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An Experimental Investigation on Strength Characteristic of Rice Husk Ash Based Low Cost Sandcrete Blocks

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Abstract: Concrete blocks containing rice husk ash should be promoted as a new construction material to replace the existing blocks in market. Properties of the material used must be better understood first to obtain the desired concrete block.This paper summarizes the research work on the properties of Rice Husk Ash (RHA) when used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with RHA by weight at 0%, 5%, 10%, 15%, 20% and 25%. 0% replacement served as the control. The Compaction factor, compressive strength, water absorption, moisture movement and modulus of elasticity were investigated. Preliminary analysis of the constituent materials of the ordinary Portland cement and Rice Husk Ash concrete blocks were conducted to confirm their suitability for block making. Physical test of the recently prepared mix was also carried out.. The results revealed that the Compacting factor decreased as the percentage replacement of OPC with RHA increased. The compressive strength of the hardened concrete also decreased with increasing OPC replacement with RHA. It is recommended that further studies be carried out to gather more facts about the suitability of partial replacement of OPC with RHA in concrete.

Keywords:RHA- Rice Husk Ash, OPC-Ordinary Portland cement

I. INTRODUCTION

Sandcrete blocks comprise of natural sand, water and binder. Cement, as a binder, is the most expensive input in to the production of sandcrete blocks. This has necessitated producers of sandcrete blocks to produce blocks with low OPC content that will be affordable to people and with much gain to achieve economy these blocks widely acceptable among the populace so as to minimize the cost of construction. The improper use of these blocks leads to microcracks on the walls after construction. The use of alternative cheaper local materials as stabilizer will greatly enhance the production of sandcrete blocks with the desired properties at low cost. It will also drastically reduce the cost of production and consequently the cost of construction works.

Rice husk is an agro-waste material which is produced in about 100 million of tons. Approximately, 20 Kg of rice husk are obtained for 100 Kg of rice. Rice husks contain organic substances and 20% of inorganic material. Rice husk ash (RHA) is obtained by the combustion of rice husk. The most important property of RHA that determines pozzolanic activity is the amorphous phase content. RHA is a highly reactive pozzolanic material suitable for use in lime-pozzolana mixes and for Portland cement replacement. RHA contains a high amount of silicon dioxide, and its reactivity related to lime depends on a combination of two factors, namely the non-crystaline silica.

This research was experimentally carried out to investigate the effects of introducing Rice Husk Ash (RHA) as a Partial Replacement of Ordinary Portland Cement (OPC) on the Structural Properties of Concrete. Rice Husk Ash which is an Agro-Waste and known to be a Super Pozzoland have been used for mass concrete and found to have compressive strength ranging from 33-38.4N/mm^{2}at replacement percentages of 10-25% in a mix of 1:1.5:3. A further study was carried out on its flexural properties to determine their module of rupture as well as its tensile strength characteristics for the determination of cracking, the values obtained at 28days is 3, 2.5 and 2.4N/mm2 while the tensile strength values are 1.94, 1.17 and 0.91N/mm2 at replacement percentages of 10%, 20% and 25%. This research has proved that RHA Concrete can be used as a Structural Concrete at suitable replacement percentages. This research therefore is an investigation of the performance of the concrete made of partially replacing OPC with RHA on the structural integrity and properties of RHA concrete.

II. OBJECTIVES

➢To utilize RHA for manufacturing sandcrete blocks by partial replacement with cement.
➢Reduce the quantity of fine aggregates. (1:2)
➢Rice husk as we know is a waste material and is thrown away after the rice taken so the cost for rice husk can be said as negligible with a prevailing nature in bonding qualities.

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➢Reduce the cost of construction.
➢To reduce the weight of the concrete block.
➢To economise the whole process of construction.

