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An Experimental Investigation on Replacement of Fine Aggregate with Washed Bottom Ash

B. Naga Niranjan Kumar, S. Sudheer, S. Karishma, Md. Rajiya Munny, S. Basith Ali, S. Abdulla, S.Chinna Chinthalaiah, P. Krupamani Paul

Department of Civil engineering, Dr. K.V.Subba Reddy Institute of Technology, Kurnnol, Andhra Pradesh, India

ABSTRACT

This paper presents the use of washed bottom ash as fine aggregates in special concrete. The WBA is a waste material that is taken from electrical power plant and the source material is called as BOTTOM ASH. To substitute the amount of carbon usage in concrete the bottom ash was utilized and fully submerged in water for 3 days to produce WBA with low carbon composition. The aim of study is to investigate the feasibility and potential use of washed bottom ash in concreting and concrete applications. The results of physical and chemical properties of WBA were discussed. the mechanical properties of special concrete with 30% WBA replacement by weight of natural sand is found to be an optimum usage in concrete in order to get a favorable strength and good strength development pattern over the increment age.

Keywords : Bottom Ash, Special Concrete, Sand Replacement.

I. INTRODUCTION

Waste Washed Bottom Ash consist of Primarily of uniformly sized, High quality silica Sand i.e. bonded to form molds for ferrous [IRON & STEEL] and nonferrous [COPPER, ALLUMINIUM] metal casting foundries use high quality size specific silica sand for use in their molding and casting operations. The Washed Bottom Ash Normally higher quality than bank run or natural sand used in fill construction sites.

In casting process, molding sands are recycled and reused multiple times however the recycling sands degrades to the point that it can no longer be reused in the casting process.

The Automotive industry and its parts suppliers are the major generations of Washed Bottom Ash. The physical and chemical properties of Washed Bottom Ash are depending on the casting process.

Washed Bottom Ash was first introduced by Chinese for making of pots now a day's INDIA is the second place in the world for manufacturing of Washed Bottom Ash.

II. METHODS AND MATERIAL

1. Problem Statement

Now–a-days, the use of Fine aggregate for concrete production has increased rapidly due to increase in number of construction industries. The increase in rate of production of concrete leads to increase in demand for raw materials which in turn leads to price hike of raw materials. Also this demand may be due to scarcity in availability of raw materials mostly the Fine aggregate. This problem of importing normal water from other places at a higher price has brought the idea of using the locally available natural waste material in the place of this Fine aggregate. So, by using the waste washed bottom ash which is abundantly available at the thermal power plant from source of coal. Much of the economy of construction could be saved.

So, by using waste washed bottom ash from the thermal power plant as a normal fine aggregate replacement in preparation of concrete will save our earth for a sustainable environment.

2. Aim and Objective

The objectives of this study are:

1. To determine the performance of using washed bottom ash as a fine aggregate in concrete.
2. To determine the most economic material that can be suitably replaced for construction.
3. To fulfil safe environment by using waste materials.
4. To investigate the basic properties such as Flexural Strength, Compressive strength of washed bottom ash replaced concrete in comparison with Normal water sand used concrete.

3. Scope of The Study

The scope of the study will be focused on the performance of concrete using washed bottom ash as a partial replacement with Fine aggregate. In this study washed bottom ash is collected from kadapa district, Andhra Pradesh, India. The sample was taken on the thermal power plant.

4. Mix Design

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative propositions with the object of producing concrete of certain minimum strength and durability as economically as possible. The mix design is based on as IS: 10262-2009.

Water Ml	Cement	Fine aggregate	Coarse aggregate
186	375	630	1092
0.49	1	1.63	2.91

Table - 1: Shows Mix Design for M30 grade

5. Test on Materials

5.1 Cement

PSC of JSW PLUS was used in this study. The following physical test should be conduct in the laboratory as per IS codes

SL. NO.	PHYSICAL TESTS	OBTAINED RESULTS	REQUIREMENTS AS PER IS CODES
1	Fineness	5%	Not >10% as per IS 4031 part 1
2	Standard Consistency	35%	IS 4031 part 4
3	Initial Setting time	35min	Not less than 30 minutes as per IS 4031 part 5
4	Final setting time	252 min	Not more than 600 minutes as per IS 4031 part 5
5	Specific gravity	3.01	IS 2720 part 3

Table 2 : Physical Test results of cement

5.2 Aggregates

The aggregate used in this study was clean river sand and crushed stone aggregate collected from near Kurnool.

