Comparative Study of Compressive Strength of Concrete with Fly ash and Ironyte Replacement by Cement

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Abstract- *Fly ash and Ironyte is a waste material generated by thermal power plants and iron plants is as such a big environmental concern. The investigation reported in this paper is carried out to study the utilization of fly ash and Ironyte in cement concrete as a partial replacement of cement as well as an additive so as to provide an environmentally consistent way of its disposal and reuse. cement in concrete mix is replaced fly ash by 0%, 5% 10% 15% ,20% .and maximum strength in 10% for replacement by cement. It is observed that replacement of cement in any proportion lowers the compressive strength of concrete as well as delays its hardening. And Ironyte replacement by cement in 2.5% to 15% and constant fly ash 10%.*

Keywords- Fly ash, Ironyte, Cement, Compressive strength.

I. INTRODUCTION

Fly ash is very much similar to volcanic ashes used in production of the earliest known hydraulic cement about 2,300 years ago. Those cements were made near the small Italian town of Pozzuoli - which later gave its name to the term "pozzolan". A pozzolan is a siliceous or siliceous / aluminous material which when mixed with lime and water forms a cementitious compound. Fly ash is the best known, and one of the most commonly used, pozzolans in the world. Fly ash is the notorious waste product of coal based electricity generating thermal power plants known for its ill effects on agricultural land, surface and sub-surface water pollution, soil and air pollution and diseases to mankind. Researchers have proposed few ways of reusing fly ash for variety of application. One of the most common reuse of fly ash is in cement concrete. Fly ash particles are almost totally spherical in shape, allowing them to flow and blend freely in mixtures. That capability is one of the properties making fly ash a desirable admixture for concrete. These materials greatly improve the durability of concrete through control of high thermal gradients, pore refinement, depletion of cement alkalis, resistance to chloride and sulphate penetration, and continued micro structural development through a long-term hydration and pozzolanic reaction. The utilization of by products as the partial replacement of cement has important economical, environmental and technical benefits such as the reduced amount of waste materials, cleaner environment, reduced energy requirement, durable service performance during service life and cost effective structures. In this experimental

Investigation, an attempt has been made to study the techno-economic analysis for the compressive strength of fly ash concrete. Here, in our work a comparative study of the characteristics compressive strength between Ordinary Portland Cement concrete and Fly ash based concrete has been made. Fly ash is used in various proportions ranging from 0% to 20% by weight of cement in steps of 5%.designed with O.P.C. as well as various proportion of fly ash is estimated and compared. It is observed that fly ash can be safely and economically used. This also provides an environmental friendly method of fly ash disposal.

Ironyte powder is a metallic aggregates-tough ductile specially processed and size graded particles of iron, combined with our exclusive chemical dispersing agent which enables the metallic hardener to move more easily into the surface .cement plaster works on concrete by nature containing innumerable microscopic cells and these cells tend to disintegrated under constant pressure .due to the chemical reaction ironyte powder oxidation of the iron particles causes expansion which results in greater density and strength under traffic and the metal tends between and produce a smoother surface Ironyte powder is usually concrete floors intended to carry heavy rolling loads ,which often withstands bearing two to five times greater than the off ordinary concrete floor .due to compression and impact loads on surface, crushing action takes place. this results in to heavy dusting and subsequently potholes in the concrete floors ,which are great impediment in the smooth and normal function of a factory .the high strength of Ironyte powder topping provides the necessary slips resistance ,when moisture & oils comes in contact with the floor ironyte powder topping is a must to protect employees working under very wet conditions ,for surefooted safety .it can be used effectively in the location like pate forms ,bridge traffic aisles, piers, industrial plants terminals, warehouse etc.

II. MATERIAL

2.1 Cement

The most common cement used is an Ordinary Portland Cement (OPC). The Ordinary Portland Cement of 43 grade conforming to IS:8112-1989 is used. Many tests were conducted on cement; some of them are specific gravity, consistency tests, setting time tests, compressive strengths, etc.

