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Effect of Thermal Power Plant Wastes on Compressive Strength of M₂₅ Grade Fibre Reinforced Concrete

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ABSTRACT: The present study aims to utilize of thermal power plant waste as construction materials in concrete, in which the cement and fine aggregates are replaced with thermal power plant wastes like fly ash and bottom ash with a constant percentage of 1% of steel fibres and 0.5% carbon fibres to the relative volume of concrete respectively. In this investigation, concrete of M₂₅ grade is used. Fly ash is partial replaced for cement at 0%, 10%, 20%, 30%, 40%, 50% and bottom ash is partial replaced for fine aggregates at 0%, 10%, 20%, 30%, 40%, 50% with addition 1% of steel and 0.5% of carbon fibres to the relative volume of concrete. The effect of thermal power plant wastes on compressive strength of the steel fibre reinforced concrete (SFRC) and carbon fibre reinforced concrete (CFRC) is studied using a specimen size of 150 X 150 X 150 mm cubes. After 28 days and 56 days of curing, the specimens are dried and tested. The result of SFRC and CFRC is compared with the normal concrete having same water cement ratio (W/C). After obtaining the result the compressive strength is found to be higher compare to conventional concrete. Compressive strength of SFRC and CFRC is increased by a percentage of 6.56 and 5.18 compare to normal concrete for optimum replacement.

KEYWORDS: SFRC, CFRC, W/C, Compressive Strength, Conventional Concrete, Fly ash, Bottom ash.

I. INTRODUCTION

In construction activities concretes is the most commonly used materials. A broad range of environment and social consequences are produced by the cement. Production of cement causes pollution due to gas emissions. Attempts have been done to reduce green house. So by substituting conventional clinkers with industrial by products like fly ash and bottom ash cement industries have taken actions. The major source of energy electrical power from thermal power station. 70% of the energy electricity is being generated by burning fossils fuels. Concrete is the most commonly used material in the construction activities. Out of 70% nearly 61% is produced by coal fired plants. This results nearly 100 tons of produced per year. This ash can be disposed either by dry or wet in a near open area. By grounding both bottom ash and fly ash we can dispose. Or mixing with water we can pump it into artificial lagoon or dumping into yards. Through there is a report that will cause environmental pollution. Due to this reason the experiment research and investigation is on the effect of use of thermal power plant wastes (bottom ash and fly ash) as replacement of fine aggregates and replacement of cement.

II. LITERATURE

P. Aggarwal et.al.,[2007]. This experimental investigations was done to study the effect of use of bottom ash as a replacement of fine aggregates. The strength properties such as compressive strength, flexural strength and split tensile strength were considered for the present study. The study reflected the fact that the strength development for various percentages (0-50%) replacement of fine aggregates with bottom ash can easily be equated to the strength development

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of normal concrete at various stages. Results showed that the compressive strength, flexural strength and split tensile strength of bottom ash concrete continue to increase with age compare to normal concrete.

Saravana Raja Mohan. K. et.al., [2011]. In their study on strength and behaviour of fly ash based steel fibre reinforced concrete composite used a control mixture of proportion of 1:1.49:1.9 with W/C of 0.45 designs. In this cement was replaced with percentages (10%, 15%, 20%, 25% & 30%) and 4 percentages of steel fibres (0.15%, 0.30%, 0.45% & 0.60%) having 20 mm length were used. Results shows that fly ash can serve as a good substitute for cement in reasonable properties by volume and whatever deficiency that may result can be easily overcome by the use of steel fibres. At 15% fly ash with 0.15% of fibres shows increase in strength of 5% to 31% at 7 days and 12% to 55% at 28 days.

G.Murali et.al.[2012]. This experimental study attempted to find the influence of crimped steel fibres concrete at a dosage of 0.8% volume of concrete. The parameters of this study were compressive strength, flexural strength and split tensile strength of conventional concrete and fibre reinforced concrete. In this study M20 mix was used for experimental purpose and tests were done as per code books. The results revealed that the compressive, split tensile and flexural strengths of fibre reinforced by 32.14%, 52.38% and 12.68% respectively when compared to the conventional concrete.

III. PROBLEM DEFINITION

In the present experimental work, the properties of concrete are thoroughly studied for M₂₅ grade with fibres as reinforcing materials. In addition to this some of the industrial wastes (fly ash & bottom ash) obtained from thermal power plant having a little cementitious properties is substituted with cement and fine aggregate respectively. Both fly ash and bottom ash are replaced with cement and sand with following variations of 0%, 10%, 20%, 30%, 40% and 50% by weight of cement and sand respectively. The fibres used for this study is steel and carbon at constant percentage of 1% and 0.5% volume of concrete respectively. Compressive strength of fibre reinforced concrete is studied in this work.