Sl. No	Physical Tests	Obtained results	Requirements as per IS 383
1	Specific gravity		
	a) Coarse Aggregate	2.27	2.6-2.9
	b) Fine Aggregate	2.8	2.6-2.8
2	Water absorption		Not>2%as per IS:2386-Part 3
	a) Coarse Aggregate	0.8%	
	b) Fine Aggregate	0.6%	

Table 3: Physical Test of aggregates

6. Tests on Concrete

6.1 Slump Test

SL NO	Percentage addition of washed bottom ash to concrete	Slump Values in mm.
1	0%	100
2	25%	95
3	50%	93
4	75%	90
5	100%	88

Table 4: Shows the slump values of washed bottom ash used concrete

6.2 Compaction Factor Test

SL NO	Percentage addition of washed bottom ash to concrete	Slump Values in mm.
1	0%	0.96
2	25%	0.95
3	50%	0.92
4	75%	0.90
5	100%	0.88

Table 4: Shows the Compaction factor values of washed bottom ash used concrete

III. RESULTS AND DISCUSSION

All specimens will be moist cured for one day and after moist curing the specimens will be water cured for required days. Traditional curing the cubes moulded with the cement concrete is subjected to curing in the water Tank and then checks the strengths at the age of 7 days and 28 days.

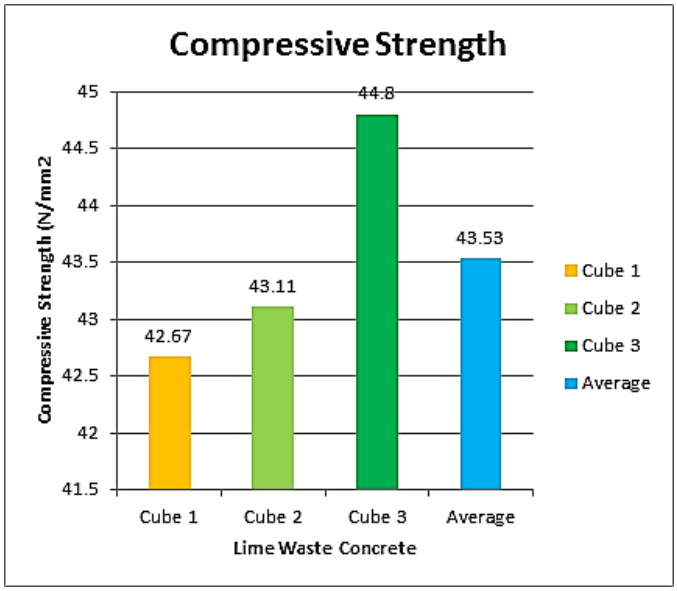


Chart-1

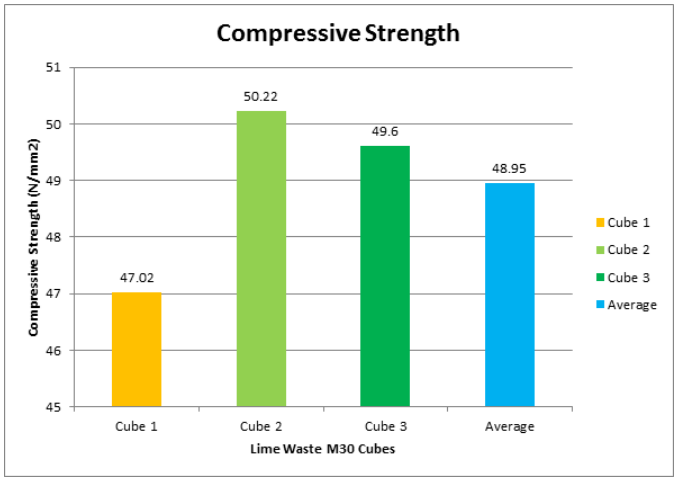
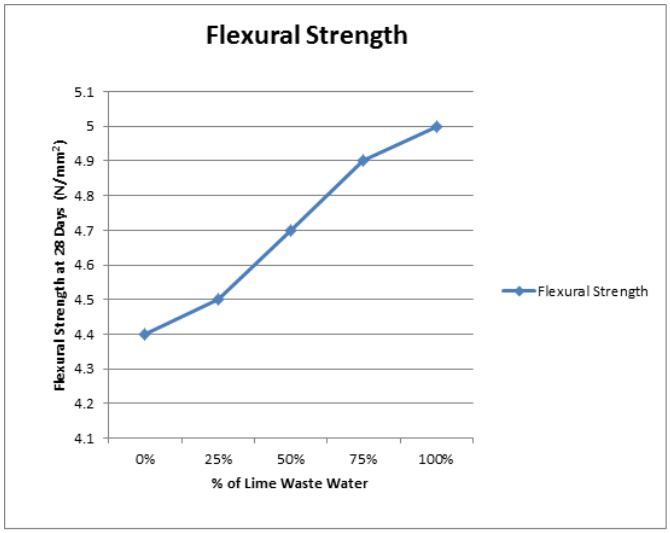


Chart-2



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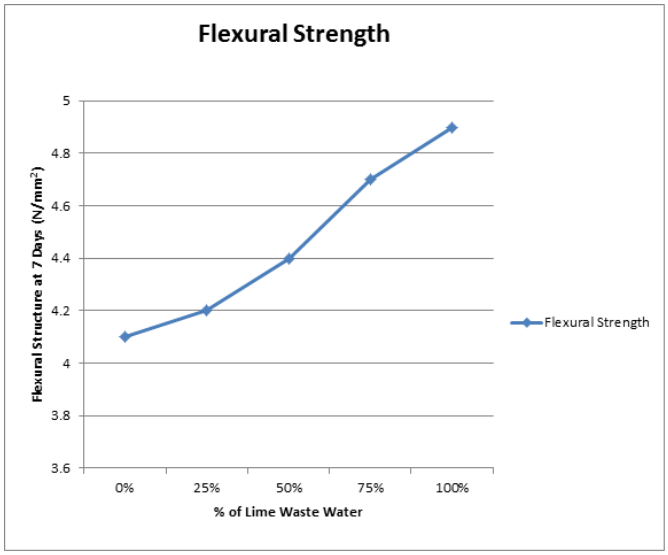

Chart-4

IV. CONCLUSION

From the test results obtained it is evident that ordinary concrete blocks can be made high strength and thereby