S.N.	Name of test	Details of relevant code	Test result
1	consistency	IS:4031(PART 4)-1998	29%
2	Initial Setting time	IS:4031(PART 5)-1998	35 min
3	Final Setting time	IS:4031(PART 5)-1998	5hr 5min
4	Specific Gravity	IS:4031(PART 11)-1998	3.15
5	Specific Surface	IS:4031(PART 4)-1998	312

2.2 Aggregate

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. One of the most important factors for producing workable concrete is good gradation of aggregates. Good grading implies that a sample fractions of aggregates in required proportion such that the sample contains minimum voids. Samples of the well graded aggregate containing minimum voids require minimum paste to fill up the voids in the aggregates. Minimum paste means less quantity of cement and less water, which is further mean increased economy, lower shrinkage and greater durability.

2.2.1 Coarse Aggregate

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 are used.

2.2.2 Fine aggregate

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed sand is used in combination as fine aggregate conforming to the requirements of IS: 383.

2.3Water

Water is an important ingredient of concrete as it

Actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. Water cement ratio used is 0.40 for M25 concretes.

III. EXPERIMENTAL WORK

3.1 Properties of fly ash:

Various tests were done to find out the physical and chemical properties of fly ash which is illustrated in table 1.

Parameter	Observed Value	Permissible Value as per IS3812-2003
Specific surface area	340-360 m^2/kg	>250m^2/kg
Particle retained on 45micron sieve	28.9%	<35%
Compressive strength at28days	44-48 to 0.018%	<39-43 N/mm^2
Soundness	0.014to 0.018%	<8%
Silica+alumina+ Iron oxide content	88-91%	>70%
Silica	58-60%	35%
Sulfur as SO_3	0.26-0.32%	<0.3%
MgO	0.26-0.34%	<0.5%
Loss on ignition	0.9-1.05%	<1.5%
Available Alkalies as Na_2O	0.16-1.05%	1.5%
Chlorides	0.016-0.02%	0.05%

Properties of ironyte-

Iron	96%
Carbon	4%

3.2 Cement fly ash blends:

The fly ash is blended in cement at a rate of 0 to 20% by weight of cement in steps of 5%. The cement-fly ash blends are then tested for following properties: consistency, setting time, Specific Gravity, specific surface and compressive strength, as per IS 546:2003.

3.3 Concrete Mix Design:

In the present study, M25 grade with design mix as per IS 10262:2009 was used. The concrete mix proportion (cement: fine aggregate: coarse aggregate) is 1: 1.52: 2.98 by

volume and a water cement ratio of 0.43 is taken. The fly ash is blended in cement at a rate of 5 to 20% by weight of cement in steps of 5%.and ironyte mix 2.5to15% by weight of cement in steps of 2.5%.

3.4 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 66 cubes were casted. Fly ash is added in place of cement in concrete in 5 different percentages starting from 0%, and raised the mixing of fly ash up to 20%, at an interval of 5%. And maximum strength in 10% replace by fly ash than 10% fly ash constant and replacement by ironyte in 2.5to 15% 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 compression Testing Machine. The load is applied smoothly and gradually. The crushing loads are noted and average compressive strength for three specimens is determined for each which is given in table 4.1.1 and 4.1.2

IV. RESULTS INTERPRETATION

In this research we show the effect of mineral admixture (fly ash) and ironyte on the properties of concrete, which has been investigated in laboratory and result obtained. So we present it graphically and discussed about it. The study has been carried out by preparing concrete cubes for M25 grade of design mix and tested after 7, and 28 days of curing. Cubes are casted for 0%, 5%, 10% and 15%, 20% replacement of fly ash (mineral admixture) with the weight of cement. And maximum strength in 10% replacement of cement .so we are constant10%fly ash and 2.5%to 15%mix ironyte reduce by weight of cement.

This study performed over design mix of M25 (1:1.52:2.98) grade of concrete only. In this project we used w/c ratio as 0.43 know in slump loss and higher strength of M25 concrete. We casted six cubes for each and cured these for 7and28 days. we get that M25 concrete delivers higher compressive strength in 10% replacement of fly ash and10%ironyte with 0.43 w/c ratio.

