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Study On The Mechanical Properties of Concrete By Replacement Of Coal Bottom Ash For Fine Aggregate

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Abstract - *Concrete is one of the major constituent as it is used for the construction purposes. Here the study deals with the use of cementitious materials such as replacing natural sand by bottom ash in 0,10,20,30,40,50&100%. In this work the mechanical properties of concrete are tested with coal bottom ash and about 30 concrete cubes of size 100x100x100mm, 15cylinders of size 300mm height and150mm diameter and 15 Beams of size 500x100x100 mm are cast for M-40 grade of concrete and tested for compressive strength, split tensile strength and flexural strength for 7 and 28 days respectively and investigated their strength properties. The obtained results were not found to be encouraging and further this study has to be done with the combination of other mineral admixtures in order to achieve the desired strength.*

***Key Words*: Coal bottom ash, Compressive Strength, Spilt tensile strength, Flexural strength.**

1. INTRODUCTION

Bottom ash is one type of the solid residue by products produced from coal power generating plants. Direct use of this material with a large quantity, will provide a solution to dispose this material, and the possibility as alternative materials in construction. India is using 1.5 million tons of coal each year. While another waste material that disposed and after process of electricity is namely as coal bottom ash. This coal bottom ash is physically coarse, porous, glassy, granular, and incombustible materials that are collected from the bottom of furnaces that burn coal.

The type of bottom ash produced depends on the type of furnace and also the sources of coal. From the burning process of coal, 80% of product will become fly ash and reaming 20% of product is bottom ash.

1.1 OBJECTIVES

1. To examine the impact of coal bottom ash content material on compressive strength of concrete for 7 and 28 days.
2. To study the split tensile strength of concrete, with the application of coal bottom ash to fine aggregate.
3. To study the behavior of concrete under flexure with the influence of coal bottom ash as substitute to fine aggregates.
4. To investigate the strength of the replaced concrete with that of the conventional concrete.

1.2 SIGNIFICANCEOF PRESENT INVESTIGATION

The aim of this work is to study the mechanical properties of concrete with coal bottom ash as an alternative constituent for fine aggregate in concrete. It is developed to study the effective utilization of the coal bottom ash in a sustainable and economic construction. Replacement of fine aggregate can be used to overcome the scarcity of the natural sand in the environment and coal bottom ash that helps to utilize the industrial byproducts. This and hence reduces the land filling and to save huge areas filling by the waste byproducts.

2. LITERATURE REVIEW

1.Rafat Siddique., conducted a study on "Effect of fine aggregate replacement with Bottom ash on the mechanical properties of concrete" has presented the results of an experimental investigation carried out to evaluate the mechanical properties of concrete mixtures in which fine aggregate (sand) was partially replaced with bottom ash. Fine aggregate (sand) was replaced with five percentages (10%, 20%, 30%, 40%, and 50%) of bottom ash by weight. Tests were performed for properties of fresh concrete. Compressive strength, splitting tensile strength, flexural strength, and modulus of elasticity were determined at 7, 14, 28, 56, 91, and 365 days. Test results indicate significant improvement in the strength properties of plain concrete by the inclusion of bottom ash as partial replacement of fine aggregate (sand), and can be effectively used in structural concrete.

2. Kadam M.P, Dr.Patil Y.D, conducted a study on "Effect of coal bottom ash as sand replacement on the properties of concrete with different W/C ratio" have found the effects of coal bottom ash as fine aggregates in place of sand. Compressive strength, split tensile strength, flexural strength, Modulus of Elasticity, Density and water permeability are studied. The natural sand was replaced with coal bottom ash by 0%, 10%, 20%, 30%, 40%, 50%and 100% by weight, as water absorption of bottom ash was more so that quantity of water was increased to achieve 100 mm slump. The results shows that the compressive strength, split tensile strength and flexural strength decreased as the percentage of replacement coal bottom ash increased as compared to controlled concrete. In this work slump was

kept constant 100 ± 10 mm. To achieve the required slump water quantity was increased as percentage replacement increased. It was observed that up to 30% replacement the results of compressive, flexural, split and water permeability test are approximately same as that of the controlled concrete.

