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EFFECT OF REPLACING FINE AGGREGATE WITH BOTTOM ASH IN M 30 GRADE OF CONCRETE WITH OPC-43S CEMENT

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ABSTRACT:- Concrete is the most important engineering material and the addition of some other materials may change the properties of concrete. Studies have been carried out to investigate the possibility of utilizing a broad range of materials as partial replacement materials for cement and aggregate in the production of concrete. The present experimental study was conceived following the general purpose of testing new sustainable building processes and modern production systems, aims not only at saving natural raw materials and reducing energy consumption, but also to recycle industrial by-products. The objectives of this study was to investigate the effect of use of coal bottom ash as partial replacement of fine aggregates in various percentages (12, 24 and 36%), on concrete properties such as compressive strength, splitting tensile strength test, flexural strength .The test results of this research work indicates that at fixed water cement ratio, workability decreased with the use of coal bottom ash as a replacement of fine aggregate in concrete. Compressive strength of bottom ash concrete at the curing age of 28 days was increased compared to control concrete. Splitting tensile strength of concrete improved at percentages of replacement of bottom ash.

Keyword: Bottom ash, Cement, Coarse aggregate, concrete, sands, strengths.

INTRODUCTION

India produces approximately more than 100 million tonnes of Coal ash annually. Coal-based thermal power plants all over the world facing serious problems of handling and disposal of the ash produced. The utilization of fly ash is about 30% as various engineering properties requirements that is for low technical applications such as in construction of fills and embankments, backfills, pavement base and sub base course. bottom ash based artificial lightweight aggregate offer potential for large-scale utilization in the construction work. Apart from using it in concrete industry as cement replacement, fly ash usages by other related industries have been for cube (Bricks) manufacture, cellular concrete, prefabricated items and road construction. Yet about 80% of bottom ash remains unutilized. The management of coal fly ash produced by coal thermal power station is a major problem in many parts of the word. However, its generation tends to increase every year. Although some coal fly ash is used in a range of applications, particularly as a substitute for cement in concrete. Large amount remain unused and thus required disposal. At present, coal fly ash is used in civil engineering for production of cement, concrete, cube and artificial aggregate. Safe disposal of the ash without adversely affecting the environment and the large storage area required are major concerns. Bottom ash is a by-product of burning coal at thermal power plants. Bottom ash particles are much coarser than the fly ash. It is a coarse, angular material of porous surface texture predominantly sand-sized. This material is composed of silica, alumina, and iron with small amounts of calcium, magnesium, and sulfate Grain size typically ranges from fine sand to gravel in size. Chemical composition of bottom ash is similar to the fly ash but typically contain greater quantity of carbon. Bottom ash exhibits high shear strength and low compressibility. These engineering properties make bottom ash an ideal material in design construction of dam and for other civil engineering applications. Bottom ash also exhibits a relatively high permeability and grain size distribution that allows the design engineer to use it in direct contact with impervious material. Bottom ash has proved to be an economical material because it has demonstrated to have not only good engineering property but also to have constructability benefits. Bottom ash can be used as concrete aggregate or for several other civil engineering applications where sand, gravel and crushed stone are used. Government should encourage the use of bottom ash related products so that bottom ash can be used in huge quantities in many civil engineering construction purposes.

BOTTOM ASH

Bottom ash is the coarser material, which drops into the bottom of the furnace in latest large thermal power plants and constitute about 20% of gross ash content of the coal fed in the boilers. It consists of non-combustible materials, and is the residual part from the incineration of household and similar waste. Raw bottom ash is a granular material that consists of a mix of inert materials such as sand, stone, glass, porcelain, metals and ash from burnt materials. The utilization of coal ash in normal strength concrete is a new scope in concrete mix design and if put to use on large scale would ameliorate the construction industry, by minimizing the construction cost and abating the ash content. This paper presents the review of various experimental investigations carried out by many researchers to study the effect of use of bottom ash as a replacement for sand, since the investigation on the use of bottom ash has been very limited.

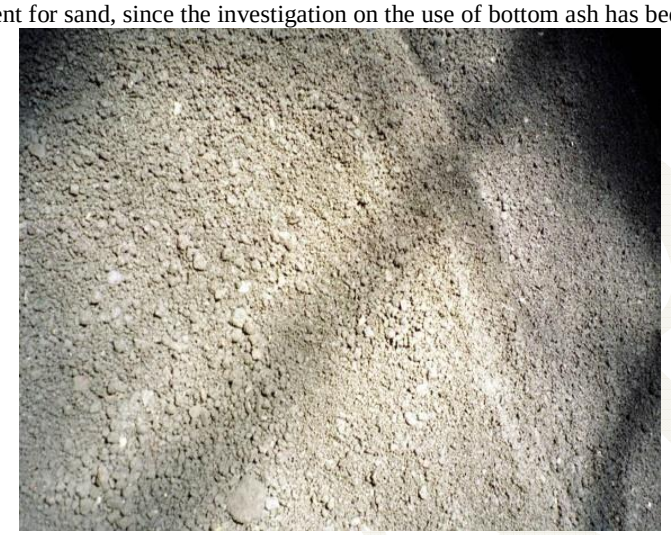
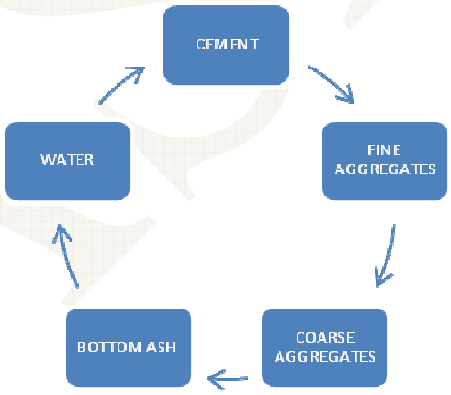


