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STRENGTH AND DURABILITY CHARACTERSTICS OF BOTTOM ASH CONCRETE

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ABSTRACT

This paper present on replacement of natural sand by-items and recyclable waste materials which incorporates ebb and flow and future patterns of research on the utilization of made fine total in Portland bond concrete. With normal sand stores the world over becoming scarce, there is an intense requirement for an item that matches the properties of regular sand in cement .In the most recent 15 years it has turned out to be obvious that the accessibility of good quality common sand is diminishing. With a couple of neighborhood exemptions, it appears to bea worldwide pattern. Existing normal sand stores are being discharged at an indistinguishable rate from urbanization and new stores are found either underground , excessively near effectively developed ranges or too far from the zones where it is required, that is the towns and urban areas where the makes of cement are located. This project presents the experimental investigations carried out to concentrate on the impact of utilization of Bottom powder (the coarser material, which falls into heater base in advanced huge warm power Plants and constitute around 20% of aggregate fiery debris substance of the coal sustained in the boilers) as a substitution of fine totals. Solid innovation can be enhanced in view of three criteria, for example, toughness, ecological kind disposition for the eventual fate of solid industry, cost of materials and development. The answer for this issue is to utilize or use modern by-items or strong squanders in delivering cement, for example, Bottom Ash (BA), Fly Ash (FA), slag, squander glass, silica rage, and so on. The different sturdiness properties of the solid comprise of RCPT test, water assimilation test and drying shrinkage. The quality improvement for different rates (20-100%) supplanting of fine totals with base fiery remains can without much of a stretch be likened to the quality advancement of ordinary cement at different ages. Base slag is normally portrayed as heterogeneous particles comprising of attractive and paramagnetic metals, glass, manufactured and characteristic earthenware production, minerals and unburned materials. Decrease in negative consequences for monetary and natural issues of solid industry can be accomplished by the utilization of these solid.

Key Words: Portland Cement, Fly ash,Bottom Ash,Slag, Waste glass and Silica fume.

1. INTRODUCTION

Rapid industrial development causes serious problems all over the world. Currently India has taken a major initiative on developing the Infrastructures such as structures etc., to meet the requirements of globalization, in the construction of buildings and other structures.

This project present a recent study carried out locally to study the feasibility of using coarse aggregate, bottom ash, and portable water in concrete. The concrete is expected to achieve a 28days compressive strength of not less than 25 MPa. The effect of replacing the natural fine aggregates with bottom ash on the properties of concrete is reported. Properties include specific gravity, water absorption, density and fineness modulus.

Bottom ash concrete is important it helps to promote sustainable development in protection of natural resources, and reduces the disposal of industrial waste from coal. Bottom ash is useful to be applied as many types of general bulk fill bank protection, sub-basement, road construction, noise barriers and embankments.

Bottom ash concrete is applied to new concrete pavements, shoulders, median barriers, side walls, curbs and gutters and bridge foundations. It can also be applied to structural grade concrete, soil cement pavement bases, lean concrete and bituminous concrete.

Fig -1: Preparation of Bottom Ash Aggregates

2. LITERATURE REVIEW

Ilangovan and Nagamani A.K.[1] et al.2006 reported that Natural Sand with granite cutting slurry as full replacement in concrete as possible with proper treatment of Quarry Dust before utilization Galetakis and Raka (2004) [2] studied the influence of varying replacement proportion of sand with quarry dust (20, 30 and 40%) on the properties of concrete in both fresh and hardened state (Nevillie, 2002).

Saifuddin et al. (2001) [3] investigated the influence of partial replacement of sand with quarry dust and cement with mineral admixtures on the compressive strength of concrete.

Sridharan A., Soosan T. G., Babu T. Jose and Abraham B. M. 2006 [4] . conducted shear strength studies on soil-quarry dust mixtures and observed that 20- 25% of the total production in each crusher unit in India is left out as waste- quarry dust. This waste problem may be avoided as it could be converted into useful application in concrete production.

Shahul et al., 2002 [5] observed that naturalsand is usually not graded properly and has excessive silt, whilequarryrock dust does not contain silt or organic impurities and can be produced to meet desired gradation and fineness as per requirement. This consequently contributes to improve the strength of concrete.