3.Aggarwal P, & Gupta S.M, conducted a study on "Effect of bottom ash as replacement of fine aggregates in concrete". Have studied about the use of bottom ash in concrete Though a large number of significant results have been reported on the use of fly ash in concrete however, Experimental investigations were carried out by replacing sand by equal weight of fly ash, with sand replacement levels of 0, 20 and 30 % and w/c ratio of 0.35, 0.40, 0.45 and 0.50, keeping cement content constant at 350 kg/m3 in all mixes. Compressive strength gain and corrosion resistance was higher for sand replaced with fly ash mixtures. Also, the corrosion rate of reinforcing steel bars in concrete was lowest in 30% replacement level. Mechanical properties like compressive strength, splitting tensile strength, flexural strength and modulus of elasticity at age of 7, 14, 28, 56, 91 and 365 days were studied. The strength difference between fly ash concrete specimens and plain concrete specimens become more distinct after 28 days. The maximum compressive strength, flexural strength, splitting tensile strength and modulus of elasticity was observed to be with 50 % bottom ash content at all ages.

3. MATERIALS AND METHODOLOGY

3.1 CEMENT

In this experimental work, Ordinary Portland Cement(OPC) 43 grade conforming to IS: 8112 - 1989 was used. The cement used was ACC from the local distributors.

3.2 COARSE AGGREGATE

Locally available crushed aggregates confirming to IS 383-1970 are used in this experimentation.

3.3 COAL BOTTOM ASH

In this experimental work, Bottom ash from the silos of Bellary thermal power plant conforming to IS: 3812 (Part 1) – 2003 was used.

3.4 FINE AGGREGATES

Locally available river sand belonging to zone II of IS 383-1970 was used for the project work. The sieve analysis data and physical properties of fine aggregates used are shown in table no 3.4

3.5 WATER

Ordinary potable tap water available in laboratory was used for mixing and curing of concrete.

3.6 TESTS ON MATERIALS

Table -1 Shows basic test results of materials

Initial setting time	125 min
Final setting time	9hours
Specific gravity of coal bottom ash	2.71
Specific gravity of fine aggregate	2.66
Specific gravity of coarse aggregate	2.82
Water absorption of coarse aggregate	0.88

4.0 METHODOLOGY

Calculate the material required for 30 cubes, 15 cylinders, and 15 beams specimens using the mix proportion by mass and water to W/C of 0.40. sand was replaced by coal bottom ash as per desired percentages. Mixing was done by hand. Cement and fine aggregate shall be mixed dry to a uniform color and then the coarse aggregate is added and mixed until the coarse aggregate is uniformly distributed. Now water is added and the whole mix is mixed until the resulting concrete is uniform in colour.

5. RESULTS AND DISCUSSIONS

5.1 SLUMP TEST RESULTS

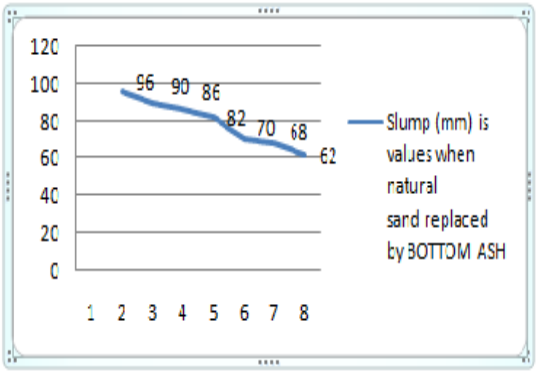

FIGURE 5.1: VARIATION OF SLUMP

The fig 5.1 shows variation of slump test results for 0,10,20,30,40,50& 100% replacement of coal bottom ash to fine aggregate. From the above graph it is observed that as the percentage of coal bottom increases there is an decrease in slump value from 96mm to 62mm.