Figure 1.1: Bottom Ash

EXPERIMENTAL WORK

1. MATERIALS AND PROPERTIES

The materials selected for this experimental study includes normal natural coarse aggregate, manufactured sand as fine aggregate, cement, Superplasticizer, bottom ash and portable drinking water. The physical and chemical properties of each ingredient has considerable role in the desirable properties of concrete like strength and workability.



1.1 Cement: Ordinary Portland cement 43 grade in one lot was procured and stored in air light container and it is very fresh cement i.e., used within three month of manufacture. The Cement was tested in accordance to test methods specified in IS: 4031-1988.

Table 1 : Physical Properties of Cement	
Brand of cement	OPC
Standard consistency	35 %
Initial setting time (in mins)	142
Final setting time (in mins)	328
Specific gravity	2.89

1.2 Fine aggregates: The sand used for the experimental program was locally procured and confirmed to grading zone III. The fine Aggregate was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

Table 2 : Physical Properties of fine aggregates	
Specific Gravity	2.54
Water absorption	12 %

1.3 Coarse aggregates: The coarse aggregate used was broken granite-crushed stone and it was free from clay, weeds, and any other organic matters, they are non- porous. The water absorption capacity is less than 1%. The size of which pass through 26 mm sieve and retained on 19 mm sieve.

Table 3 : Physical Properties of Coarse aggregates	
Specific Gravity	2.674
Water absorption	0.25 %

1.4 BOTTOM ASH

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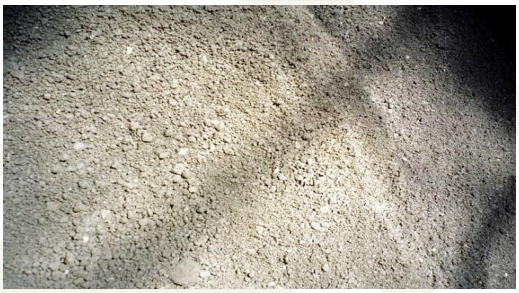

Fig 1: Bottom Ash

1.5 Water: Water should be free from acids, oils, alkalies, vegetables or other organic impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix. Firstly, it reacts chemically with the cement to form the cement paste in which the inert aggregates are held in suspension until the cement paste has hardened. Secondly, it serves as a lubricant in the mixture of fine aggregates and cement.

1.6 Super Plasticizer: In this investigation super plasticizer- CONPLAST-SP 430 in the form of sulphonated Naphthalene polymers complies with IS: 9103-1999 and ASTM 494 type F was used to improve the workability of concrete.

2. TESTING PROCEDURE

Concrete test specimen consists of 150x150x150mm cubes, Concrete cube specimen were tested at 7 and 28 days to obtain the compressive strength of concrete.

Fig 2: Compressive strength machine

RESULTS AND DISCUSSION

The compressive strength of the cubes at different days and Bottom ash combination are given in table 4. And the slump value and compaction factor is given in table 4.

Table 4: Compressive strength of concrete

Mix	Compressive strength(MPa)	
	7 Days	28 days
Normal Concrete	17.32	31.70
12 % Bottom ash	19.12	33.10
24 % Bottom ash	19.75	36.57
36 % Bottom ash SF	18.54	34.58

The slump are given in table 5

Table 5: Slump test

Mix	Slump (mm)
Normal Concrete	60
12 % Bottom ash	62
24 % Bottom ash	59
36 % Bottom ash	55

CONCLUSION

The following conclusions could be arrived at from the study:

- The sustainable utilization of bottom ash improves production efficiency, reduces production costs and waste product disposal problems.
- When used in concrete, bottom ash is used as replacement of fine aggregate in which concrete has advantageous properties like improved workability, resistance to chemical attack.
- It eliminates the need to mine virgin materials and conserves limited land and material resources.
- The workability of concrete decreased with the increase in bottom ash content due to the increase in water demand.
- The density of concrete decreased with the increase in bottom ash content due to the low specific gravity of bottom ash as compared to fine aggregates.
- Compressive strength, splitting tensile strength and Flexural strength of fine aggregates replaced bottom ash concrete specimens were higher than control concrete specimen.
- Compressive strength, splitting tensile strength and Flexural strength of fine aggregate replaced bottom ash concrete continue to increase with age for all the bottom ash contents.
- Compressive strength of concrete containing 5% of bottom ash attaining more strength than the control concrete specimen.

Bottom ash used as fine aggregates replacement enables the large utilization of waste product.

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