International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163
Volume 1 Issue 6 (July 2014) http://ijirae.com

ALTERNATE AND LOW COST CONSTRUCTION MATERIAL: RICE HUSK ASH (RHA)

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Abstract— Due to pozzolanic reactivity, Rice Husk Ash is used as a supplementary cementing material in concrete. It has economical and technical advantages to be used in concrete. I am going to replace cement by the use of RHA by 5%,10% & 15% by weight of cement in three different experiment to find out the maximum strength and compare it with the strength of normal concrete by using the grade of M20 at the days of 7 and 14. 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.

Keywords- Rice Husk Ash, concrete and structural properties of RHA

INTRODUCTION

Rice husk is generated from the rice processing industries as a major agricultural by product in many parts of the world especially in developing countries. About 500 million tons of paddy is produced in the world annually After incineration only about 20% of rice husk is transformed to RHA. Still now there is no useful application of RHA and is usually dumped into water streams or as landfills causing environmental pollution of air, water and soil. RHA consists of non-crystalline silicon dioxide with high specific surface area and high pozzolanic reactivity, thus due to growing environmental concern and the need to conserve energy and resources, utilization of industrial and biogenic waste as supplementary cementing material has become an integral part of concrete construction. RHA is an active pozzolana. Pozzolans improve strength because they are smaller than the cement particles, and can pack in between the cement particles and provide a finer pore structure. RHA has two roles in concrete manufacture, as a substitute for Portland cement, reducing the cost of concrete in the production of low cost building blocks, and as an admixture in the production of high strength concrete.

MATERIALS-

Rice Husk Ash (RHA):

Rice Husk used in this experiment was obtained from N.K Enterprises,Surat,Gujrat. specification, physical and chemical properties as given by the supplier are given in the table:

Table 1 Specifications:

Silica	90% min
Humidity	2% max
Mean particle size	25 microns
Color	Grey
Loss on ignition at 800°C	4% max

Table 2 Physical Properties of Rice Husk Ash:

Physical state	Solid-non hazardous
Appearance	Very fine powder
Particle size	25 microns-mean
Color	Grey
Odour	Odourless
Specific gravity	23

Table 3 Chemical Properties of Rice Husk Ash:

SiO_2	93.80%
Al_2O_3	0.74%
Fe_2O_3	0.30%
TiO_2	0.10%
CaO	0.89%
MgO	0.32%
Na_2O	0.28%
K2O	0.12%

Cement:
Cement used in the experiment work is White Portland cement conforming to IS: 8042-1989. The properties of White cement is nearly same as OPC. A typical test result of Birla White Cement as given by manufacturer are shown in Table

Table 4 Chemical Properties:

Characteristics	IS:8042:1989	Birla White
Insoluble residue%	Max 2.0	0.60
Iron oxide%	Max 1.0	0.20
Magnesium oxide%	Max 6.0	0.80
Sulphur trioxide%	Max 3.0	2.90
Alumina/iron oxide%	Min 0.66	9.0
Lime saturation factor	0.66-1.09	0.9
Loss on ignition%	Max 5.0	<3%

Table 5 Physical Properties:

Characteristics	IS:8042:1989	Birla White
Degree of whiteness%	Min 70	88+
Fineness(m^2/kg)	Min 225	450
Setting time: Initial(minutes) Final(minutes)	 Min 30 Max 600	 80 120
Compressive strength(cement and standard sand mortar 1:3) 3 days (MPa) 7 days 28 days	 Min 14.4 Min 19.8 Min 29.7	 45 55 67
Soundness 1.Lechateliers method(mm) 2.Autoclave expansion%	 Max 10 Max 0.8	 1.0 Negligible
Retention on 63 micron sieve%	-	1.0

Fine Aggregates:
Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone III as per the specifications of IS 383:1970.
a) Specific gravity = 2.7
b) Fineness modulus = 2.71

Coarse Aggregates:
Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates.
a) Specific gravity =2.64
b) Fineness Modulus = 6.816

Water:
Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water is used.

Mix design for M-20 Grade Concrete-

Design Stipulations:
Characteristic Compressive Strength required at the end of 28 days: 20 N/mm^2
Maximum size of Aggregate: 20mm (Angular)
Type of Exposure: Moderate
Degree of Quality Control: Good

Test Data For Materials:
Specific Gravity of Cement: 3.15

Specific Gravity of Coarse Aggregate: 2.64
Specific Gravity of Fine Aggregate: 2.70

Target Mean Strength of Concrete:
For a tolerance factor of 1.65, the obtained target mean strength for the given grade of concrete
= 20 + 4.6 x 1.65 = 27.6 N/mm^2

Selection of Water Cement Ratio:
The free water cement ratio for the obtained target mean strength is 0.50.This is equal to the value prescribed for Moderate conditions in IS 456-2000.