5.2 COMPRESSIVE STRENGTH TEST

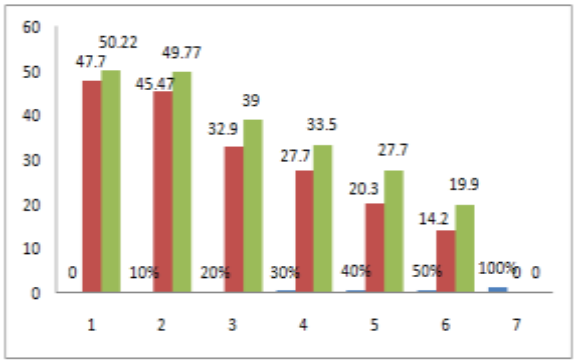

FIGURE 5.2: VARIATION OF COMPRESSIVE STRENGTH

The fig 5.2 shows compressive test results for 0,10,20,30,40,50 & 100% replacement of coal bottom ash to fine aggregate. It can be seen from figure that as the percentage of coal bottom ash goes on increasing there is an decrease in the compressive strength for both 7 & 28 days up to 50% i.e. from 47.7N/mm^2 to 14.2N/mm^2 for 7days and 50.22N/mm^2 to 19.99N/mm^2 for 28 days.

5.3 SPLIT TENSILE STRENGTH TEST RESULTS

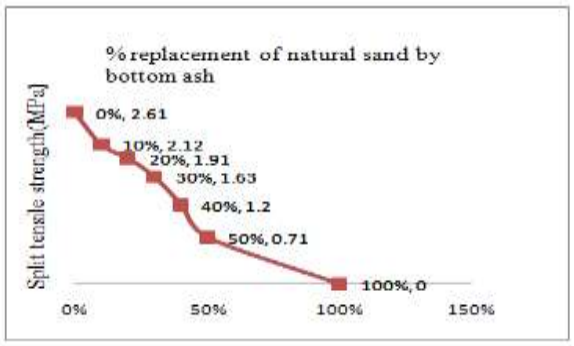

FIGURE 5.3 VARIATION OF SPLIT TENSILE STRENGTH

The figure 5.3 shows split tensile strength result for 0,10,20,30,40,50 & 100% replacement of coal bottom ash to fine aggregate. It can be seen from figure that as the percentage of coal bottom ash goes on increasing there is an decrease in the split tensile strength for 28 days i.e. from 2.61N/mm^2 to 0.71N/mm^2.

5.4 FLEXURAL STRENGTH TEST RESULTS

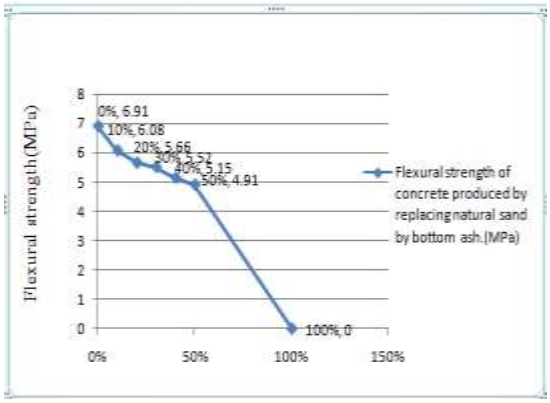

FIGURE 5.4: VARIATION OF FLEXURAL STRENGTH

The figure 5.4 shows flexural strength result for 0,10,20,30,40,50 & 100% replacement of coal bottom ash to fine aggregate. It can be seen from figure that as the percentage of coal bottom ash goes on increasing there is an decrease in the flexural strength test for 28 days i.e. from 6.91N/mm^2 to 4.9N/mm^2.

6. CONCLUSION

1. The target compressive strength can be achieved when the 10% natural sand replaced by bottom ash.
2. By replacing more than 10% of bottom ash the compressive strength decreases.
3. Workability goes on increasing up to 20% replacement of natural sand by bottom ash. Beyond 20% replacement level workability drastically reduces.
4. Workability goes on increasing up to 10% replacement of natural sand by bottom ash. Beyond 10% replacement level workability drastically reduces.
5. Workability of concrete produced by replacing natural sand by fly ash is higher as compared to concrete produced by replacing natural sand by bottom ash.
6. Higher compressive strength can be obtained when the 10% natural sand replaced by bottom ash.
7. Higher split tensile strength can be obtained when the 10% natural sand replaced by bottom ash.
8. Higher flexural strength can be obtained when the 10% natural sand replaced by bottom ash.
9. Concrete produced by replacing natural sand by fly ash exhibit higher flexural strength as compared to

concrete produced by replacing natural sand by bottom ash.

10. Higher shear strength can be obtained when10% natural sand replaced by bottom ash.

11. Finally as the results were not encouraging this study can be made with the addition of any other mineral admixtures in order to achieve the desired strength.

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