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Comparative Study of Compressive Strength of Concrete with Fly Ash Replacement by Cement

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Abstract - *Fly Ash is residue material Produced by thermal power plants is such a big environmental threat. The investigation report in this paper is carried out to study the utilization of fly ash in cement concrete as a ingredient of cement as well as an additive so as to provide an environmentally consistent way of its disposal and reuse. Cement in concrete mix design is replaced by fly ash as 0%, 10% 20% 30% ,40% 50% and maximum strength in 30% for replacement of cement. It is stimulated that replacement of cement in any proportions earlier higher the compressive strength of concrete and later lower the compressive strength as well as slow its hardening. And also increase the workability and setting time of concrete.*

***Key Words*: *M-30 Concrete, Fly Ash Cement, Water, Compressive strength test*.**

1. INTRODUCTION

Fly ash is one of the naturally occurring from combustion of coal & emission of volcanic ash. In hi-tech electric plant when coal burned at high temperature near 2800°F noncombustible minerals occur from burning coal from bottom ash which is classified as fly Ash. Fly Ash is the material that is carried off with flue gases, where it is collected by electric precipitator, on the method of burning the fly Ash Residue varies[1][2][3][4].

Fly Ash: This kind of ash is extracted from flue gases through Electrostatic Precipitator in dry form. This ash is fine material & possesses good pozzolanic property.

Bottom Ash: This kind of ash is collected in the bottom of boiler furnace. It is comparatively coarse material and contains higher un burnt carbon. It possesses zero or little pozzolanic property.

Pond Ash: When fly ash and bottom ash or both mixed together in any proportion with the large quantity of water to make it in slurry form and deposited in ponds where in water gets drained away. The deposited as his called as pond ash.

Mound Ash: Fly ash and bottom ash or both mixed in any proportion and deposited in dry form in the shape of a mound is termed as mound Ash [5][6][7][8].

1.1 Chemical Properties

It is spherical in shape and solid in state, ranges in size from 0.5µm-300µ. The major constituents of fly ash are silica (SiO_2), Alumina (Al_2O_3), Ferric Oxide (Fe_2O_3) and Calcium Oxide (CaO). The other minor constituents of fly ash are MgO Na_2O, K_2O, SO_3, MnO, TiO_2, and unburnt Carbon. The variation in the principal constituents is about Silica (25-60%), Alumina (10-30%) and Ferric Oxide (5-25%).When the sum of these three principal constituents is 70% or more if calcium oxide is less than 10% -Technically the fly ash is considered As **siliceous fly Ash** or class F fly ash. Such type of fly ash is produced by burning of anthracite or bituminous coal having pozzolanic properties. If some of these constituents is more than 50% and reactive calcium oxide is not less than 10% , fly ash will be considered as calcareous fly ash also called Class C fly Ash. This type of fly Ash is produced by burning of ignite or sub-bituminous coal and possess both pozzolanic and hydraulic properties [9][10].

1.2 Physical Properties

Fly ash particles are generally glassy Solid or hollow and spherical in shape. The hollow spherical particles called as cenospheres . The fineness of individual fly ash particle range from 1 micron to 1 mm size. The fineness of fly Ash particles has a significant influence on its performance in cement concrete[11].

The fineness of particles is measured by specific surface area of fly ash by Blaine's specific area technic .Greater the surface area more the fineness of fly ash. The specific gravity of fly ash varies over a wide range of 1.9 to 2.55[12][13].

1.3 Pozzolanic Properties

Fly Ash is a pozzolanic material which is defined as siliceous or siliceous and aluminous material which in itself possesses little or no cementitious value, chemically react with Calcium Hydroxide (lime) in presence of water at ordinary temperature and form soluble compound comprises cementitious property similar to cement.

The pozzolana term came from Roman. About 2,000 years ago, Roman used volcanic ash along with lime and sand to produce mortars, which possesses superior strength characteristics & resistances to corrosive water. The best variety of this volcanic ash was obtained from the locality of pozzoli and thus the volcanic ash had acquired the name of Pozzolana. In section I introduction part is expalianed.In section II methodology to solve the various problems in section III literature reviews by various author's. In section IV Experimental Investigation is explained. In last section conclusion of paper is explained[14][15][16][17].

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2. METHEDOLOGY

In the present study, M25 grade with design mix as per IS 10262:2009 was used.Compressive Strength,Z =fck+1.65s 30+1.65x5=38.25N/mm
Following materials were used in experimental work:

Cement: Ordinary Portland cement (make Ultratech 53 Grade having specific gravity 3.15, consistency 32.5% and compressive strength 54 Mpa).

Fly Ash: Class C type is used for replacement of Cement obtained from NTPC thermal power plant Badarpur.

Fine Aggregate: Natural Sand Zone (II) with maximum size of 4.75mm was used with specific gravity 2.6 and fineness modulus 2.63.

Coarse Aggregate: Natural Aggregates with maximum size of 20 mm were used with specific gravity 2.7 and fineness modulus 7.1.

Water: Drinking water from Al– Falah University campus used for preparation of Concrete. The water Sample was soft and having less TDS with uniform quality.M-30 concrete mix design is used for experimental work as per IS –10262-1982.Mix Design for concrete was made considering the properties of constituents of concrete .Different concrete mixes with varying fly ash content percentage were produced. Replacing 0 (ideal Concrete),10%,20%,30%,40% and 50% in terms of weight. Cubic specimen of 150 mm size were casted for Compressive strength test. The cubes were casted in mould and wet cured at standard temperature until the test started.

