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An experiment on CBA concrete

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ABSTRACT

The coal-fired thermal power plants are the main source of coal bottom ash. Coal Bottom Ash is used as a replacement of both sand and cement depending on the size of bottom ash. The present study will provide a better understanding of the mechanical and durability properties of concrete in which cement is partially replaced with bottom ash. The present thesis would contribute to the efforts being made in the field of concrete technology towards the development of concretes possessing good strength. Based on the study, valuable advice will be given to concrete structures. In the present experimental study, the various strength properties like a compressive strength of concrete and also durability properties like Acid attack test on both ordinary concrete and coal bottom ash Concrete, best coal bottom ash concrete mix is carried out and compared with an ordinary concrete mix for economic and ecological study. In this study different percentage of ordinary and grinded coal bottom ash is used. It was found that with the increase in the amount of coal bottom ash, standard consistency, initial and final setting time increases at the same time workability of concrete decreases. It was also found that initial day's strength is less for bottom ash concrete compare to control mix, but as the age increases, they show good improvement in strength due to a pozzolanic reaction. Optimum dosage is observed to be 15% GBA which shows more strength compared to the control mix at 56 days. It was found that with the increase in an amount of bottom ash resistance to acid attack increases. GBA shows more resistance to acid attack compared to OBA. With the increase in the amount of bottom ash. It was also found that at optimum dosage i.e. at 15% replacement of cement with GBA it is also economical and also amount of CO2 Emitted is also decreasing that means it is also environmentally friendly compared to control mix.

Keywords: *Initial and final setting time, Consistency, Workability, Compressive strength*

1. INTRODUCTION

Coal combustion products are mainly utilized in the building materials industry, in civil engineering, in road construction, for construction works in underground coal mining as well as for re-cultivation and restoration purposes in open cast mining. They are used as a replacement for natural resources. Their utilization helps to save natural resources and to reduce the energy demand and greenhouse gas emissions to the atmosphere caused by mining and generation of products which are replaced by coal combustion products. Coal combustion products include fly ash, bottom ash, and boiler slag and flue gas desulfurization material.

2. MATERIALS USED

2.1 Cement

Ordinary Portland cement (OPC) from a single lot was used throughout the course of the investigation. The physical properties of the cement as determined from various tests conforming to Indian Standard IS 1489-1991(Part-1). All the tests were carried out as per the recommendations of IS: 4031-1988. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture. The fineness of cement is obtained at 3%. Standard consistency is obtained to be 31%. Initial setting time is 65 minutes and final setting time is 315 minutes.

2.2 Fine Aggregate

IS: 383-1970 defines the fine aggregate, as the one passing 4.75mm IS sieve. The fine aggregate is often termed as a sand size aggregate. Locally available riverbed sand was used in the present study. The percent passing 600-micron sieve = 62.35. The sand conforms to grading Zone – III as per IS 383 – 1970 respectively.

2.3 Coarse Aggregate

River sand was used as fine aggregate. The specific gravity and fineness modulus was 2.61 and 2.84 respectively and it belongs to zone II of grading.

3. RESULT AND DISCUSSION ON EXPERIMENTAL TEST

3.1 Slump test

The workability of concrete mixes was found out by slump test as per procedure is given in chapter 3. W/c ratio was kept constant at 0.45 for all the concrete mixes. The workability results of different concrete mixes were shown in Table 1.

Table 1: Workability values for different concrete mixes

Mix No.	Description	Slump (mm)
1	100%OPC+0%OBA+0%GBA	110
2	85%OPC+15%OBA+0%GBA	108
3	70%OPC+30%OBA+0%GBA	101
4	55%OPC+45%OBA+0%GBA	98
5	85%OPC+0%OBA+15%GBA	100
6	70%OPC+0%OBA+30%GBA	96
7	55%OPC+0%OBA+45%GBA	89

Table 1 shows that as the replacement of cement with bottom ash increases, the workability of concrete mix decreases as compared to control mix. And it also shows that the addition of GBA decreases the workability more compared to OBA. Workability of concrete is reduced because bottom ash absorbs the water.

