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Studies on strength and durability properties of rice husk ash concrete

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Abstract
The waste product (rice husk ash) is already causing very serious problem of surrounding environmental pollution which causes for most way to handling for this ash. The rice husk ash was mainly contains silica and aluminium ion contents. In this experimental research conducted on Rice Husk Ash (RHA) concrete to analyse the compressive strength and to study its water absorption properties. The preparation of rice husk ash concrete, cement was replaced by weight at different percentage levels like as 0%, 5%, 10%, 15%, 20% and 25% with M20 grade of concrete and 0.50 water cement ratio. The various fresh and harden concrete properties test was conducted like compaction factor and slump cone test as well as harden concrete properties like compressive strength and water absorption properties at the age of 7 and 28 days obtained. The experimental results shows that the maximum replacement level of 20% with weight of cement. Beyond limits of increasing level of cement strength will be reduced.

Keywords: rice husk ash, water absorption, compressive strength

1. Introduction
Ordinary Portland Cement (OPC) is popularly known about the universally adopted construction material. Many researchers, engineers and scientists are all over the world to focussing on the ways of utilizing either agricultures or industrial waste as a origin of raw materials for industry. This waste materials utilization not only economical but also to reduce environmental pollution and also to conserve the natural resources like water, land and air.The industrial waste materials like that, bagasse ash, fly ash, silica fume, ground nut shell ash are being used as a cement replaced materials.an trial to

Now a days, there has been trial to use the large amount a rice husk industry and rice husk the residue from rice husk biomass fuel from electrical generation industry having amorphous silica, which has the pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement. So that, it is possible to use rice husk ash as cement replacement material to improve quality and reduce the cost of construction materials such as mortar specimens, concrete paver blocks, concrete roof tiles and soil cement interlocking block. This research paper analyses the effect of RHA in concrete by partial replacement of cement at the ratio of 0%, 5%, 10%, 15% and 25% by weight. The experimental study determine the compressive strength, and water absorption of concrete. The main ingredients consists of Portland cement, RHA, river sand, coarse aggregate and water. After mixing, concrete specimens were casted and subsequently all test specimens were cured in water at seven and 28 Days.

2. Experimental programme
2.1 Materials used
Ordinary Portland cement of 53 grade conforming to Indian standard IS: 12269 (1987) was used for the present experimental investigation. Its specific gravity is 3.15. The cement was tested as per the procedure given in Indian standards IS 4031 (1988).

2.1.1 Cement
Ordinary Portland cement used 43 grade conforming to Indian standards 8112 – 2013 was used for the present experimental investigation. Its specific gravity is 3.02. The cement was tested asper the procedure given in Indian standards

Table 1: Chemical composition of Rice husk ash

S. no	Chemical properties	% in values
1	SiO_2	86.32
2	CaO	2.51
3	MgO	0.44
4	Iron Oxide	0.67
5	Na_2O_3	0.12
6	K_2O	2.91

2.1.2 Fine aggregate
Fine aggregate and retained on 600 µm sieve, conforming to Zone II as per the river sand, passing through 4.75 mm sieve IS 383-1970 was used as fine aggregate in the present study. The sand is free from deleterious impurities. The aggregate was tested for its physical requirements such as gradation, fineness modulus, and specific gravity in accordance with IS:2386-1963.

2.1.3 Coarse aggregate
A crushed stone angular granite metal of20mm nominal size from the local available source is used as coarseaggregate. It is free from deleterious impurities such as dust, clay particles and organic matter etc.

2.1.4 Water
The water used for the study was obtained from a tap water from environmental laboratory. The water was clean and free from unwanted impurities. The pH value should not be less than 6 asper IS456 - 2000.

2.1.5 Rice husk Ash
The Rice Husk Ash was obtained from modern rice mill at alangulam, Tirunelveli, District. In open air atmosphere in the under normal temperature. The burning ash was passed through 90 micron sieve. It contains silica, lime, iron oxide and alumina.

2.1.6 Mix design
The mix proportion for the M20 grade of concrete is using IS: 10262 -2009. The ratio of materials required for M20 grade of concrete 1: 1.47:3.10 with water cement ratio 0.50.

3. Experimental investigation
The compressive strength test and water absorption test for M20 grade of concrete were experimentally analysed. The concrete cube size for 150mm x 150mm x 150mm and 100mm diameter with 50mm thick cylindrical disc for water absorption test was carried out. The test should be carried out as per codal provision IS 516: 1959.

3.1 Compressive Strength Test
Compressive strength test was carried out on the concrete specimens after 7 and 28 days of curing by universal testing machine. The test should be carried out as per codal provision IS: 516-1959. Totally 36 cubes were casted. The compressive strength is calculated by Fck = P/A
P = total load in N
A = cross sectional area of concrete specimens in mm^2
Fck = Characteristic strength of concrete cube.

3.2 Water Absorption Test
For water absorption 100mm diameter with 50mm thick cylindrical disc was casted and tested after 28 days and 56 days continuous curing period. Then after cube specimen were dried for 24 hours at open atmosphere. This weight should be measured in Kg (W_1). Then afterspecimens were kept in water for 24 hours, this wet weight noted is (W_2).

