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Research Article

A STUDY ON STRENGTH PARAMETERS OF CONCRETE USING BOTTOM ASH

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ABSTRACT

Now a days construction work is increasing day by day all over the world, our natural sources such as aggregates which is used in large volume in concrete are depleting at a rapid rate. Among aggregates there is a scarcity for fine aggregates. The demand for the protection of the natural environment and the ban on mining of fine aggregates in some areas is further aggravating the problem of availability of river sand. In this present work experimental investigation is carried out to study the different strength characteristics of concrete using coal bottom ash as a partial replacement for sand. Here replacement is done as 0-50%. In order to study the mechanical properties of concrete, M25 grade was fixed. Cubes, cylinders were casted and cured for 7 and 28 days. Cubes are tested for compressive strength, cylinders for splitting tensile strength and beams for flexural strength. A comparative analysis is then studied of mix with bottom ash with normal concrete and found the optimum dosage of Bottom ash for further use in constructions for the replacement of sand.

INTRODUCTION

Concrete is the most vital material for the construction of high rise buildings and various infrastructures. Infrastructure development in such areas particularly in developing countries like India is more. Concrete is a mixture of cement, fine aggregate, coarse aggregate and water and river sand is the main raw material used as Fine aggregate in the production of concrete. The natural sources of river sand are getting depleted gradually. At present, the construction industry is plagued with the scarcity of this essential constituent material of concrete. Therefore, in the present circumstances of scant sources of river sand and boom in infrastructure development, it becomes essential and more significant to find out its substitute material in concrete The natural river sand is one of the cheapest resources of sand material available However the excessive mining of river bed to meet the increasing demand for sand in construction industry has led to the ecological imbalance in the country. Now a day's sand available in the river bed is very coarse and contains very high percentage of silt and clay, the silt and clay present in sand will reduce the strength of the concrete. In our project bottom ash is used as a partial replacement for sand to check the strength of concrete. Coal bottom ash or boiler slag are the coarse, granular, incombustible by-products that are collected from the bottom of furnaces that burn coal for the generation of steam, the production of electric power, or both. The majority of these coal by-products are produced at coal-fired electric utility generating stations, although considerable bottom ash and/or boiler slag are also produced from many smaller industrial or institutional coal-fired boilers and from coal-burning. It is composed of mainly silica, alumina and iron with small amounts of calcium, magnesium sulphate. The appearance and particle size distribution of coal bottom ash is similar to that of river sand. These properties of coal bottom ash make it attractive to be used as fine aggregate in the production of concrete.

LITERATURE REVIEW

Gagan deep *et al* (1) carried a work on Bottom ash as partial replacement for sand in concrete. They concluded, based on the work of various researchers it was seen that bottom ash can be a suitable material for replacement of concrete mix. The compressive strength for 7, 28, 56 and 90 days was increased up to 15-20% replacement and after that compressive strengths were decreased for further more replacement.

P. Aggarwal *et al* [(2)] carried a work on effect of bottom ash as replacement of fine aggregates in concrete The strength development for various percentages (0-50%) replacement of fine aggregates with bottom ash can easily be equated to the strength development of normal concrete at various ages

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Sathya Prabha, *et al* [3] carried a work on experimental study on properties of concrete using bottom ash with addition of polypropylene fiber. Bottom ash is a non- hazardous by-product from coal based thermal power plants. In this study fine aggregate in concrete mix has been replaced with bottom ash and Polypropylene fiber is additionally used to enhance the strength characteristics of concrete. Results showed that there was no degradation of strength for beams with bottom ash as replacement for fine aggregates.

Sandhya B, *et al* [4] carried a work on mechanical properties of cement concrete by partial replacement of fine aggregates with bottom ash. Bottom Ash is a new waste material and abundantly available. Direct use of this material with a large quantity, will provide a solution to dispose of this material, and the possibility as alternative materials in construction. Bottom ash can be a suitable material for replacement of concrete mix.

