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Engineering

CONTRIBUTION OF FLY ASH IN CONVENTIONAL CONCRETE HAVING MEDIUM STRENGTH

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ABSTRACT A fly ash is by product of coal combustion collected by electrostatic precipitator (ESP). Fly ash consist of silicon dioxide, iron oxide, magnesium oxide , aluminum oxide and calcium oxide forms a compound like Portland cement when added with lime and water. High volume of fly ash are used in concrete displacing the cement, its create more strong, durable products and reduces environmental impact. Due to lower water content cracking is reduced.

This research consists of check the workability of the mixture contains fly ash with replacing the cements with different proportion and also check the compressive strength of concrete cube

This study is for exploring the feasibility of using compressive strength of concrete cube using fly ash in mixture of concrete in place of cement by examining its basic properties and durability characteristics fresh properties such as workability and the hardened properties like compressive strength. An widespread literature survey was oriented for exploring the present state of improving durability of concrete.

KEYWORDS : CTM (compressive testing machine),0PC(ordinary Portland cement),PPC(pozzolona portland cement)

I. INTRODUCTION

CONCRETE IS THE MOST WIDELY USED STRUCTURAL MATERIAL IN CONSTRUCTIONS IN THE WORLD. MASSIVE CONCRETING IN HUGE CIVIL PROJECTS LIKE DAMS, POWER PLANTS, BRIDGES AND ETC. USUALLY IS NOT PRACTICABLE AND IT IS NECESSARY TO BE PERFORMED IN SEVERAL LAYERS AND THE COMPRESSIVE STRENGTH OF EACH LAYER SHOULD NOT BE LESS THAN THE SPECIFIED COMPRESSIVE STRENGTH.

II. RELATED WORK

- To determine the contribution of fly ash in conventional concrete having medium strength. Cement will be replaced by fly ash on equal mass basis over a wide range of w/cm ratios and binder contents. Hence at a particular w/cm ratio, the change in concrete properties will be primarily due to fly ash replacements and total binder contents. Since the water contents of the mixtures will vary over a wide range, workability of the mixtures also will vary widely. But the workability will be carefully observed and measured to ensure that all the mixes are workable. To minimize variations in workability, the compaction energy will be varied for obtaining proper compaction.
- Compressive strength is considered as an index to assess the overall quality of concrete. Hence more emphasis has been laid on the determination of compressive strength which has been evaluated at six age levels spanning from 3 to 365 days whereby strength of concretes can be evaluated from the very early ages to the long run. Since the present work has a practical implication and hence to simulate the field conditions long term curing periods will be avoided. Specimens will be cured under water for 28 days and then air cured in the laboratory. The influence of fly ash on compressive strength of concrete, rate of strength development and percentage reduction with respect to control concrete will be studied in detail.