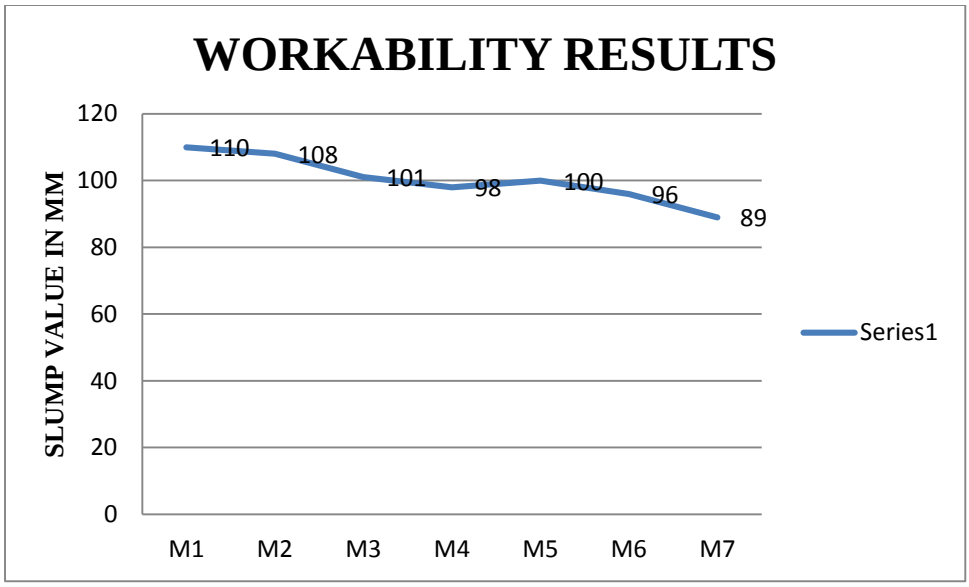

Fig. 1: Workability results

3.2 Standard consistency

The standard consistency of concrete mixes was found out by vicat apparatus as per procedure is given. The standard consistency results for different mixes are given in Table 2.

Table 2: Standard consistency values of different mixes

Mix no	Description	Standard consistency
1	100%OPC+0%OBA+0%GBA	31%
2	85%OPC+15%OBA+0%GBA	31%
3	70%OPC+30%OBA+0%GBA	32%
4	55%OPC+45%OBA+0%GBA	32%
5	85%OPC+0%OBA+15%GBA	33%
6	70%OPC+0%OBA+30%GBA	33%
7	55%OPC+0%OBA+45%GBA	34%

It was found that the standard consistency of paste increases with an increase in replacement of cement with bottom ash. This is even more when we add GBA. Standard consistency increases because bottom ash absorbs the water. Grinded bottom ash absorbs more water than ordinary bottom ash so standard consistency is more for GBA than OBA at the same replacement of cement.

3.3 The compressive strength of mortar results

The results of the compressive strength tests conducted on cement mortar specimens of different mixes cured at different ages are presented and discussed in this section. The compressive strength test was conducted at curing ages of 7, 14, 28, 56 and 90 days. The compressive strength test results of all the mixes at different curing ages are shown in Table 4.4. Variation of compressive strength of all the mixes cured at 7,14,28,56 and 90 days with respect to control mix are also shown in Figure 2. Experimental process was explained in chapter 3.

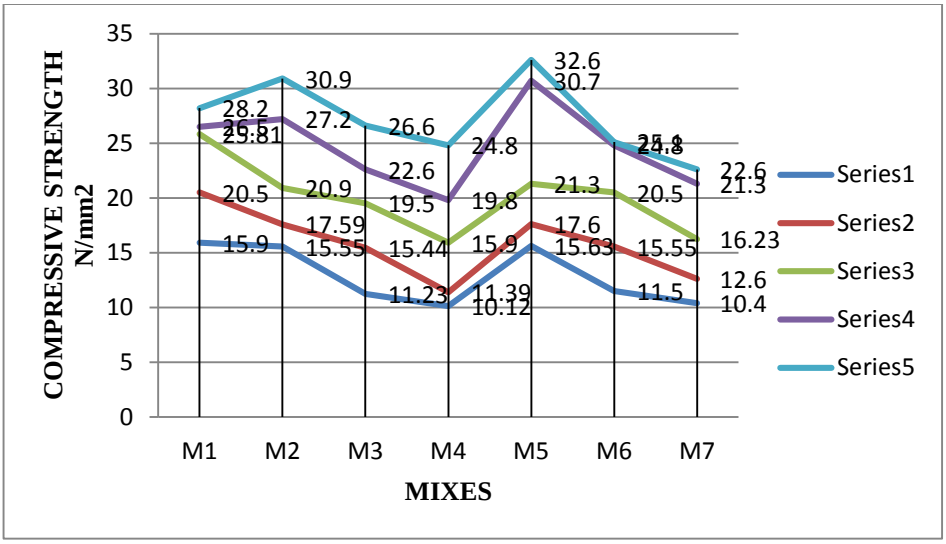

Fig. 2: Compressive strength of cement mortar

Table 3: Compressive strength (MPa) results of all mortar mix at different curing age