3. MATERIAL PROPERTIES

Following materialsare usedfor preparing test specimens

I. Ordinary Portland cement (53 grade).
II. Fine Aggregate (sand).
III. Coarse Aggregate (20mm and 12mm gravel).
IV. Bottom Ash

3.1. Ordinary Portland cement

Cement is a fine, grey, and dry powder. It is mixed with water and aggregate materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary portland cement contains two basic ingredients namely argillaceous and calcareous.

3.2. Fine Aggregate

The sand used for the experimental programmed was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand 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. The aggregates were sieved through a set of sieves of 4.75,2.36,1.18, , and pan to obtain sieve analysis.

3.3. Coarse Aggregate

The broken stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested per Indian Standard Specifications IS: 383-1970. The aggregates were sieved through a set of sieves of 80mm,40mm,20mm, 12.5mm, 10mm, 4.75mm and pan to obtain sieve analysis.

3.4. Bottom Ash

Bottom ash is part of the non-combustible residue of combustion in a furnace or incinerator. In an industrial context, it usually refers to coal combustion and comprises traces of combustibles embedded in forming clinkers and stick in.

4. MANUFACTURING PROCESSES-MIX DESIGN

This section describes the steps for calculation of M 25 grade conventional concrete mix proportions as per IS 10262 (2009) and IS 456 (2000).

4.1. Stipulations for Proportioning

a) Grade designation : M 25
b) Type of cement : OPC 53 grade (IS 12269)
c) Maximum nominal size of aggregate:20 mm
d) Exposure conditions : Moderate
e) Minimum cement content : 300 kg/m3
d) Maximum water-cement ratio : 0.5
f) Workability : 75 mm
g) Type of aggregate : Crushed angular
h) Maximum cement content : 450 kg/m3
i) Method of placing : Compaction
j) Degree of supervision : Good

4.2. Adjustment of Mix Proportions

Aggregates are assumed in saturated surface dry condition (SSD).

Quantity of water absorbed by coarse aggregate = (0.3/100) x 1142 = 3.426 kg/m^3

Therefore, dry weight of coarse aggregate i.e., weight of coarse aggregate in field condition = 1142 – 3.426 = 1138.57 kg/m3 ≈ TT,9 kg/m3.

Similarly, quantity of water absorbed by fine aggregate = (1/100) x 642.2 = 6.422 kg/m3

Therefore, dry weight of coarse aggregate i.e., weight of fine aggregate in field condition = 642.2 – 6.422 = 635.778 kg/m3 ≈ ,kg/m3.

Adjusted water content = 192 + 3.426 + 6.422 = 201.85 kg/m3 ≈ ‘T‘ kg/m3

4.2. Actual Quantities of Mix Proportions

The duly adjusted actual quantities of mix proportions are described below. In the mix, 20 mm and 10 mm coarse aggregates are blended in 60:40 proportion by percentage weight of total aggregate. Mix proportion of cement, fine aggregate and coarse aggregate by weight is given by 1 : 1.66: 2.97.

Cement : 384 kg/m3

Water : 202 kg/m3 Coarse aggregate : 1139 kg/m3 20 mm : 683.4 kg/m3

10 mm : 455.6 kg/m3 Fine aggregate : 636 kg/m3

EXPERIMENTAL DETAILS AND CONCLUSIONS

In the present proposal after referring the work is planned to conduct lab Investigation using bottom ash and crushed stones in various proportions, for M25 grade of concrete. The main purpose of this Project investigation Is to study, is to develop confidence among user agencies in India to use bottom ash and crushed stones in a desirable proportion in all civil engineering constructions.

5.1. Experimental Procedure

The main aim of this research project is to utilize crushed stones as coarse aggregate and bottom ash as fine aggregate and excesses cement for the production of concrete. It is essential to know wheter the replacement of bottom ash in concrete is in appropriate or acceptable. Three types of aggregates are used in this project which include natural coarse aggregate, Natural fine aggregate and bottom ash Natural coarse aggregate used is microtonal with Maximum size of 20mm. Natural fine aggregate used sand, bottom ash from crushing coal industries. Tests are carried out on these bottom ash to determine the specific gravity, sieve analysis, bulk density. After testing, A mix design is produced in Accordance with the properties.