III. LITERATURE REVIEW

- Fattuhi and Hugle (1987) In his presentation stated that different cement pastes and concrete mixes were prepared using ordinary Portland cement and subjected to sulphuric acid attack. The main parameters investigated included w/c ratio (and cement content) and age of the cementitious materials. 102 mm cubes were immersed in a channel containing an approximately 2% solution of continuously flowing sulphuric acid. The changes in weight with time for each cube were determined continuously up to a maximum exposure period of 50 days. The results indicated that the deterioration of the cubes for this high acid concentration decreased with a decrease in the cement content. The effect of age was slightly more significant for cement paste than for concrete cubes.
- Fareed Ahmed Memon et al (2010) in this study concrete cube are made with OPC (Ordinary Portland Cement) and with different configurations of fly-ash by replacing cement and fine aggregate. To achieve the aim of this study, total 81 concrete cubes were cast. Among 81 cubes, 9 cubes were made with normal concrete, 36 cubes were made by replacing 25, 50, 75 and 100% of fine aggregate with fly-ash and 36 cubes were made by replacing 10, 25, 50 and 75% of cement with fly ash. The cubes were 6"X6" in crosssection, and the mix design was aimed for 5000 psi. After proper curing of all 82 cubes, they were tested at 3, 7 and 28 days curing age. The cubes were tested in Forney Universal Testing Machine. The compressive strength of concrete cubes made by replacing 100% fine aggregate by fly-ash was higher than the concrete cubes made with OPC at all 3, 7 and 28 days curing ages. On the other hand, the compressive strength of concrete cubes.
- Murthi p and Siva Kumar v (2008) did detailed experimental investigation on the acid resistance of ternary blended concrete immersed up to 32 weeks in sulphuric acid (H2SO4) and hydrochloric acid (HCl) solutions. The results are compared with those of the control and binary blended concrete. ASTM class F fly-ash was considered to develop the binary blended concrete at the replacement level of cement as 20% by weight. Then silica fume was considered to develop the ternary blended concrete and the replacement of cement in the ternary system by silica fume was suggested as 8% of total powder content by weight. The variable factors considered in this study were concrete grades (M20, M30 and M40) and curing periods (28days and 90 days) of the concrete specimens. The parameter investigated was the time in days taken to cause 10% mass loss and strength deterioration factor of fully immersed concrete specimen in a 5% H_2SO_4 and 5% HCl solutions. The investigation indicated that the ternary blended concrete prepared by 20% fly-ash and 8% silica fume performed better acid resistance than the ordinary plain concrete and binary blended concrete made by replacing 50 and 75% of cement by fly-ash were quite lower than the concrete cubes made with OPC at all curing ages.

IV. MATHODOLOGY AND MATERIALS TESTING

CEMENT- Cement used was 43 grade ordinary Portland cement (manufacturers name Ultra tech) conforming to IS: 8112 – 1989.

AGGREGATES- The size of the aggregate bigger than 4.75 mm is considered as coarse aggregate and aggregate whose size is 4.75 mm and less is considered as fine aggregate.

Although some variation in aggregate properties is expected, characteristics that are considered include Fine aggregate was purchased which satisfied the required properties of fine Aggregate required for experimental work and we used sand in the experimental work conforms to zone IV as Per the specifications of IS 383: 1970. Fine modulus of Sand is 2.4 and Specific gravity is 2.62. The coarse aggregate was crushed granite with size of 4.75 - 19 mm. The specific gravity as well as absorption tests for both coarse and fine aggregate were done respectively. The sieve analysis was done in compliance. Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates. Crushing value of aggregate is 13.35%, Abrasion value is 21.65% and Fine modulus is 6.98.

FLYASH-
Class F Fly Ash:
The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolanic in nature, and contains less than 7% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime mixed with water to react and produce cementitious compounds. Alternatively, adding a chemical activator such as sodium silicate (water glass) to a Class F ash can form a geopolymer.

Class C Fly Ash:m
Fly ash produced from the burning of younger lignite or sub-bituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, Class C fly ash hardens and gets stronger over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike Class F, self cementing Class C fly ash does not require an activator.

Water:
Potable water was used in present investigation as per IS: 456. Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked in to very carefully. Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water was obtained from Department of Civil Engineering, IFTM University for mixing and curing of concrete.

Field testing of cement:
- Open the bag and take a good look at the cement. There should not be any visible lumps. The colour of the cement should normally be greenish grey.
- Thrust your hands into the cement bag. It must give you a cool feeling. There should not be any lump inside.
- Take a pinch of cement and feel between the fingers. It should give a smooth and not a gritty feeling.
- Take a handful of cement and throw it on a bucket full of water, the particles should float for some time before they sink.
- Take about 100gm of cement and a small quantity of water and make a stiff paste. From a stiff paste, pat a cake with sharp edges. Put it on a glass plate and slowly take it under water in a bucket. See that the shape on the cake is not disturbed while taking it down to the bottom of the bucket. After 24 hour the cake should retain its original shape and at the same time it should also set and retain some strength.

The range of applications, the physical/chemical requirements as per Bureau of Indian Standards (BIS) and strength of OPC as discusses in the following sections.