- To check strength of blocks

III. METHODOLOGY

MATERIALS USED:

Rice Husk Ash (RHA): Rice husk was burnt approximately 48 hours under uncontrolled combustion process. The burning temperature was within the range 600 to 8500C. The ash obtained was ground in a ball mill for 30 minutes and its appearance color was greY. Their physical and chemical characteristics were determined according to the Indian Standards (Table 1). In addition, X-ray diffraction was used to verify the presence of crystalline silica in RHA and a laser diffraction particle size analyzer was used to determine the particle size distribution of RHA.

Table 1: Physical Properties of R.H.A

S.No	PARTICULARS		PROPERTIES
1	Color	Gray	
2	Shape texture	Irregular	
3	Mineralogy	Non crystalline	
4	Particle size	>45 micron	
5	Odour	Odourless	
6	Specific gravity	1.9 - 2.3	

Table 2: Chemical properties of R.H.A

S.No	Particulars		Proportion
1	Silicon dioxide		86.94%
2	Aluminum oxide		0.2%
3	Iron oxide		0.1%
4	Calcium Oxide		03.-2.2%
5	Magnesium Oxide		0.2- 0.6%
6	Sodium Oxide		0.1- 0.8%

Cement: The cement type used in this research was high early strength Portland cement. All their characteristics were according to Indian standards.

Aggregates: The fine aggregate used is a natural sand with fineness modulus of 2.25 and specific gravity 2.58. The coarse aggregate (basalt rock) has maximum size of 10mm and specific gravity 2.96. The project work is restricted to sand collected from the river. The sand was collected to ensure that there was no allowance for deleterious materials contained in the sand. In this research, granite of 20mm max size used. Proper inspection was carried out to ensure that it was free from deleterious materials.

Water:
Water plays an important role in concrete production (mix) in that it starts the reaction between the cement and the aggregates. It helps in the hydration of the mix. In this project, the water used was Pipe borne water and free from contaminants.

Method Followed In Block Production and RESULTS:

For the purpose of this study, about twenty four blocks sandcrete blocks were produced. The total mixing time was 5 minutes, the samples were then casted and left for 24 hrs before de-molding They were then placed in the curing tank until the day of testing Cement, sand, Rice husk ash and fine and coarse aggregate were properly mixed together in accordance with Indian Standard Code of Practice(Is-2185.1.2005) in the ratio 1:2:4 by weight before water was added and was properly mixed together to achieve homogenous material. Water absorption capacity and moisture content were taken into consideration.

The sand was poured on to the concrete floor in the concrete laboratory. The cement, RHA, coarse aggregate and sand were then mixed together to obtain a homogeneous mixture. The measured quantity of water was then sprayed on to the mixture using bucket. The mixture was further turned with shovels until a mix of the required workability was obtained. The resulting mortar was transferred to the block production machine mould to half the depth. This was tamped uniformly over the cross section of the mould with 25 strokes with a tamping rod. More mortar was added and tamped until the mould was

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completely filled to the brim. The block samples were spraying by water in 7 and 28 days.

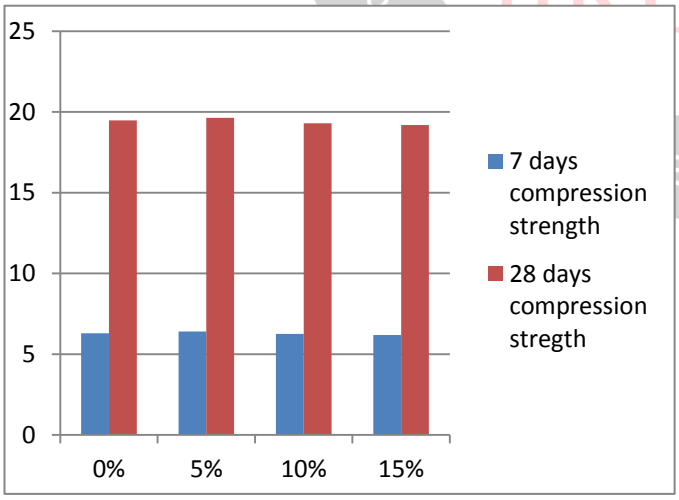
QUANTITY OF SOLID BLOCKS:

