NOVATEUR PUBLICATIONS
International Journal of Research Publications in Engineering and Technology [IJRPET]
ISSN: 2454-7875
VOLUME 3, ISSUE 7, July-2017

EXPERIMENTAL STUDY ON PROPERTIES OF CONCRETE USING BOTTOM ASH WITH ADDITION OF POLYPROPYLENE FIBRE

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ABSTRACT:

The present research work has been carried out to evaluate the feasibility of utilization of coal bottom ash as fine aggregate in concrete and Polypropylene fibre is additionally used to enhance the strength characteristics of concrete. The concrete mix of M25 grade is prepared for different combinations of 0%, 10%, 20% and 30% of replacement of sand by bottom ash with 0.5%, 1.0%, 1.5% polypropylene fibre by total weight of taken Cube. The durability properties of concrete after 28days of curing age are tested.

KEYWORDS: Bottom ash, Polypropylene fibre, Compressive strength, Split Tensile Strength.

I. INTRODUCTION:

At present-day, the structural industry is afflicted with the paucity of this crucial constituent material of concrete. Hence, in the present scenario, it is essential to find out alternate material for sand to overcome its demand. Coal bottom ash is a coarse rough and fire-resistant by-product from coal burning furnaces. It is poised of mainly silica, alumina and iron with small amounts of calcium, magnesium sulphate, etc. The particle size and appearance of bottom ash is seems to be similar to that of natural river sand and these properties inspired researchers to use bottom ash as the alternative material to the fine aggregate in the production of concrete. Usage of bottom ash will also help us to reduce pollution of environment.

II. OBJECTIVE:

- Effect of combined application of Bottom Ash and Polypropylene on Durability of concrete.
- Comparison of the test results of Conventional Concrete and Bottom Ash concrete.
- Comparison of the test results of Conventional Concrete with combined use of Bottom Ash and Polypropylene concrete preparation.

III. LITERATURE REVIEW:

Cheriaf et al. (1999) revealed that at 28 and 90 days of hydration, quality action file of Coal Bottom Ash with Ordinary Portland bond was 0.88 and 0.97. These qualities are higher than 0.85 at 90 days and 0.75 at 28 days, required by the European standard EN 450. The higher estimations of quality action file show the pozzolanic action of Coal Bottom Ash. They likewise announced that pozzolanic action of Coal Bottom Ash begins at 14 days and utilization of calcium hydroxide was critical following 90 days of hydration. As indicated by European standard EN 450, Coal Bottom Ash debris is a reasonable material to be utilized as a part of cement.

IV.MATERIALS AND ITS PROPER:

A. CEMENT:

Ultratech Ordinary Portland Cement (OPC) of 53 grade of Cement conforming to IS: 12269 standards have been procured and various tests have been carried out according to IS: 8112-1989 from them it is found that

- Specific Gravity of Cement is 3.15
- Initial and Final setting times of Cement are 50min and 480 min respectively
- Fineness of cement is 6.0%

B. FINE AGGREGATE:

The locally available natural river sand is taken and is taken according to IS 383-1970, table 4 confirming to grading zone I. Various tests have been carried out as per the procedure given in IS 383(1970) from them it is found that,

- Specific Gravity of fine aggregate is 2.52
- Fineness Modulus of Fine Aggregate is 3.19

C. COARSE AGGREGATE:

Machine Crushed granite aggregate confirming to IS 383-1970 consisting 20 mm maximum size of aggregates has been obtained from the local quarry. It has been tested for Specific Gravity, Sieve Analysis, and the results are as follows.

- Obtained Specific Gravity of coarse aggregate is 2.7
- Fineness Modulus of Coarse Aggregate is 3.36.

D. BOTTOM ASH:

Bottom ash is part of the non-combustible residue of combustion in a furnace or incinerator. In an industrial context, it usually refers to coal combustion and comprises traces of combustibles embedded in

forming clinkers and sticking to hot side walls of a coal-burning furnace during its operation. The portion of ash that escapes through chimney called fly ash and the clincker that are collected from the bottom hooper and cooled called bottom ash. Coal Bottom Ash was procured from Astrra Chemicals, Mumbai. The properties of Bottom Ash are shown in Table 1.

