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Influence of Source of Fly Ash on Compressive Strength of Concretes

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Abstract: In this paper, research has been carried out pertaining to the influence of source of fly ash on compressive strength of concrete, due to the change in source both physical and chemical properties of fly ash has been carried out. It was found that there was no influence of source on the three fly ashes collected for this investigation. The compressive strength of concretes in which cement was partially replaced with fly ash is presented.

Keywords: Fly ash, properties, workability, Compressive Strength

I. INTRODUCTION

Fly ash has been procured from three different thermal power plants in India. The Fly ash samples collected were tested for their physical and chemical properties to identify the Class of Fly ash as per ASTM. The compressive strength of concretes made with fly ash is compared with the control concrete. The results pertaining to the compressive strength have been shown in table no. 5 & 6.

II. MATERIALS USED

A. Cement

Ordinary Portland cement of 53 grade with specific gravity of 3.15 has been used. The initial setting time and final setting time were found to be 33min and 315min respectively.

B. Fine Aggregate

Locally available natural river sand passing through 4.75 mm I.S. Sieve with a fineness modulus of 2.97, and water absorption of 1.5% in saturated surface dry (SSD) condition was used. The specific gravity of the sand is found to be 2.57 and was confining to ZONE-III.

C. Natural coarse aggregate

Crushed granite metal from local sources, passing through 20 mm and retained on 4.75 mm sieve was used as natural coarse aggregate. The fineness modulus of Natural Coarse Aggregate (NCA) is 6.48 and its water absorption is 0.94% in SSD condition. The specific gravity of coarse aggregate is found to be 2.65.

E. Water

Potable fresh water available from local sources free from deleterious materials was used for mixing and curing of all the mixes tried in this investigation. W/C ratio is taken as 0.47 for M25 and 0.45 for M30 concrete.

F. Fly Ash

The three fly ash samples were procured from three different thermal power plants in India. To identify the influence of source the physical and chemical properties were tested as Bureau of Indian Standards. The physical properties of the

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tested samples of fly ash as per IS 3812-Part 1, 2003 are given in table 1. The chemical properties of the tested samples of fly ash as per IS 3812-Part 1, 2003 are given in table 2. The collected fly ash samples represent the Class F Fly ash as per ASTM classification of fly ashes.

Table: 1 Test results of Physical Properties of collected samples of fly ash tested as per IS:3812 (part-1) -2003

S.No	Particulars	Requirement as per IS:3812 (part-1)-2003	Sample of fly ash - FA1	Sample of fly ash- FA2	Sample of fly ash- FA3
1	Fineness (cm ² /Kg) Blain's permeability method	3200 Minimum	3900	4120	4030
2	Lime Reactivity Average compressive strength, N/mm ²	4.5 Minimum	5.4	4.8	5.2
3	compressive strength at 28 days, N/mm ²	Not less than 80% of the strength of corresponding plain cement mortar cubes	85	90	89
4	Soundness by auto clave (%)	0.8 Maximum	0.10	0.11	0.10
5	Particles retained on 45 micron IS : sieve (wet sieving), (% by mass)	34 Maximum	29	31	32
6	Specific Gravity		2.35	2.48	2.25

(As per Test certificate issued by the source of the Thermal Power Station)

Table: 2 Test results of Chemical Properties of collected samples of fly ash tested as per IS:3812 (part-1) -2003

S.No	Particulars	Requirement as per IS:3812 (part-1)-2003	Sample of fly ash - FA1	Sample of fly ash - FA2	Sample of fly ash- FA3
1	SiO ₂ +Al ₂ O ₃ + Fe ₂ O ₃ , (% by mass)	70 Min.	93.84	94.56	94.67
2	Silicon dioxide (SiO ₂), (% by mass)	35 Min.	61.82	61.90	58.50
3	Magnesium oxide (MgO), (% by mass)	5.0 Max.	0.89	0.48	0.60
4	Total sulphur as Sulphur trioxide (SO ₃), (% by mass)	3.0 Max.	0.26	0.10	0.54
5	Available alkalis as Sodium oxide (Na ₂ O), (% by mass)	1.5 Max.	0.90	0.28	0.30
6	Total chlorides (% by mass)	0.05 Max.	0.016	0.023	0.020
7	Loss on Ignition (% by mass)	5.0 Max.	0.68	0.82	0.76

(As per Test certificate issued by the source of the Thermal Power Station)

Table 3: Concrete Mix Proportions of M25 grade

Mixes	Raw Materials in kg per m ³				
	Cement	Fly ash	Sand Zone-II	Aggregate	w/b ratio
0% FA	340	-	663	1160	0.50
5% FA	323	17	663	1160	0.50
10% FA	306	34	663	1160	0.50
15% FA	289	51	663	1160	0.50
20% FA	272	68	663	1160	0.50
25% FA	255	85	663	1160	0.50
30% FA	238	102	663	1160	0.50
35% FA	221	119	663	1160	0.50
40% FA	204	136	663	1160	0.50