it can be used in construction of shear walls, load bearing walls, infill walls etc. It can also be used in earth quake prone areas for higher lateral resistance.

- ✓ Incorporation of waste Washed Bottom Ash increases the strength of blocks and optimum percentage of replacement was found between 20 to 30 %.
- ✓ For 100% replacement efflorescence was noted which may be due to heavy salts present in waste Washed Bottom Ash.
- ✓ Hence 100% replacement is not advisable as it may be harmful for connected R.C.C works like footings,
- ✓ columns, beams, slabs etc.
- ✓ The Indian Standard codes IS 2185(1979) [11] prescribes strength up to 5 N/mm2 for concrete masonry blocks whereas burnt clay bricks are available in different grades starting from a strength of 3.5N/mm2 to 35N/mm2 as per IS 1077(1992) [12]. For special applications heavy duty burnt clay bricks are available in strengths of 40
- ✓ N/mm2 and 45 N/mm2 as per IS 2180(1988) [13]. In the present scenario the code prescribed strengths for concrete masonry blocks are very insufficient to cater the loads especially in seismic regions. So the Indian standard code for the concrete blocks has to be revised accordingly to accommodate a wide range of strengths for different applications.
- ✓ Volumetric batching specified in the code has to be changed to weigh batching in line with the good construction practices as modern weigh batching equipment's are available in affordable cost for the commercial production to ensure durability and consistent strength for the manufactured blocks.

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