Ratio of B	0%	5%	10%	15%	20%	Tot
SOLID BLOCKS	5	6	6	6	5	28

Figure 1 BLOCKS PREPARED

Table 3: COMPRESSIVE STRENGTH OF CONCRETE AT VARIOUS % OF RHA

	Avg compression strength (N/mm^2)			
Days	**0% RHA**	**5% RHA**	**10% RHA**	**15% RHA**
7	6.29	6.4	6.25	6.187
28	19.48	19.63	19.30	19.200



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Block density test:

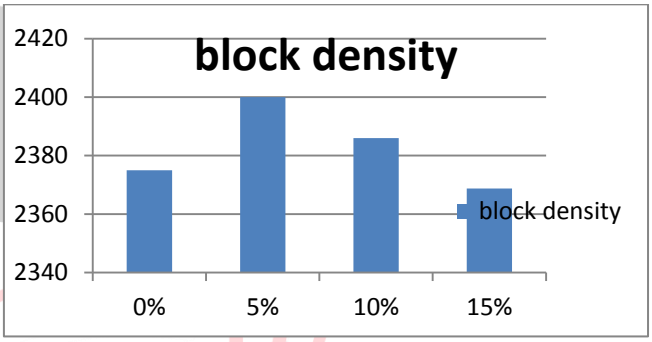
3 blocks shall be taken to conduct this test. To determine the density of block, first heat the block in the oven to 100^{o}c and then cooled it to room temperature. Now take the dimensions of block and from that find out the volume and weigh the block. The density of block is determined from the below relation and the average density of 3 blocks will be the final block density.

Density of block = mass/volume (kg/m^3)

Table 4: Calculation;

% RHA	Weight of block(Kg)	Volume of block(m^3)	Density(Kg/m^3)
0%	19.00	0.008	2375
5%	19.20	0.008	2400
10%	19.09	0.008	2386
15%	18.95	0.008	2368.75

Table no



Water absorption test:

Three full size blocks shall be completely immersed in clean water at room temperature for 24 hours. The blocks shall then be removed from the water and allowed to drain for one minute by placing them on a 10 mm or coarser wire mesh, visible surface water being removed with a damp cloth, the saturated and surface dry blocks immediately weighed. After weighing all blocks shall be dried in a ventilated oven at 100 to 115^{0}C for not less than 24 hours and until two successive weighing at intervals of 2 hours show an increment of loss not greater than 0.2 percent of the last previously determined mass of the specimen. The water absorption calculates as given below:

Absorption, percent = (A-B)/B * 100

Where,A = wet mass of unit in kg.
B = dry mass of unit in kg.

Observation and calculation:Table:5

% of RHA	Avg block weight after 24hrs curing(Kg).		Water absorption in%
0%	19.650	18.69	5.14 %
5%	19.850	18.59	6.78 %
10%	19.790	18.49	7.04 %
15%	19.700	18.28	7.77 %

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IV. CONCLUSION

From the tests conducted on OPC/RHA hollow sandcrete blocks as in the various sections, the following conclusions are made:

For a given mix, the water requirement increases as the rice husk ash content increases and setting times of OPC/RHA paste increase as the ash content increases. The density of OPC/RHA is within the range for sandcrete blocks (500 to 2100kg/m3) The compressive strength of the blocks for all mix increases with age at curing and decreases as the RHA content increases; Due to the low cost of the materials, the manufacturing cost also decreases and the compressive strength is also good. Rice husk is available in significant quantities as a waste and can be utilized for making blocks. This will go a long way to reduce the quantity of waste in environment; The optimum replacement level of OPC with RHA is 20%replacement. So we conclude that the rice husk ash that is used in the replacement of ordinary Portland cement can be utilized in day today life of manufacturing building blocks which are more economical and more eco-friendly than the cement concrete blocks which are produced now-a-days…

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