Table 1 Properties of Bottom Ash

Physical Properties	value
Specific Gravity	2.19
Water Absorption	28.9
Fineness Modulus	1.83

E. POLYPROPYLENE FIBRE:

Polypropylene (PP), also known as polypropene, is a thermoplastic polymer used in a wide variety of applications including packaging and labeling, textiles, stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components, and polymer banknotes. The properties of Polypropylene Fibre are shown in Table 2.

Table 2 Properties of Polypropylene Fibre

S.No	Properties	Value (As per MTC)
1	Specific gravity of fibre	0.9-0.91
2	Length	6mm to 12mm
3	Water absorption	0.3% after 24 hours (The water absorption of polypropylene fibre is about 0.3% after 24 hours immersion in water, and thus its regain – the amount of water absorbed in a humid atmosphere – is virtually nil)

F. WATER:

Water used for casting and curing of concrete test specimens is free from impurities which when present can adversely influence the various properties of concrete.

V. CONCRETE MIX PROPORTION:

Quantities of Ingredients like, cement, fine aggregate, coarse aggregate, bottom ash, polypropylene fibre and water per cum of M20 Grade Concrete are shown in table 3.

Table 3 Quantities of Ingredients per cum of M20 Grade Concrete

Concrete	Cement (kg)	BA (kg)	PPF (kg)	Water (Lit)	FA (kg)	CA (kg)
Control	330	0	0	165	736	1183
BA 10%	330	63.96	0	165	662.4	1183
BA 10%	330	63.96	0	165	662.4	1183
BA 20%	330	127.92	0	165	588.8	1183
BA 30%	330	191.88	0	165	515.2	1183
BA 10% + PF 0.5%	330	63.96	11.24	165	662.4	1183
BA 10% + PF 1.0%	330	63.96	22.48	165	662.4	1183
BA 10% + PF 1.5%	330	63.96	33.72	165	662.4	1183
BA 20% + PF 0.5%	330	127.92	11.24	165	588.8	1183
BA 20% + PF 1.0%	330	127.92	22.48	165	588.8	1183
BA 20% + PF 1.5%	330	127.92	33.72	165	588.8	1183
BA 30% + PF 0.5%	330	191.88	11.24	165	515.2	1183
BA 30% + PF 1.0%	330	191.88	22.48	165	515.2	1183
BA 30% + PF 1.5%	330	191.88	33.72	165	515.2	1183

5.1 TEST SPECIMEN:

Concrete test specimens consist of 150 mm × 150 mm × 150 mm cubes, is tested for its durability criterion for 28 days period.

VI. RESULTS AND ITS DISCUSSIONS:

6.1 DURABILITY:

SULPHATE RESISTANCE:

The concrete specimens were immersed in a 10% solution of magnesium Sulphate after an initial water curing period of 28days. The initial length of specimens was recorded before immersion in magnesium Sulphate solution. The response of bottom ash concrete specimens to external Sulphate attack was almost identical to that of control concrete.

MASS LOSS:

No crack sand spalling was observed in all the concrete specimens during the entire duration of test. Even after 42 days of immersion in 10% magnesium sulphate solution, no loss in mass of all the concrete specimens was observed. However, signs of white deposit were noticed after 42days of immersion period.

Mix Designation	Weight of cubes (Kg)		% Loss in wt.	Comp strength N/mm²		% Loss of Comp Strength
	Before	After 28 days		Before acid attack	After acid attack 28 days	
Control	8.63	8.42	2.43	32.97	30.94	6.16
BA 10%	8.63	8.5	1.51	30.29	28.28	6.63
BA 20%	8.96	8.72	2.68	31.72	29.33	7.53
BA 30%	8.82	8.76	0.68	31.59	28.63	9.36
BA 10% + PF 0.5%	9.2	9.12	0.87	31.98	29.91	6.46
BA 10% + PF 1.0%	8.55	8.45	1.17	32.29	29.48	8.7
BA 10% + PF 1.5%	9.01	8.85	1.78	32.19	29.75	7.56
BA 20% + PF 0.5%	8.8	8.65	1.70	32.71	30.14	7.85
BA 20% + PF 1.0%	9.05	8.79	2.87	34.06	31.22	8.34
BA 20% + PF 1.5%	9.18	9.13	0.54	33.59	30.41	9.46
BA 30% + PF 0.5%	8.72	8.45	3.10	31.90	29.04	8.97
BA 30% + PF 1.0%	8.92	8.74	2.02	32.16	29.09	9.56
BA 30% + PF 1.5%	8.91	8.82	1.01	31.85	28.68	9.94