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Table 4: Concrete Mix Proportions of M30 grade

Mixes	Raw Materials in kg per m ³				
	Cement	Fly ash	Sand Zone-II	Aggregate	w/b ratio
0% FA	360	-	654	1178	0.48
5% FA	342	18	654	1178	0.48
10% FA	324	36	654	1178	0.48
15% FA	306	54	654	1178	0.48
20% FA	288	72	654	1178	0.48
25% FA	270	90	654	1178	0.48
30% FA	252	108	654	1178	0.48
35% FA	234	126	654	1178	0.48
40% FA	216	144	654	1178	0.48

III. EXPERIMENTAL DETAILS

The concrete specimens were made with fly ash of different replacement of cement. The compressive strength of two different grades M25 and M30 were casted. The specimens of 150x150x150 mm cubes were used for the Compression test. Three specimens were tested for the required age and mean value were taken and reported. The compressive strength of concrete mixes at 28 days were shown in tables 5 and 6.

Table: 5 Compressive strength of specimens at 28 days made with fly ash obtained from three different power plants of M25 grade of concrete

% of Replacement of cement with fly ash	Compressive strength of specimens at 28 days		
	FA1	FA2	FA3
0	26.57	26.57	27.34
5	26.83	26.72	26.69
10	27.04	26.98	26.00
15	27.32	27.11	25.45
20	27.45	27.34	25.00
25	27.55	27.4	24.12
30	27.77	27.54	23.45
35	25.34	25.22	22.89
40	24.32	23.98	22.12

Table: 6 Compressive strength of specimens at 28 days made with fly ash obtained from three different power plants of M30 grade of concrete

% of Replacement of cement with fly ash	Compressive strength of specimens at 28 days		
	FA1	FA2	FA3
0	32.61	32.61	32.61
5	32.98	32.78	32.68
10	33.18	32.96	32.84
15	33.48	33.22	33.04
20	33.74	33.34	33.22
25	33.98	33.58	33.36
30	34.16	34.08	33.98
35	32.24	32.02	31.98
40	31.98	31.78	31.64

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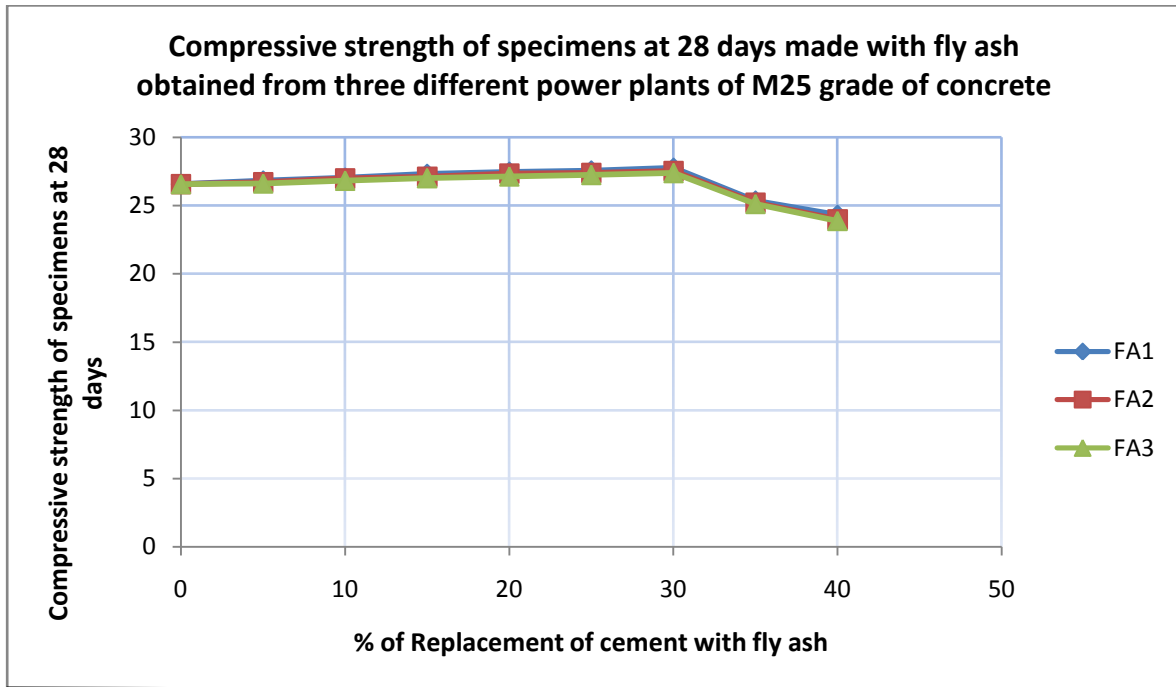


