3	(0.70% Cement +0.30% Fly Ash)

Variation of Compressive Strength to Conventional Concrete with Fly ash



FCC: Flyash Conventional Concrete

CC: Conventional Concrete

V. CONCLUSION

From the above investigations, it is observed that structural properties like Compressive Strength, workability of concrete with the replacement of cement by S Flyash which are close to the strength of conventional concrete. Test results indicate that the strength results of conventional mix close to the strength of concrete which is replace by 10% and 20% Flyash can be replaced in cement which gives results equal to the normal concrete but repiaced by flyash 30% gradually decreasing the values. The utilization of by-products in the production of concrete has gained considerable interest among concrete technologists in the recent years. Mineral admixtures

like flyash are the most common type of by-product. The cost of the conventional materials like cement is increasing gradually, by the economical consideration, sugar cane bagasse ash and Fly- ash which are industrial wastes available at low cost. A proper mix design and use of plasticizers can further improve the acceptable quality of cement concrete for construction. When compared to the other waste materials it is very economical.

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