Table.1: Physical characteristics of Portland pozzolana cement:

Type of cement	Fineness m^2/kg(min)	Soundness by	Setting time		Min. Compressive strength (mp)		
		Lecchatelier (%) max.	Initial (min)	Final (min)	3 days	7 days	28 day
43 Grade OPC (IS8112-1989)	225	10	30	600	23	33	43

Table.2: Test performs on Portland pozzolana cement:

S.no.	Test	Value
1	Consistency of cement	33%
2	Initial Setting Time	92 min (30 min. min)
3	Final Setting Time	176 min (600 min. max)
4	Specific Gravity	3.424

Table.3: Material for M25 Concrete 10 Cubes:

Code no	% of Fly Ash	Binding Material		Fine Agg (kg)	Course Agg (Kg)	Water (%)
		Cement (kg)	Fly Ash (kg)			
AK-1	0	22.312	0	22.312	44.624	0.40
AK-2	5	21.197	1.115	22.312	44.624	0.40
AK-3	10	20.081	2.231	22.312	44.624	0.40
AK-4	12.5	19.523	2.789	22.312	44.624	0.40
AK-5	15	18.964	3.346	22.312	44.624	0.40
AK-6	20	17.85	4.462	22.312	44.624	0.40

V. RESULT AND DISCUSSION
Some experiments such as slump-flow and compaction test was performed and result are given below in table

Table4.1:

Mix No	Percentage of Fly Ash	Water Cement Ratio	Slump Test	Compaction Factor Test
Mix 1	0	0.40	0	0.89
Mix 2	5	0.40	2	0.86
Mix 3	10	0.40	4	0.92
Mix 4	12.5	0.40	11	0.94
Mix 5	15	0.40	8	0.85
Mix 6	20	0.40	7	0.87

were as the compaction factor test for mix 1, mix 2 , mix 3 , mix 4 , mix 5 and mix 6 were observed 0.89,0.86,0.92,0.94,0.85 & 0.87 respectively were as the compaction factor test .

Table .4.2: Compressive strength for 7Days curing (0% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm^2)
1	8.300	461.6	20.51
2	8.170	391.5	17.4
3	8.510	594.7	26.43
4	8.610	457.3	20.32
5	8.510	436.7	19.408

Average cube compressive strength = 22.4 N / mm^2

Table .4.3: Compressive strength for 7Days curing (5% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (KN)	Compressive strength (N/mm^2)
1	8.270	508.2	22.58
2	8.230	430.4	19.12
3	8.360	488.7	21.72
4	8.240	391.0	17.37
5	8.560	319.6	14.20

Average cube compressive strength = 21.14 N / mm^2

Table .4.4: Compressive strength for 7Days curing (10% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (KN)	Compressive strength (N/mm^2)
1	8.250	503.9	22.39
2	8.200	448.5	19.93
3	8.310	402.9	17.88
4	8.410	267.5	11.88
5	8.170	393.8	17.50

Average cube compressive strength = 20.06 N / mm^2

Table . 4.5: Compressive strength for 7Days curing (12.5% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm^2)
1	8.170	488.3	21.70
2	8.240	615.8	27.36
3	8.150	441.0	19.6
4	8.360	356.8	15.85
5	8.190	463.6	20.60

Average cub compressive strength = 23.22 N / mm^2

Table .4.6: Compressive strength for 7Days curing (15% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (KN)	Compressive strength (N/mm2)
1	8.430	292.8	13.01
2	7.970	251.1	11.19

3	8.460	271.0	12.04
4	7.900	316.9	14.08
5	7.930	277.6	12.33

Average cube compressive strength = 13.14 N / mm^2

Table .4.7: Compressive strength for 7Days curing (20% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm^2)
1	8.030	318.6	14.16
2	7.990	443.0	19.68
3	7.700	301.5	13.4
4	8.030	433.0	19.24
5	7.990	295.8	13.14