M. Purushothaman, *et al* [5] carried a work on Strength properties of high performance concrete using bottom ash as fine aggregate. The industrial waste Bottom ash could be transformed into useful fine aggregate in concrete making. Even partial replacements in volume of cement and sand with silica fume and bottom ash respectively in concrete mixes would lead to considerable savings in consumption of cement and sand and enables the large utilization of waste product.

MATERIALS PROPERTIES

Cement

Ultra-tech cement of OPC 53 grade which confirms to IS 8112-1976 was used. The physical characteristics of the cement are tested and are shown in table1.

Table 1 Test Results of Cement

Sl no	Tests Conducted	Results
1	Normal consistency	29%
2	Initial setting time	120min
3	Final setting time	600min
4	Specific gravity of cement	3.1
5	Compression strength at 28 days	40.62Mpa

Fine Aggregate

The sand used in this experimental investigation was local river sand confirming to Grading Zone II of IS: 383-1970.The river sand was screened, to eliminate waste material and over size particles. Test results of fine aggregates are shown in table 2.

Table 2 Test Results of Fine Aggregates

Sl no	Tests conducted	Results
1	Specific gravity	2.55
2	Water absorption	5.25
3	Fineness modulus	2.91

Natural Coarse Aggregate

20mm down size coarse aggregates were considered for the project. The test on coarse aggregate was conducted in according with IS 2386-1963. Test results of coarse aggregates are shown in table 3.

Table 3 Test Results of Coarse Aggregates

Sl. no	Tests Conducted	Results
1	Specific gravity	2.70
2	Fineness modulus	6.10
3	Aggregate crushing value (%)	17.50
4	Aggregate impact value (%)	14.40
5	Aggregate abrasion value (%)	28.10

Bottom Ash

It was procured from Udupi Power Corporation Limited, Nandikuru, Udupi. It was black in color and it was sieved to maintain the size of the particle similar to particle size of fine aggregates. Test results of bottom ash are shown in table 4

Table 4 Test Results of Bottom Ash

Sl.no	Tests Conducted	Results
1	Specific gravity	2.30
2	Water absorption (%)	3.0

Experimental Investigation

In this research the mix proportioning was done according to the IS 10262-2009.Grade of concrete was M25. Mix proportion was 1:1.25:2.26.Water cement ratio 0.4. Bottom ash is replaced to fine aggregates in varying percentage 0 to 50%. Concrete ingredients were mixed in a standard manner to maintain workability. The slump was maintained to 100mm.It was noticed that slump value decreased with increase in percentage of bottom ash mainly after 40%. The size of compressive test mould was 150x150x150mm, 150x300mm for split tensile, and 500x100x100mm for flexural test. Cubes, cylinders and beams moulds were casted. Specimens were cured in water curing and hardened properties were determined for 7 & 28 days.

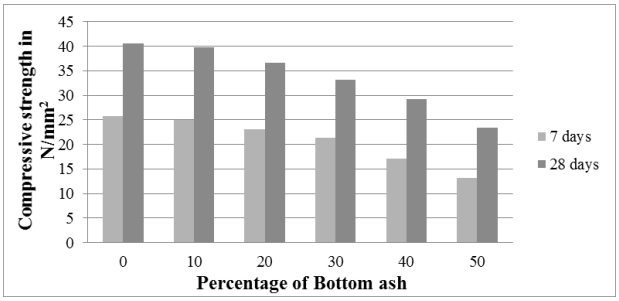
RESULTS AND DISSCUSION

Compressive Strength Test

The compressive strength test on cubes for different mixes was determined using compressive testing machine for 7 and 28 days. Test results on cubes is shown in table 5. Results shows that the increase in percentage of Bottom ash content decreases the compressive strength. Replacement of bottom ash can be done up to 30% as compressive strength value at 30% is nearer to target strength of M25.

