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Rice Husk Ash Sandcrete Block as Low Cost Building Material

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ABSTRACT
Concrete is a widely used construction material for various types of structures due to its structural stability and strength. The construction industry is today consuming more than 400 million tonnes of concrete every year .Most of the increase in cement demand will be met by the use of supplementary cementing materials, as each ton of Portland cement clinker production is associated with similar amount of CO_2 emission, which is a major source of global warming. Partial replacement of ordinary Portland cement with mineral admixtures like fly ash, ground granulated blast furnace slag, silica fume, metakaolin, Rice husk Ash (RHA),etc with plasticizers eliminates these drawbacks. The use of rice husk modifies the physical qualities of fresh cement paste as well as microstructure of paste after hardening. By burning the rice husk under a uncontrolled temperature in the atmosphere, a highly reactive RHA was obtained and the ash was utilized as a supplementary cementing material. This paper presents the effects of using Rice Husk Ash (RHA) as a partial cement replacement material in mortar mixes. This work is based on an experimental study of mortar made with replacement of Ordinary Portland Cement (OPC) with 10%, 20% 30% & 40% RHA. The properties investigated were the compressive strength, setting time, consistency, workability and specific gravity. Finally, a cost analysis was also done to compare the efficiency of rice husk ash sandcrete blocks. From the test results it can be concluded that rice husk ash 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.
Keywords *:Rice husk ash, Pozzalano, sandcrete, mortar*

I. INTRODUCTION

In the last few decades several researches are being carried out for using cementitous materials in concrete production as a partial replacement material for cement. India produces 18 million tons of rice husk annually and it is estimated that approximately 12 million tons are readily available for disposal from the rice mills. It is an excellent cement replacement material which is 20% of 12 million. Rice husk is an agricultural residue obtained from the outer covering of rice grains during milling process. It constitutes 20% of the 500 million tons of paddy produced in the world initially rice husk was converted into ash by open heap village burning method at a temperature, ranging from 300 ^{o} C to 450 ^{o} C.

When the husk is converted into ash by uncontrolled burning below 500 degree Celsius the ignition is not completed and considerable amount of unburnt carbon was found in the resulting of ash. Carbon content in excess of 30% is expected to have an adverse effect upon the pozzolanic activity of RHA. The ash produced by controlled burning of the rice husk between 550 to 700 degree Celsius incinerating temperature for 1 hour transforms the silica content of the ash into amorphous phase.Thereby reducing the potential CO_2 emission

RHA is fibrous, crystalline and amorphous. It is found that RHA in cement or concrete leads to the improvement in various properties, and also the compressive strength increase for different age. Mehta has observed that 70% of cement replaced by RHA, the strength was slightly higher than the cement mortar it also understood that the percentage of carbon decides the compressive strength in cement mortar. Cook suggested that the cement replacement with RHA is limited to 30%. Many researchers(1,2) observed that increase in compressive strength ranged between 10 to 20% for concrete mixtures 10, 15 and 20% RHA in concrete.It was also found that on partial replacement of cement using RHA in cement mortar that there is gradual reduction in strength with the increase in % of RHA.Dashan I. I and Kamang had observed this experimental study aimed to analyze the effect of rice husks as fine aggregate in terms of water-cement ratio, quality and size of coarse aggregate, and consistency of the mixture and determine how rice husk differ with other ordinary concrete mix as fine aggregate in terms of water adsorption, compressive strength, tensile strength and modulus of elasticity. This also aims to help contribute to the industry in saving the environment, to encourage the government to find solutions regarding the disposal to landfills of waste materials and save the environment, to provide new knowledge to the contractors and

developers on how to improve the construction industry methods and services by using rice husk, and to sustain good product performance and meet recycling goals. Observations from the tests performed were conducted in the laboratory where precise data were gathered and completely attained. Each year large quantity of RHA produced and is an environmental concern. RHA is taking as replacement material in this project. Concrete blocks containing rice husk ash can be used as a new construction material to replace the existing blocks in market.

II. OBJECTIVES OF THE INVESTIGATION

- To utilise 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 is taken so the cost for rice husk can be said as negligible with a prevailing nature in bonding qualities.
- Reduce the cost of construction.
- To reduce the weight of the concrete block.
- To reduce the pollution during the manufacturing of cement.
- To economise the whole process of construction.

III. METHODOLOGY OF STUDY

To study the the mechanical properties of concrete with RHA, specific gravity test, setting time time test and compressive strength test were conducted on specimens with 0%,10% ,20%,30% & 40% RHA replacement with cement. Rate analysis was also performed to check whether it is economical to replace it with cement.

IV. MATERIAL DESCRIPTION

Materials used in this study consisted of Portland cement type 1, water, rice husk ash, fine aggregate and coarse aggregate and superplasticiser.

4.1 Rice Husk Ash

Rice husk is an agricultural residue obtained from the outer covering of rice grains during milling process. The rice husk used for the study was collected from a local rice mill. The RHA was burnt in open air condition and grinded. The physical and chemical properties of all the materials were studied in detail. The IS 90

Concrete blocks with different proportion of replacement of rice husk ash such as 10%,20%,30% and 40% are casted .The compressive strength of the block samples was determined in accordance with the standard procedure for pre-cast concrete blocks. Samples

micron sieve was used to sieve RHA to obtain best specific surface area.