4.1 Compressive strength of concrete-

The characteristic compressive strength of various concrete is presented in table no.3.1 and 3.2 and graphical representation of data table no 3.1 and 3.2

Target strenght for mix proportioning

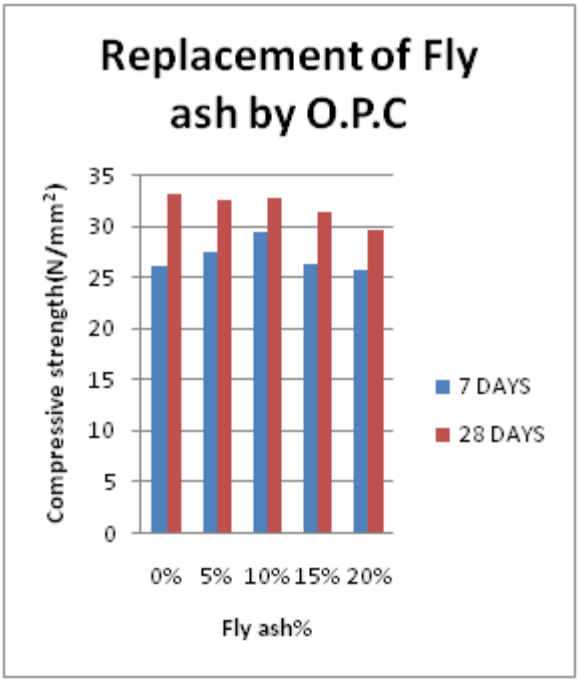
f,ck =fck+1.65s

$25+1.65x4=31.6N/mm^2$

4.1.1 Compressive strength of cement replacement of fly ash (three sample average)

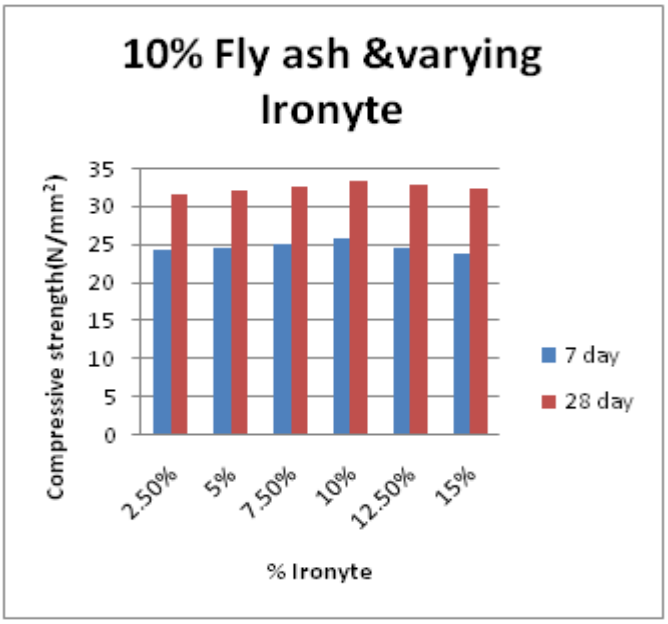
%fly ash	Compressive strength (N/mm^2)	
	7day	28day
0%	25.92	33.11
5%	27.40	32.44
10%	29.40	32.74
15%	26.29	31.2
20%	25.63	29.62

When we are replacement different % of fly ash and we get maximum strength in 10% replacement of fly ash by cement



4.1.2 Compressive strength of cement replacement with fly ash 10% &2.5% to 15%varying ironyte by weight of cement (three sample average)

10% Fly ash &different %of Ironyte	Compressive strength (N/mm²)	
	7day	28day
2.5%	24.14	31.48
5%	24.59	32.07
7.5%	25.11	32.59
10%	25.70	33.25
12.5%	24.44	32.74
15%	23.77	32.29



Then we replaced 10% fly ash & varying % of ironyte by weight of cement and we get maximum compressive strength in 10%ironyte and 10%fly ash.

V. CONCLUSION

This study proves that fly ash and ironyte can be successfully used in the cement concrete in minor amount as an additive. Considering the intangible cost of disposal problem of fly ash & ironyte and hidden cost of environmental protection. Fly ash and Ironyte is actually a solid waste. So, it is priceless. If it can be used for any purpose then it will be good for both environment and economy. Use of this fly ash as a raw material in Portland cement is an effective means for its management and leads to saving of cement and economy consequently. Hence it is a safe and environmentally consistent method of disposal of fly ash. However the rate of strength development is less, Due to lesser rate of strength fly ash finds specific application in mass concreting e. g. dam construction. It can be concluded that power plant waste is extensively used in concrete as a partial replacement for cement and an admixture.

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