IV. METHODOLOGY

The materials like fibres, fly ash, bottom ash, aggregates and grade of concrete is selected and their characteristics are thoroughly studied. Using these materials, mix design is carried out with suitable w/c ratio for M₂₅ grade concrete with Both fly ash and bottom ash are replaced with cement and sand with following variations of 0%, 10%, 20%, 30%, 40% and 50% by weight of cement and sand respectively. The fibres used for this study are steel and carbon at constant percentage of 1% and 0.5% volume of concrete respectively. The effect of thermal power plant wastes on compressive strength at 28 and 56 days of SFRC and CFRC is determined by using 150X150X150mm blocks in compression testing machine.

V. IMPLEMENTATION

This test is performed to ensure whether the specimens have achieved required target strength and the procedure of testing is done as per IS 516-1959. The ingredients required for the preparation of concrete for each batch were weighed and mixed in a laboratory tilting drum mixer. Water was added into the mixer after the dry mix of materials and then superplasticizer is introduced. The concrete is mixed until a homogeneous and uniform mixture is obtained. The moulds of standard size (150 × 150 × 150) mm were kept ready, they were coated with one layer of oil concrete is filled.

The moulds were kept in a place free from disturbance and after 24 hours the moulds are demoulded and kept under water for curing. The cured specimens are tested at 28 and 56 days with compression-testing machine. The ultimate load at which specimen fails is recorded and compression strength is calculated using the expression,

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$$f_c = P/A$$

Where

f_c = Compressive Strength in N/mm^2

P = Load Causing Failure in N

A = Area of Cross Section in mm^2

VI. RESULTS

Table 1: Compressive Strength of M_{25} of SFRC in N/mm^2

Replacement of FA & BA in % with 1% of Steel Fibres	28 Days Compressive Strength in N/mm^2	56 Days Compressive Strength in N/mm^2
CC (Without fibres)	37.21	39.11
0% (With fibres)	38.33	39.55
10%	39.54	39.95
20%	39.01	41.69
30%	35.55	38.40
40%	32.00	32.88
50%	28.88	29.77

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Table 2: Compressive Strength of M₂₅ of CFRC in N/mm²

Replacement of FA & BA in % with 0.5 % of Carbon Fibres	28 Days Compressive Strength in N/mm ²	56 Days Compressive Strength in N/mm ²
CC (Without fibres)	38.22	39.11
0%(With fibres)	38.53	39.57
10%	38.87	39.71
20%	39.25	39.91
30%	38.25	41.10
40%	31.55	32.00
50%	27.11	28.44

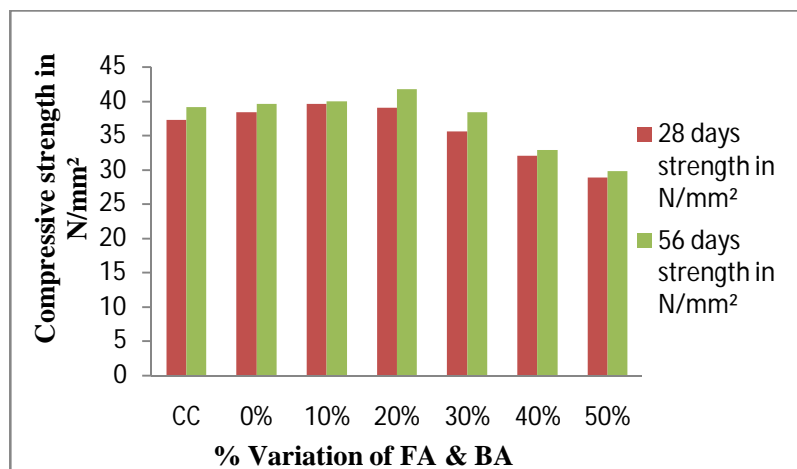


Fig.1 Compressive Strength Variations with % Variation of FA & BA of SFRC in N/mm²

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Fig.1 shows compressive strength at 28 and 56 days was optimum at at 10% and 20% FA and BA replacement found to be optimum for SFRC. When compare to CC , SFRC showed 6.56% increase in compressive strength for 20% FA and BA replacement.