Determination of Cement Content:
For M20 concrete volume of cement required for 1cum of concrete = (1/5.5)×1.57=0.286m^3
1 bag of cement contains 0.034m^3 volume
No. of cement bags required for 1 cum concrete
= 0.286/0.034 =8.4 bags
cement required in kg = 8.4×50 = 420kg

Selection of Water and Sand Content:
For 20 mm nominal maximum size aggregate and sand confirming to grading zone III, water content per cubic meter of concrete =420/2 kg=210 kg and sand content as percentage of total aggregate by absolute volume = 33 %.

Determination of Coarse and Fine Aggregate:
Fine aggregate required =1.5×420=630kg/m^{3}coarse aggregate required=3×420=1260kg/m^3

Table 6 The mix proportion then becomes

Water	Cement	Fine aggregate	coarse aggregate
0.5	1	1.5	3.0
210kg	420kg	630kg	1260kg

Note-In this experiment, we prepared 6 test specimens of control concrete,5% ,10%,15% cement replaced by rice husk ash by weight.

Table 7 The results of the compressive strength of RHA Concrete-

	Age (days)	Control concrete	Percentage Replacement with RHA		
			5%	10%	15%
Average Compressive strength N/mm^2	7 14	18.59 20.59	20.81 22.22	19.33 19.77	17.77 17.77

Table 8 for Increase or decrease in strength at 7 And 14 days with respect to % replacement of RHA-

	Age	Percentage Replacement with RHA		
		5%	10%	15%
Increase(+) or decrease (-) strength %	7 14	11.9 7.92	3.98 -3.98	-7.15 -13.69

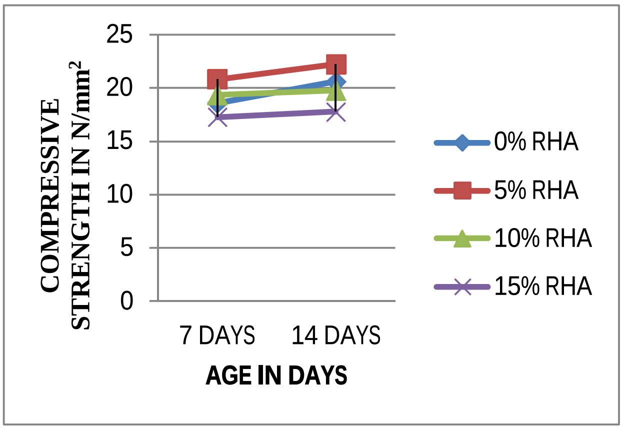

Fig.1 Variation of Compressive strength with age and percentage of Rice Husk Ash

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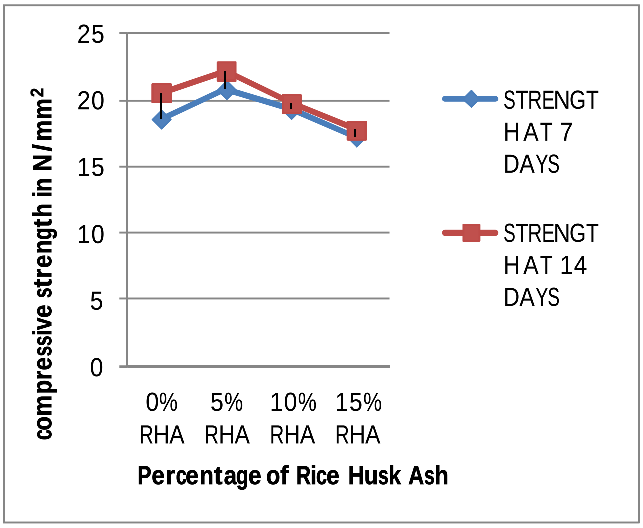

Fig. 2 Percentage of Rice Husk Ash v/s Compressive strength

CONCLUSIONS-

Based on the limited study carried out on the strength behaviour of Rice Husk ash and saw dust the following conclusions are drawn:

- At all the cement replacement levels of Rice husk ash; there is gradual increase in compressive strength from 0 days to 7 days. However there is significant increase in compressive strength from 7 days to 14 days
- At the initial ages, with the increase in the percentage replacement of Rice husk ash, the compressive strength increases.
- By using this Rice husk ash in concrete as replacement, the emission of greenhouse gases can be decreased to a greater extent. As a result there is greater possibility to gain more number of carbon credits.
- The technical and economic advantages of incorporating Rice Husk Ash in concrete should be exploited by the construction and rice industries, more so for the rice growing nations of Asia.
- Moreover with the use of rice husk ash , the weight of concrete reduces, thus making the concrete lighter which can be used as a light weight construction material.

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