Fig.1. Compressive Strength of specimens made with fly ash obtained from three different power plants of M25 grade of concrete

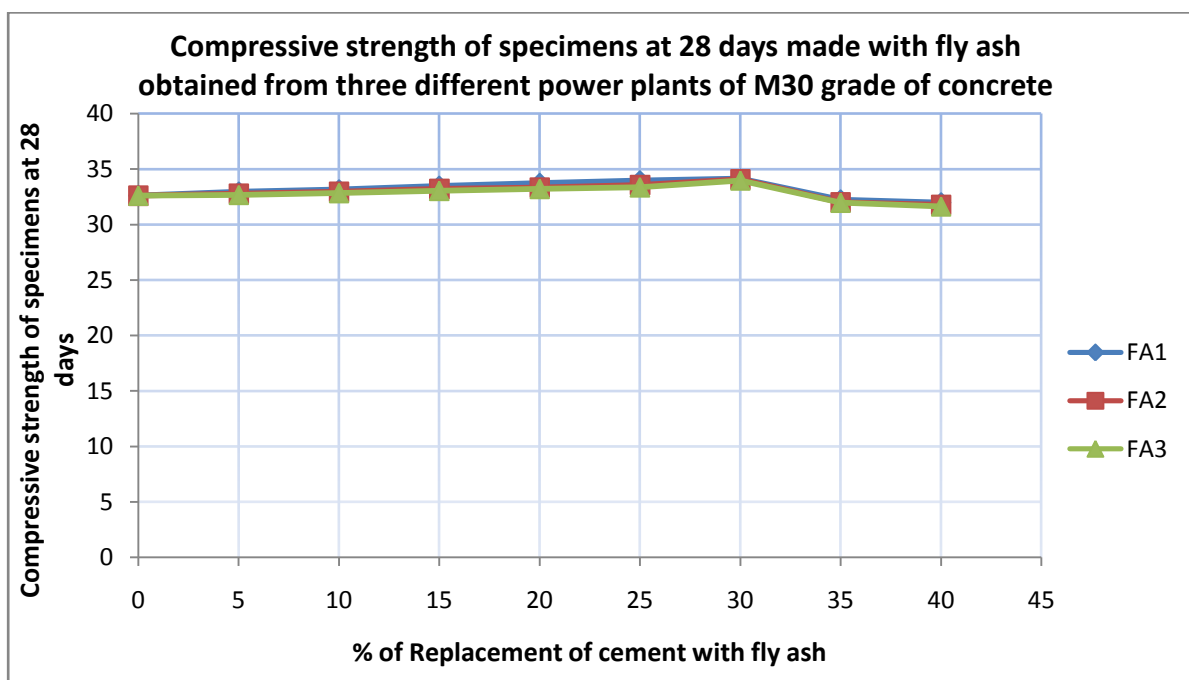


Fig.2. Compressive Strength of specimens made with fly ash obtained from three different power plants of M30 grade of concrete

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IV. CONCLUSIONS

1. The fly ash samples collected were satisfying the requirements of Bureau of Indian Standards in both physical and chemical characteristics.
2. From the above graphs and tables, it was observed that there is not much difference in compressive strengths of concrete mixes made with fly ash obtained from three different sources.

REFERENCES

- 1) IS 3812-1 (2003): Specification for pulverized Fuel Ash, Part 1: For use as pozzolana in cement, cement mortar and concrete
- 2) IS 3812-2 (2003): Specification for pulverized Fuel Ash, Part 2: For use as Admixture in cement mortar and concrete
- 3) IS 10262: 2009 Concrete Mix Proportioning –Guide lines, First Revision, Bureau of Indian Standards, New Delhi, 2009
- 4) Malhotra V.M. and Ramezani pour A.A. "FLY ASH IN CONCRETE". Canada center for mineral and Energy Technology (CANMET), Sep 1994.
- 5) Malhotra V.M., " CANMET Investigations dealing with high-volume fly ash concrete" Advances in Concrete Technology, CANMET Publication MSL 94-1(IR), pp.445-482, 1994.
- 6) Mehta P.K., and Monteiro P. J. M., "Concrete Microstructure, properties and materials", 4th Ed. Prentice Hall, NJ, 2013.
- 7) Shetty.M.S., Concrete Technology (Theory and Practice), S.Chand & Company Ltd., New Delhi, 2012.
- 8) Sivasundaram V., " Evaluation of Indian Fly ashes for use in HVFA concrete, Part II: Behaviour of concrete", The Indian Concrete Journal, November, pp. 41-50, 2011.
- 9) Sivasundaram V., Georges G.Carette, Malhotra V.M., " Mechanical properties, Creep and Resistance to diffusion of Chloride Ions of Concretes Incorporating High Volumes of ASTM Class F fly ashes from seven different sources", ACI Materials Journal, July-August, 407-416., 1991

BIOGRAPHY



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