	Parameters	Percentage
1	SULPHUR TRIOXIDE (SO3)	0.24 %
2	CARBON (C)	5.91 %
3	LOSS IN IGNITION	5.44 %
4	SILICON DIOXIDE (SIO_2)	87.20 %
5	ALUMINIUM OXIDE (AL_2O_3)	0.15 %
6	FERRIC OXIDE (FE_2O_3)	0.16 %
7	CALCIUM OXIDE (CaO)	0.55 %
8	MAGNESIUM OXIDE (MgO)	0.35 %

4.2 Super Plasticiser

Glenium B233 is a ready-to-use liquid, based on modified polycarboxylic ether which is dispensed into the concrete together with the mixing water. The product has been primarily developed for applications in high performance concrete where the highest durability and performance is required. Glenium B233 is free of chloride & low alkali. It is compatible with all types of cements.. The plasticising effect and water reduction are higher if the admixture is added to the damp concrete after 50 to 70% of the mixing water has been added. The addition of Glenium B233 to dry aggregate or cement is not recommended. Thorough mixing is essential and a minimum mixing cycle, after the addition of the Glenium B233, of 60 seconds for forced action mixers

V. EXPERIMENTAL INVESTIGATION

In order to pre-mix design, the general physical properties of cement, sand and gravel were calculated. Tests on setting time and workability were conducted to evaluate the physical properties of rice husk ash used in the study and results are tabulated in table 2.The specific gravity of rice husk was found to be 2.16

Table 2 Setting time and workability

S.No	% Replacement With OPC	Initial setting time(min)	Final setting time (Hours)	Workability (mm)
1.	0%	30	9	100
2.	10%	25	9 hours 30 minutes	95
3.	20%	20	10	95
4.	30%	15	10	90
5.	40%	60	12	88
6.	50%	70	15	80

were immersed into water 24 hours before testing. The weights of the block samples were always taken before the compressive strength test was conducted. Ten sample blocks were crushed each at 7, 14, 28 days after casting at different

replacement levels using the compressive testing machine.

Figure 1 Compressive Strength test on Sandcrete Blocks

VI. RESULTS AND DISCUSSION

From the compressive strength results ,it was found that upto 20 % it has shown in considerable increase in compressive strength, so optimum percentage of replacement can be taken as 15 -20%.

Specimen	Weight of Block (Kg)	Size (Inches)	Rate Per Piece (Rs)
RHA 10	6.89	6	16
RHA 20	6.10	6	15
RHA30	5.75	6	13
RHA40	5.50	6	12

Table 3 Compressive strength of sandcrete block:

Mix Ratio	Average Weight Of Block (Kg)	Water Content (%)	Compressive Strength (N/mm²)		
			7 days	14 days	28 days
90% OPC & 10% RHA	6.89	0.54	4.56	5.67	8.88
80% OPC & 20% RHA	6.10	0.55	4.11	5.24	6.88
70% OPC & 30% RHA	5.75	0.56	1.76	2.75	3.88
60% OPC & 40% RHA	5.50	0.57	1.25	1.87	2.23

VII. RATE ANALYSIS

As per the recent market rates we have compared the following commodities and with the percentage usage with the Indian market. For hollow and solid blocks which are manufactured in industries need cement, sand, chemical oil, chip powder and chips. the market price for these blocks are characterised according to the width of the blocks and which are for 4 inch block it is 19 rupees, for 6 inch block it is 29 rupees and for 8 inch it is 40 rupees as in comparison to manufacture rice husk ash sandcrete blocks where only a partial replacement of cement is done as 10%,20%,30%,40% and its price ranges from 16 rupees for 10%,15 rupees for 20%,13 rupees for 30%,12 rupees for 40%.as we can see that as the percentage for replacement of cement increases in the building of rice husk ash sandcrete blocks, the price goes decreasing but the compressive strength as also to be considered, so we conclude that 30% replacement of rice husk is the most appropriate replacement to manufacture these low cost building blocks. Since the price for rice is very low, the price is very affordable for every status of building. A comparison is made between a normal solid block,concrete block and a block made with different replacement levels of rice husk is tabulated in table 3 & 4

Table 3 Rates of different types of block

Shape of Block	Size of Blocks (Inches)	Rate Per Piece (Rs)
SOLID BLOCK	4	19
	6	29
	8	40
HOLLOW BLOCK	4	19
	6	29
	8	40

Table 4 Cost of Rice Husk Ash Sandcrete blocks

VIII. CONCLUSIONS

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

- The rice husk ash produced using charcoal from firewood is pozzolanic and therefore is suitable for use in block making.
- For a given mix, the water requirement increases as the rice husk ash content increases;
- The setting times of OPC/RHA paste increases 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 our environment;
- The optimum replacement level of OPC with RHA is 15 -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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