Mix name	Mix description	7 Days	14 days	28 days	56 days	90 days
M1	100%OPC+0%OBA+0%GBA	15.9	20.5	25.81	26.5	28.2
M2	85%OPC+15%OBA+0%GBA	15.55	17.59	20.9	27.2	30.9
M3	70%OPC+30%OBA+0%GBA	11.23	15.44	19.5	22.6	26.6
M4	55%OPC+45%OBA+0%GBA	10.12	11.39	15.9	19.8	24.8
M5	85%OPC+0%OBA+15%GBA	15.63	17.6	21.3	30.7	32.6
M6	70%OPC+0%OBA+30%GBA	11.5	15.55	20.5	24.8	25.1
M7	55%OPC+0%OBA+45%GBA	10.4	12.6	16.23	21.3	22.6

In the first 28 days, the strength of the bottom ash cement mortar mix is less compared to control mix because there is less cement in bottom ash cement mortar mix compared to control mix. After 28 days the difference is gradually reduced because after 28 days pozzolanic reaction starts and calcium hydroxide will react with the bottom ash and strength increases.

3.4 The compressive strength of concrete results

The results of the compressive strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The compressive strength test was conducted at curing ages of 7, 14, 28, 56 and 90 days. The compressive strength test results of all the mixes at different curing ages are shown in Table 4. Variation of compressive strength of all the mixes cured at 7,14,28,56 and 90 days are also shown in Figure 3. It shows the variation of the compressive strength of concrete mixes with respect to control mix after 7,14,28,56 and 90 days respectively.

Table 4: Compressive strength (MPa) results of concrete at different curing ages

Mix name	Mix description	7 Days	28 days	56 days	90 days
M1	100%OPC+0%OBA+0%GBA	24	35.50	37.45	39.9
M2	85%OPC+15%OBA+0%GBA	21.61	28.66	34.9	38.22
M3	70%OPC+30%OBA+0%GBA	21.09	24.8	29.5	34.20
M4	55%OPC+45%OBA+0%GBA	16.32	20.54	28.55	30.3
M5	85%OPC+0%OBA+15%GBA	21.63	30.33	42.21	42.50
M6	70%OPC+0%OBA+30%GBA	21.23	24.4	36.7	39.11
M7	55%OPC+0%OBA+45%GBA	17.82	24.7	33.51	35.9