Average cube compressive strength = 17.69 N / mm^2

Table .4.8: Compressive strength for 28Days curing (0% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm2)
1	8.290	608.7	27.05
2	8.440	638.8	28.39
3	8.420	889.5	39.53
4	8.130	687.3	30.54
5	8.250	577.5	25.66

Average cube compressive strength = 17.69 N / mm^2

Table .4.9: Compressive strength for 28Days curing (5% Fly Ash)

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (n/mm2)
1	8.290	671.4	29.84
2	8.330	577.5	25.66
3	8.170	583.6	25.93
4	8.630	811.5	36.06
5	8.610	541.4	34.06

Average cube compressive strength = 17.69 N / mm^2

Table .4.10: Compressive strength for 28Days curing (10% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength in (N/mm2)
1	8.170	680.2	30.23
2	8.360	563.2	25.03
3	8.300	686.4	30.50
4	8.260	753.7	33.49
5	8.600	785.6	34.91

Average cube compressive strength = 32.96 N / mm^2

Table .4.11: Compressive strength for 28Days curing (12.5% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm2)
1	8.130	881.0	39.15
2	8.240	662.1	29.42
3	8.290	866.7	38.34
4	8.260	708.8	31.50
5	8.310	556.8	24.74

Average cube compressive strength = 36.33 N / mm^2

Table .4.12: Compressive strength for 28Days curing (15% Fly Ash):

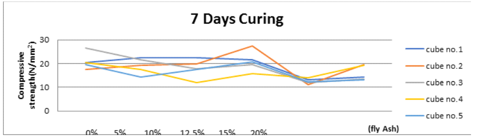
Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm2)
1	8.140	460.2	20.45
2	8.210	415.1	18.44
3	8.040	467.1	20.76
4	8.190	326.2	14.50
5	8.220	548.0	24.35

Average cube compressive strength = 21.85 N / mm^2

Table .4.13: Compressive strength for 28Days curing (20% Fly Ash):

Cube no.	Weight of 1 cube in (kg)	Peak point in (kN)	Compressive strength (N/mm2)
1	8.050	314.2	13.96
2	8.270	327.8	14.56
3	7.930	566.4	25.17
4	8.450	642.4	28.55
5	8.390	338.8	15.05

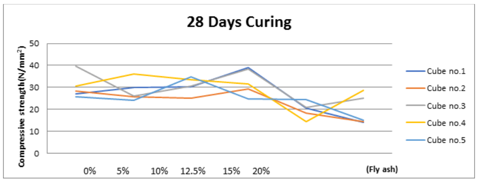
Average cube compressive strength = 22.92 N / mm^2



COMPARATIVE CHART OF CUBE COMPARATIVE STRENGTH AFTER 7 DAYS CURING

Graph.4.13:Avg. Compressive strength 7 days curing:

COMPARATIVE CHART OF CUBE COMPARATIVE STRENGTH AFTER 28 DAYS CURING



Graph.4.14:Avg. Compressive strength 28 days curing

VI. CONCLUSION

1. The compressive strengths of concrete (with 0%, 5%, 10%, 12.5%, 15% and 20%, weight replacement of cement with FA) cured in Normal water for 7 and 28 days have reached the target mean strength.
2. The strength decreases in acidic environment with age of concrete also with increasing of FA content in concrete. In concrete cement can be replaced with 10% FA with maximum increase in strength beyond starts decreases.
3. Due to slow pozzolanic reaction the FA concrete achieves significant improvement in its mechanical properties at later ages.
4. Replacements of cement by fly ash have resulted in considerable variation in the properties of fresh concrete. Incorporation of fly ash in concrete increased the cohesiveness of the mix, prevented segregation and resulted in reduced bleeding. Fly ash concretes have been found to be amiable to compaction than the control mixes. Higher percentages of fly ash can cause a change in color of the mix.
5. From 7 to 28 days the rates of strength development have been found to be similar for control and fly ash concretes. However, up to 7 days control concrete develops strength at a much faster rate than fly ash concrete. The rate of strength development of fly ash concrete is faster than that of control beyond 28 days.

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