% of water absorption should be calculated is =
$$[(W_2-W_1) / (W1)]*100.$$

Where
W_1= Oven dry weight of cylindrical disc.
W_2 = Wet weight of cylindrical disc after 24 hours.

Table 2

sl.no	% replacement of cement	Average compressive strength in N/mm^2	
		7 days	28 days
1	0	15.40	22.20
2	5	17.00	23.40
3	10	18.20	24.30
4	15	20.10	25.40
5	20	21.30	26.20
6	25	15.80	18.90

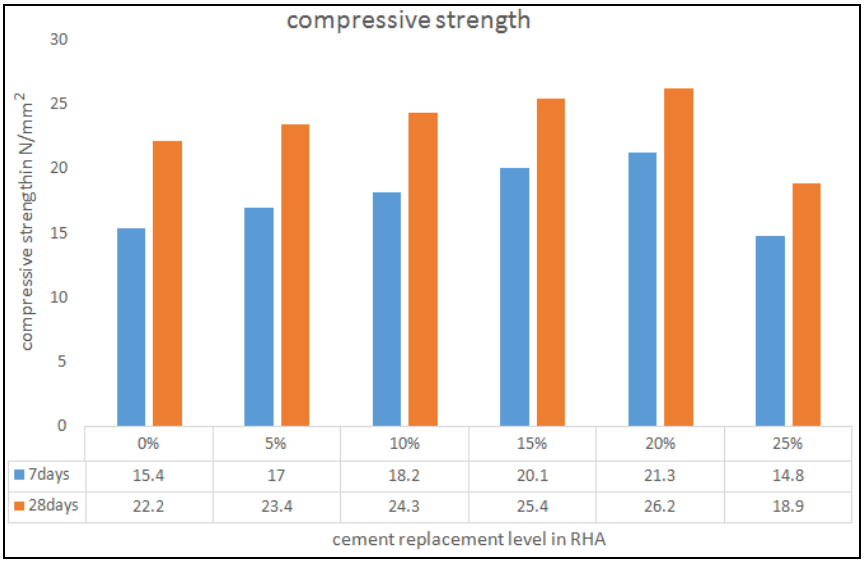

Fig 1: Compressive strength in RHA concrete

Table 3: Water absorption in RHA concrete

Sl No	% replacement of cement	Average water absorption in %	
		28 days	56 days
1	0	1.22	1.20
2	5	1.10	1.10
3	10	0.98	1.05
4	15	0.87	0.95
5	20	0.79	0.85
6	25	1.30	1.15

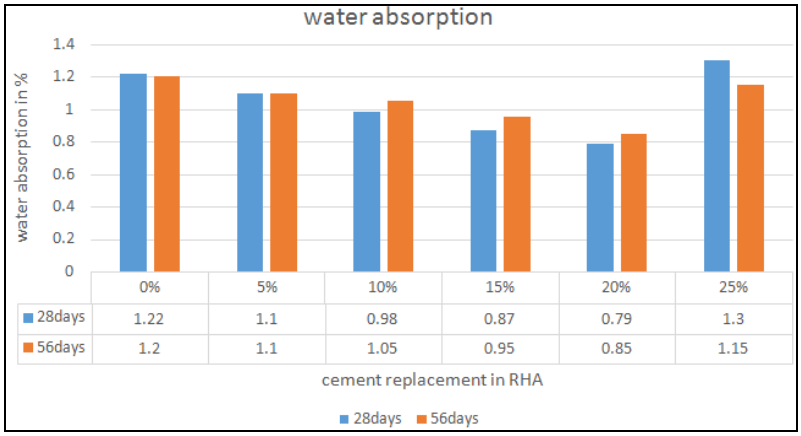

Fig 2

4. Results and Discussion

4.1 Compressive strength test

The Compressive strength test results after 7 days and 28days are shown in given Table – 2. The experimental test results shows that in the strength increases at 20 % replacement by Rice Husk Ash. There is an increase in strength of concrete up to 20% replacement of cement by RHA because after the replacement of 20%the potassium oxide content in RHA gets increases which disrupt the concrete, thereby decreases its strength. This is illustrated in Fig.1

4.2 Water absorption test.

The Figure 2 and Table 3 shows that water absorption for conventional concrete is more than optimum mix because the RHA is a fineness material, it may block the pores in the concrete there by decreases its water absorption capacity.

Conclusion

The experimental test results shows that the rice Husk Ash in blended concrete had significantly higher compressive strength, and lower water absorption properties compare to that of the concrete without RHA. Itis obtained that the cement could be advantageously replaced with RHA up to maximum limit of20%. The strength of concrete decreases with increase in RHA content, low weight concrete produced in the society with waste materials of rice Husk Ash.

- The compressive strength of 20% replacement of RHA shows an increase of 39.21% and 18.01% for 7days and 28days.
- Test conducted on water absorption showed that the optimum mix with RHA absorbs only less amount of water when compared to Conventional mix. This may be attributed to the fineness of RHA that blocks the pores thereby reducing its water absorption capacity.

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