The mix design is produced with the selected Slump of 30 mm, design Compressive strength of 25 MPa and the maximum aggregate size of 20 mm Other aggregate properties available From previous Tests are used in the Calculation for mix design. Numerous trial mixes are carried out to produce concrete with20% 30,40%, 50%, 60% and 100 replacement of bottom ash . This concrete serves as Reference concrete (con concrete) and tests are conducted on this concrete to determine its properties. Tests are conducted to checkdurability.

5.2. Rapid Chloride Penetration Test.

Rapid chloride permeability test (RCPT) is a quick test to measure the rate of transport of chloride ions in concrete. Rapid chloride permeability of BAC and CC expressed in terms of charge passed in Coulombs after 28 days of curing are shown in Table.

Table -1: RCPT Values of BAC and CC

S.NO	% of replacement of bottom ash	Age (days)	Charge passed(coulombs)	Chloride penetrating rate
1	0	28	1563	NORMAL
2	20	28	9552	HIGH
3	30	28	6082	HIGH
4	40	28	3803	NORMAL
5	50	28	5640	HIGH
6	60	28	6509	HIGH
7	100	28	8253	HIGH

From the above Table.1, it is observed that M 25 grade have attained low penetrating rate at the age of 28 when compared to other replacements of bottom ash in concrete. The chloride penetrating rate of M 25 grade and BAC-40 is same i.e, normal penetrability of chloride.

5.3. Water Absorption Test

Fig -2: Specimens placed in Water for Curing

Water absorption of BAC and CC after 28 days of curing are shown in Table 2. From the Table 2, it is observed that M 25 grade of BAC have attained lower percentage of water absorption values at all ages when compared to those of M 25 grade of CC. Significant reduction was observed in the water absorption values of BAC mainly due to continued pozzolanic action of fly ash with the age and micro filling of fly ash.

Table -2: Water absorption values of BAC and CC

S.NO	% of replacement of bottom ash	Age (days)	Charge passed(coulombs)
1	0	28	3.71
2	20	28	0.8
3	30	28	1
4	40	28	2.6
5	50	28	3.5
6	60	28	3.8
7	100	28	4.1

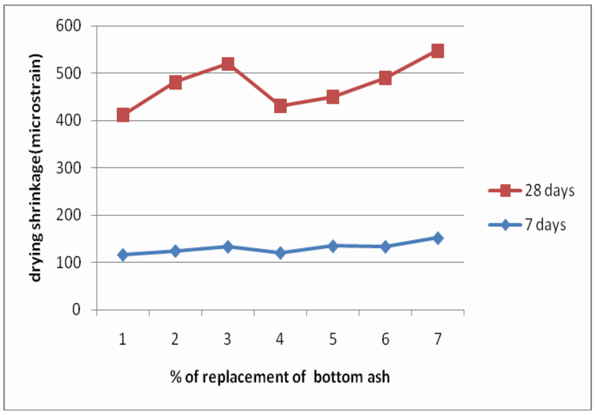
From the above results, it can be noted that the designed M 25 grade of CC and BAC-60 has approximately equal amount of water absorption.

5.4. Drying Shrinkage Test

The average drying shrinkage strains of M 25 grade of BAC and CC after 7, 28 days of drying after 7 days of curing were presented in the Tables 1 and 2 respectively. The drying shrinkage of all mixes as a function of drying period was plotted and shown in Graph 1.

Table -3: Average Drying shrinkage values of BAC and CC

S.NO	% of replacement of bottom ash	Drying Shrinkage (Micro strain)	
		7 days	28 days
1	0	117	295
2	20	125	356
3	30	134	386
4	40	121	310
5	50	135	315
6	60	134	356
7	100	152	396



Graph 1. Drying shrinkage of BAC and CC

CONCLUSION

- From Table 7.1 it can be inferred that Rapid Chloride Penetration test for BAC -40 at 28 days satisfied the criteria for M25 mix.
- From Table 7.2 it can observed that Water Absorption of BAC-60 was equivalent with M25 mix
- From Table7.3 it can be stated that Drying Shrinkage values of BAC-60 was nearly equal to M25 mix
- So from the above results it can be concluded that BAC-60 is showing much resemblance to M25 Mix Design when evaluated from durability point of view.

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