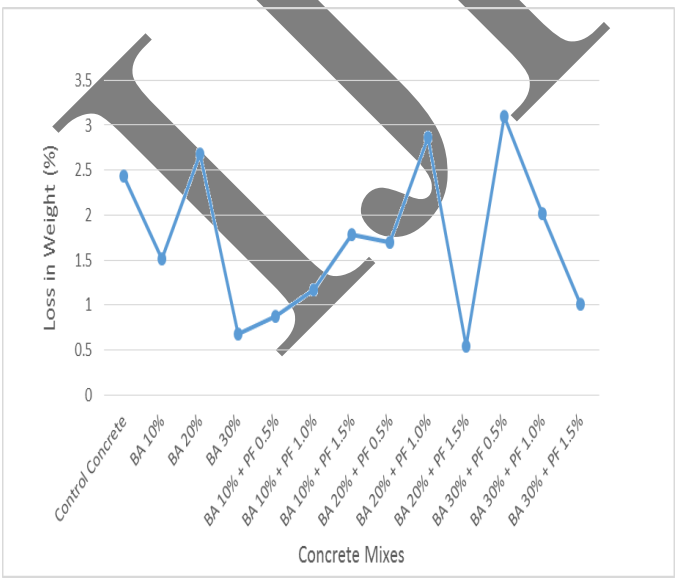

Fig 1 – Comparison of Loss of Weight with various percentages of Bottom Ash and Polypropylene Fibers at 28 days age of concrete

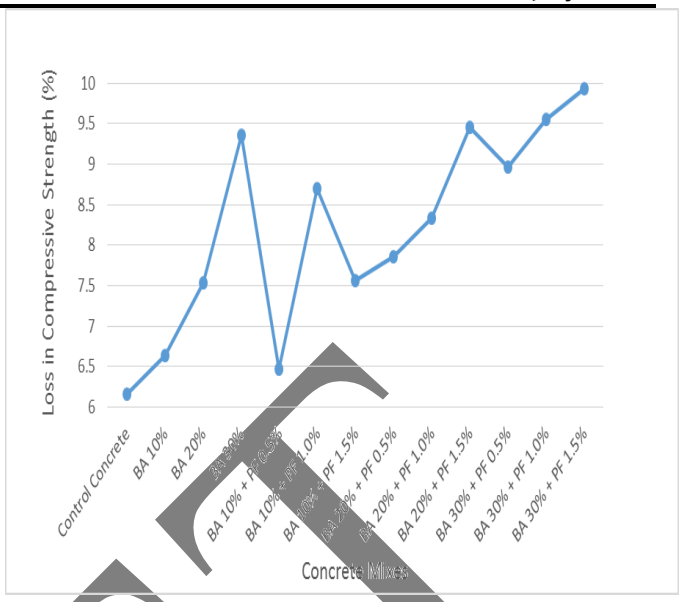

Fig 2 – Comparison of Loss in Compressive Strength with various percentages of Bottom Ash and Polypropylene Fibers at 28 days age of concrete

From the Fig 1 & 2, The Loss of Weight (%) is minimum for Concrete with 20% Bottom Ash and 1.5% Polypropylene Fibre (PF) when compared to other proportions and Control Concrete. It can also be observed that only controlled Concrete has lesser % Loss of Compressive Strength.

VII. CONCLUSIONS

- Bottom ash concrete mixtures experienced very little loss in weight compared to control mix of concrete when exposed to external sulphate attack. Maximum percent loss observed was 3.1%
- After 42 days of immersion in sulfate solution, compressive strength of bottom ash concrete mixtures vary at a maximum percentage of loss 9.94% for higher Bottom Ash and polypropylene combination

VIII.ACKNOWLEDGMENT:

Gratitude to all faculty, staff members of Civil Engineering Department of our institute for helping to complete this work by giving precious suggestions

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