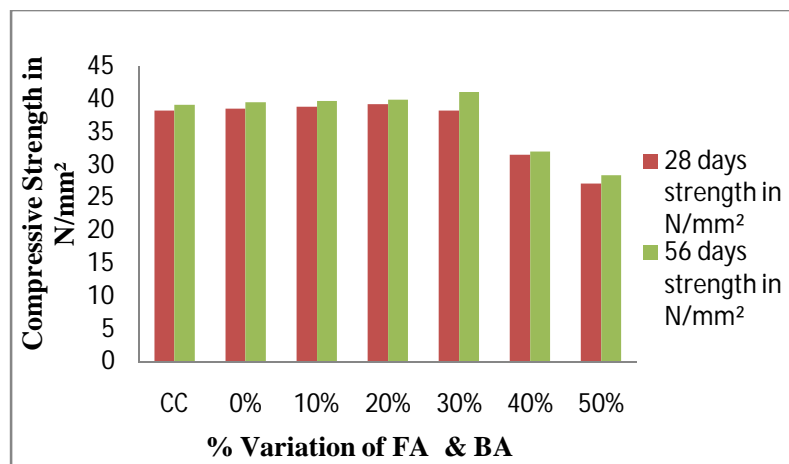


Fig.2 Compressive Strength Variations with % Variation of FA & BA of CFRC in N/mm²

Fig.2 shows compressive strength at 28 and 56 days was optimum at at 20% and 30% FA and BA replacement found to be optimum for CFRC. When compare to CC , CFRC showed 5.18% increase in compressive strength for 30% FA and BA replacement.

Decrease in strength at early ages is due to the slow pozzolanic action of FA and BA and the low specific gravity of bottom ash.

VII. CONCLUSION

- Compressive Strength at 28 days is optimum at 10% FA and BA replacement, but at 56 days 20% replacement is found to be optimum for SFRC. When compared to CC, SFRC showed 6.56% increase in compressive strength for 20% FA and BA replacement which is optimum.
- Compressive Strength at 28 days is optimum at 20% FA and BA replacement, but at 56 days 30% replacement is found to be optimum for CFRC. When compared to CC, CFRC showed 5.18% increase in compressive strength for 30% FA and BA replacement which is optimum.
- Decrease in strength at early ages is due to the slow pozzolanic action of FA and BA and the low specific gravity of bottom ash.

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REFERENCES

1. P. Aggarwal, Y. Aggarwal and S.M. Gupta “Effect of Bottom Ash as Replacement of Fine Aggregates in Concrete”, *Asian Journal Of Civil Engineering (Building And Housing)* Vol. 8, No. 1 (2007).
2. Saravana Raja Mohan. K and Parthiban. K “Strength and Behaviour of Fly Ash Based Steel Fibre Reinforced Concrete Composite” *International Journal of Civil and Structural Engineering* , Vol. 2, No 1,(2011) ISSN 0976 – 4399 .
3. G.Murali, C.M. Vivek Vardhan, P. Sruthee and P. Charmily , “Influence of Steel Fibre on Concrete”, *International Journal of Engineering Research and Applications (IJERA)* ISSN: 2248-9622 Vol. 2, Issue 3, May-Jun 2012.
4. M.A.Pathan and M.A.Jamnu. “Compressive Strength of Conventional Concrete and High Strength Concrete with Temperature Effect” *International Journal of Advanced Engineering Research and Studies IJAERS/Vol. I/ Issue III/April-June, 2012/101-102.*
5. R.Vasusmitha and Dr.P.Srinivasa Rao , “Effect of Elevated Temperature on Mechanical Properties of High Strength Self Compacting Concrete” *International Journal of Engineering Research & Technology (IJERT)* Vol. 1 Issue 8, October - 2012 ISSN: 2278-0181
6. Gunavant K. Kate and Pranesh B. Murnal “Effect of Addition of Fly Ash on Shrinkage Characteristics in High Strength Concrete”, *International Journal of Advanced Technology in Civil Engineering*, ISSN: 2231 –5721, Vol.-2, Issue-1, 201.
7. Bai, Yun., Ibrahim, Ratiyah., and Basheer, P.A.Muhammed., Properties of light weight concrete manufactured with fly ash, furnace bottom ash, and lytag.International Workshop on Sustainable Development and Concrete Technology.
8. IS: 10262-2009.Concrete Mix Proportioning Guidelines, Bureau of Indian Standards, New Delhi, India. 4. IS 456:2000. Plain and Reinforced Concrete – Code of Practice.
9. IS: 1199-1959.Indian Standards methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi, India.
10. IS: 516-1959.Indian standard code of practice methods of test for strength of concrete, Bureau of Indian Standards, New Delhi, India.
11. IS: 1489 – 1 (1991) .Specifications for portland pozzolona cement, Part 1: Flyash based, Bureau of Indian Standards, New Delhi, India.
12. IS: 383-1970.Specifications for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi, India.