Table 5 Results of Compressive strength Test of Bottom ash with varying percentage.

Percentage of bottom ash	Number of days	
	7 days	28 days
0	23.85	40.62
10	25.05	39.78
20	23.15	36.65
30	21.36	33.25
40	17.08	29.30
50	13.20	23.35



Graph 1 Compressive strength test results of Bottom ash with varying percentage

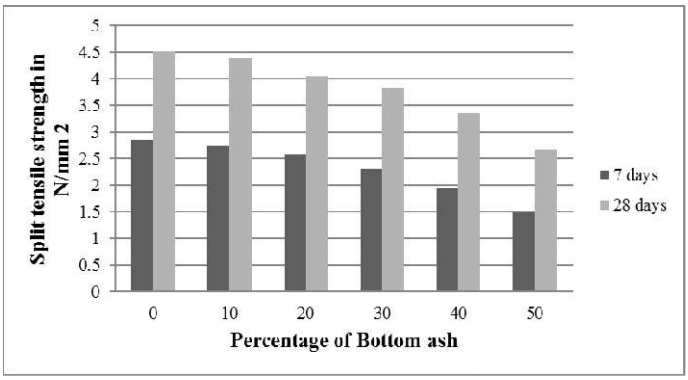
Split Tensile Strength Test

The Split tensile strength test on cylinders for different mixes was determined using compressive testing machine for 7 & 28

days. Test results on cylinders is shown in table 6. Results shows that the increase in percentage of Bottom ash content increases the split tensile strength up to 30%. Replacement of bottom ash can be done up to 30% as split tensile strength value at 30% is nearer to target strength of M25.

Table 6 Results of Split tensile strength test of Bottom ash with varying percentage.

Percentage of bottom ash	Number of days	
	7 days	28 days
0	2.86	4.51
10	2.75	4.38
20	2.58	4.05
30	2.3	3.82
40	1.93	3.36
50	1.48	2.67



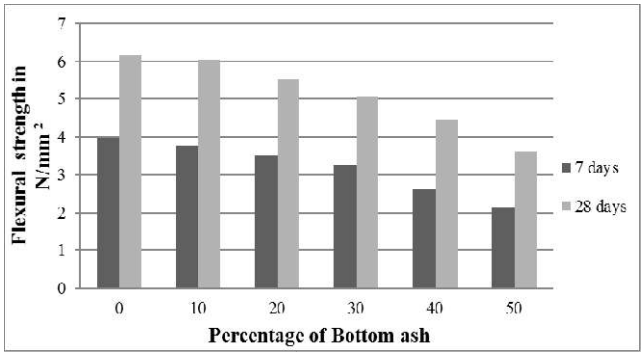
Graph 2 Split tensile strength test results of Bottom ash with varying percentage.

Flexural Strength Test

The Flexural strength test on beams for different mixes was determined using flexural testing machine of single point loading for 7 & 28 days. Test results on beams is shown in table7. Results shows that the increase in percentage of Bottom ash content increases the flexural strength up to 30%. Replacement of bottom ash can be done up to 30% as flexural strength value at 30% is nearer to target strength of M25

Table 7 Results of flexural strength test of Bottom ash with varying percentage.

Percentage of bottom ash	Number of days	
	7 days	28 days
0	3.95	6.16
10	3.76	6.03
20	3.51	5.52
30	3.26	5.06
40	2.62	4.46
50	2.13	3.62



Graph 3 Flexural strength test results of Bottom ash with varying percentage.

CONCLUSION

Increase in the percentage of bottom ash the strength of concrete decreased. Result shows that bottom ash can be replaced up to 30% because at 30% replacement the strength obtained is almost equal to target strength of M25 grade concrete. Use of Bottom ash in concrete will save the natural fine aggregates. Bottom ash can be utilised in concrete as it is a waste product obtained from burning of coal in power plant. Utilisation of bottom ash saves the natural fine aggregates and landfill can be reduced.

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