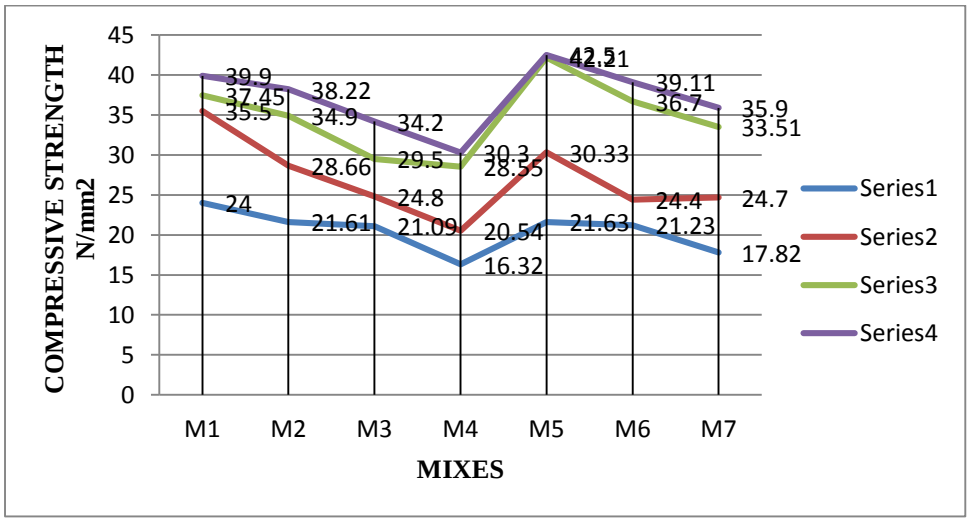

Fig. 3: Compressive strength of concrete at different age

After 28 days bottom ash concrete gains more strength compared to the control mix and the difference between them is reduced because of the pozzolanic reaction of bottom ash with calcium hydroxide. After 28 days GBA concrete gains more strength than OBA concrete because the pozzolanic reaction is more in GBA concrete. From 56 days strength of the GBA concrete at 15% replacement (M5) is more than the control mix (M1) because of pozzolanic reaction. But at the same 15% replacement OBA concrete (M2) is having less strength because it is cored than GBA and having more voids than GBA, the pozzolanic reaction in OBA is less.

4. CONCLUSIONS

a. The results show that as the cement replacement with bottom ash increases standard consistency increases. Addition of GBA increases the standard consistency more compared to OBA. As the cement replacement with bottom ash increases initial and final setting is increased. It is observed that GBA and OBA show nearly the same effect.
b. It was found that as the bottom ash content increases in the concrete workability decreases. For the same amount of bottom ash in GBA workability decreases more compared to OBA.
c. In cement mortar mix optimum dosage of GBA was found to be 15 % at which the maximum strength was found.
d. It was observed that addition of bottom ash reduces strength initially but later age strength was found to be more compared to control mix. Addition of GBA gives more strength compared to OBA concrete at all the ages. Addition of 15% GBA shows more strength compared to the control mix at 56 days and 90 days.
e. The durability of concrete from the aspect of resistance to acid attack on concrete increases by replacing the cement with bottom ash. It was observed that replacement of cement with GBA gives more resistance to acid attack as compared to OBA.
f. Concrete containing bottom ash was found to absorb more water compared to ordinary concrete. As the curing age progress, water absorption capacity of concrete before and after replacement with bottom ash decreases.
g. It was observed that at optimum dosage i.e. at 15% replacement of cement with GBA concrete is economical and CO_2 emission also decreased that means it is environment-friendly compare to control mix.

5. REFERENCES

[1] Aggarwal Yogesh and Siddique Rafat., 2014.Microstructure and properties of concrete using bottom ash and waste foundry sand as partial replacement of fine aggregates, Construction and Building Materials, Vol 54, PP 210–223.
[2] Almusallam A.A, Maslehuddin M, Abdul-Waris M, and Khan M.M., 1998. Effect of mix proportions on plastic shrinkage cracking of concrete in hot environments, Construction and Building Materials, Vol 12, PP 353-358.
[3] Andrade L.B, Rocha J.C, and Cheriaf M., 2007. Aspects of moisture kinetics of coal bottom ash in concrete, Cement and Concrete Research, vol 37, PP 231–241.
[4] Andrade L.B, Rocha J.C, and Cheriaf M., 2009. Influence of coal bottom ash as a fine aggregate on fresh properties of concrete, Construction, and Building Materials, Vol.23, PP 609-614.
[5] Bai J and Wild S., 2002. Investigation of the temperature change and heat evolution of mortar incorporating PFA and metakaolin, Cement & Concrete Composites, vol 24, PP 201–209.
[6] Bai Y, Darcy F, and Basheer P.A.M., 2005. Strength and drying shrinkage properties of concrete containing furnace bottom ash as fine aggregate, Construction, and Building Materials, vol 19, PP 691-697.
[7] Baja real Diana, Bumanisb Girts, and Upeniece Liga., 2013. Coal Combustion Bottom Ash as Microfilter with Pozzolanic Properties for Traditional Concrete, Procedia Engineering, vol 57, PP 149 – 158.
[8] Barbare Nikhil, Shukla Arun and Bose Arijit., 2003. Uptake and loss of water in a cenosphere–concrete composite material, Cement and Concrete Research, vol 33, PP 1681–1686.
[9] Bilir Turhan., 2012. Effects of non-ground slag and bottom ash as a fine aggregate on concrete permeability properties, Construction and Building Materials, vol 26, PP 730–734.
[10] Cheriaf M, Cavalcante Rocha M, and Pera J., 1999. Pozzolanic properties of pulverized coal combustion bottom ash, Cement and Concrete Research, vol 29, PP 1387–1391.