3. LITREATURE REVIEW

Tarun Sama [2014][1]:- This paper effect of strength of concrete by partial replacement of cement with fly Ash and addition of Steel Fiber**.**
After the addition of fly ash there was slightly increment in compressive strength of concrete.Specimen sample is eco-friendly and cost effective.

Alvin Harrison [2014][2] :- This paper presents Effect of Fly Ash on Compressive Strength of Portland Pozzolona Cement Concrete.
Compressive strength of of concrete 30% replacement by cement give the stimulated result as on the days of 28 days and 56 days concrete strength.

Prince Arul raj [2011][3] :-In this paper the workability and compressive strength of concrete with Nano fly Ash were determined and the results were compared with that of Normal Cement Concrete .
Specimen with Nano fly ash was found more stronger than normal cement concrete and the average rate of increase of strength is 30% within range of 15-46 N/mm^2.

Rama Mohan Rao [2010][4] :- In this investigation the inclusion of fly ash in glass fiber reinforced concrete reduces the environmental pollution and improves the workability and durability properties of concrete.
In the experimental investigation glass fibers in different volume fractions with 25% and 40% replacement of cement by fly ash has been used to study the effect on compressive strength, split tensile strength, flexural strength of concrete. The addition of fibers in the plain concrete will control the cracking due shrinkage and also reduce the bleeding of water.

P. R. Wankhede [2014][5] :- In this paper investigation Effect of Fly Ash and Properties of Concrete the effect of fly ash.
Ultimate compressive strength of concrete goes on decreasing with increase in w/c ratio of concrete.
Slump loss of concrete goes on increasing with increase of quantity of fly ash.
Concrete with 20% and 30% replacement of cement with fly ash shows good compressive strength for 28 days than normal concrete for 0.35 w/c ratio.

Abhishek Jain [2013][6] :- In this paper investigated use of fly ash as partial replacement of sand in cement mortar

Syed Afzal Basha [2014][7] :- In this paper Compressive Strength of Fly Ash Based Cement Concrete an attempt is made for assessment of compressive strength of Fly ash cement concrete.
Concrete mixes M25, M30, are designed as per the Indian standard code (IS-10262-82) by adding, 0%, 10%, 20%, 30% and 40% of fly ash.

It is found that there is a decrease in compressive strength for M25 and M30 grade concrete with increase in the percentage of fly ash[18][19][20][21][22].

4. EXPERIMENTAL INVESTIGATION

The Experimental investigation was done for comparative study of compressive strength of concrete mix with addition of fly ash and stone dust. Here 36 cubes were prepared for test , fly ash is added in place of cement in concrete in 5 different mode ranging from 0% to 50% at an interval of 10% and the maximum strength is obtained by replacement of cement 30% with fly Ash, the cubes were kept wet by gunny bags for 24 hours after casting of concrete then cured for curing tank at 7 days and 28 days. After that cubes is removed and test under compressive strength test machine. The crushing strength is note down for three consecutive cube.

Table1:- Compressive strength of cement concrete by fly Ash Replacement.

S.No	% of fly Ash	Compressive strength		
		7 days	14 days	28 days
1	0%	26.7	36.7	40.2
2	10%	27.4	38.25	41.9
3	20%	28.3	39.5	43.23
4	30%	30.25	41.4	45.28
5	40%	27.75	37.74	42.00
6	50%	25.5	37.03	39.15

The above result shows that the maximum compressive strength at 30% replacement of cement at 28 days.

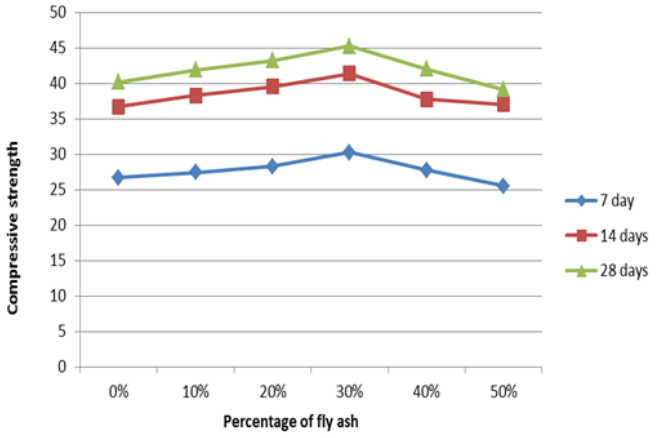

Figure-1: Compressive Strength Graph

The above Indicates the higher value is 45.28 N/mm^2 obtained at the replacement of 30% cement by fly Ash.

5. CONCLUSIONS

The above state results go towards the conclusion that to compare the strength of concrete with conventional waste materials is fruitful. Fly ash and stone dust in concrete mix proved to be very useful to solve environmental problems and up to some extent one can minimize the requirement of cement in large quantity.

Hence it is safe and environmentally consistent method of disposal of fly ash. And it can be find that the power plant are uses the fly ash as replacement of cement .Based on the studies of different literatures from book, journals on application of fly-ash cement concrete .It is being concluded that most of the experiment were based on different material such as, silica flumes ,marble dust ,stone waste, pond ash , sugarcane bagasse in the fly-ash cement It is difficult the find actual proportion and types of fly ash in concrete cubes concrete..

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