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A Experimental Study on Partial Replacement of Cement by RHA

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***Abstract*— The partial replacement of PPC cement with Rice Husk Ash (RHA) has been discussed in this paper. It is known that RHA is a cheaply available and unused material, but it can be used as the replacement of cement because the silica content in RHA is more. In this experiment cubes of 150 mm dimensions were casted by replacing PPC by RHA in 0%, 5%, 10%, 15% & 20% of the weight of cement respectively and their compressive strength was tested after 1, 3,7 & 28 days of curing by using the compression testing machine. From this experiment we came to know that the compressive strength of the cubes with desired percentages of RHA gradually increases from 0-10% and gets its peak at 10% after that it gradually decreases with increase in percentage of RHA. From this present study it is seen that RHA can be an effective partial replacement of cement as it proves to have more strength, cost effective and eco-friendly in nature.**

Keywords—RHA, PPC, Compressive strength, Slump test

I. INTRODUCTION

The cost of building materials these days is so high in a few sections of the world; especially in developing nations, that lone the administration, enterprises, business participation and couple of individual can bear the cost of it. This high and as yet increasing expense can however be diminished to a base by utilization of option building materials that are shoddy and locally accessible. Some mechanical and horticultural items that would some way or another litter the earth as waste or, best case scenario can be putting it into productive utilization as building material rather than dumping it.

Rice husk is a farming deposit generally accessible in significant rice producing nations. The husk encompasses the paddy grain. The processing procedure results rice, broken rice and grains of about 78% of weight of paddy grains and remaining 22% is husk. This husk is utilized as fuel in different factories to create steam for the parboiling procedure. This husk contains around 75 % natural unpredictable matter and the rest 25 % of the weight of this husk is changed into cinder amid the terminating procedure, this Ash is known as rice husk cinder. This RHA contains around 85 % - 90% formless silica.

Different research works have been completed on the blend mixes of PPC and OPC with different pozzolans in making concrete composites (Adewuyi and Ola, 2005; De Sensale, 2006; Saraswathy and Song, 2007; Ettu et al, 2013). Their study demonstrated that blend of RHA with lime creates a powerless cementitous material which could however be utilized to settle laterite and enhance the bearing quality of the material. Habeeb and Fayyadh (2009) researched the impact of RHA normal molecule estimate on the properties of concrete and discovered that at early ages the quality was practically identical, while at 28 days old RHA displayed higher quality than the specimen.

II.MATERIALS

A.Cement

Pozzolanic Portland cement is manufactured by using pozzolanic materials as one of the main ingredients. The percentage of pozzolanic material used in the preparation should be between 10 to 30%. If the percentage exceeds, the strength of cement is reduced. Here we are taking the PPC of 43grade.

B.Aggregate

Aggregates are inert granular materials such as sand, gravel or crushed stone. They are also the raw materials that are an essential ingredient in concrete. It is of two types coarse and fine aggregate. The fine aggregate is the material usually known as sand or river sand which is used in the construction, it is sieved in 4.75 mm sieve and used in the construction. Then comes the coarse aggregate which is usually taken of size 10-35 mm and here in this paper we have used the combination of the 10mm and 20mm stone chips as our coarse aggregate.

C. RHA(Rice Husk Ash)

The Rice Husk used in this experiment was procured from the nearby rice mill. After collection, the Rice Husk was burnt at a temperature of around 700 0 C within an enclosed place to prevent its blowing off. The ash was ground to the required level of fineness and sieved through 300 µm sieve in order to remove any impurity and larger size particles. This sieved ash is the pozzolanic material which was used in the experiment. Here below the chemical properties of the cement and RHA is given in table 1.

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Table 1: Composition of PPC and RHA

	PPC (In %)	RHA (In %)
CaO	66	0.67
SiO_2	22	88.32
Al_2O_3	3.5	0.46
Fe_2O_3	3	0.67
MgO	2	0.44
Na_2O_3	0.5	0.12
LOI	1	5.81
K_2O	2	2.91

III.METHODOLOGY

A.Mix proportion

By taking the M20 grade into consideration five blends were prepared utilizing distinctive rates of 0%, 5%, 10%, 15% and 20% of RHA. The proportion for M20 grade is 1:2:4, in this term we had taken one part of cement, two parts of fine aggregate and 4 parts of coarse aggregate. Here the water cement ratio is taken as 50% or 0.5. The actual mixing proportion by quantity can be seen in the table 2.

Table 2:- Quantity of materials as per the proportion

%age of RHA	Grade	Cement	Fine Aggregate	Coarse Aggregate	W/C Ratio	RHA
0	M_{20}	1	2	4	0.5	0
5	M_{20}	0.95	2	4	0.5	0.05
10	M_{20}	0.9	2	4	0.5	0.1
15	M_{20}	0.85	2	4	0.5	0.15
20	M_{20}	0.8	2	4	0.5	0.2

B.Slump test

First of all the slump cone of bottom diameter 20cm and top diameter 10cm with a height of 30cm was taken and placed on a base plate. After placing the cone the concrete was poured up to a height of the 1/3rd of the slump cone. After filling the concrete, the concrete was tamped for 25 times with the help of a steel tamping rod of diameter 16mm and a height of 60mm for compacting. This procedure was repeated until the slump cone was filled up. After the top layer was filled, the top layer was tamped and was trimmed to fill exactly the top. This operation should be carried out without any vibration. Within 2 minutes the slump was gradually removed. The concrete was subsiding. This subside is known as slump.

The slump cone was kept beside the subsided concrete and the difference was measured between the slump cone and subsided concrete.

C.Compressive strength

A mould of dimension (150*150*150) mm3 was taken. The mould to be used should have rigid connection with base essential in order to prevent the leakage of mortar during compaction. The cube was filled with fresh concrete in 3 layers and was compacted well using standard tamping rod of diameter 16mm and a height of 60mm. Each layer should be compacted with 35 blows . The tamping rod should enter the previous layer while tamping the subsequent layer. After compacting the top layer the surface was made in flat with edges of mould by the help of a trowel then the cubes were kept for 24hrs and then the moulds were taken off and the cubes were kept for curing for 1,7, 14, 28 days. After curing the cubes were tested in the compression testing machine for respective days of curing and the results were noted.

IV.RESULT AND DISCUSSION

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A.Slump test

In the present work this test is being taken for the proper elaboration of the different characteristics of the concrete mix like- consistency and workability. So, by conducting the test by proper procedure we got some result which is being placed below in the table 3.

Table 3:- Height of slump according to the %age of RHA

% OF RHA	SLUMP (cm)
0	22.5
5	19.0
10	20.5
15	21.7
20	21.3

Here the results what we got comes under the true slump category that is the height of the slump can be measured. The slump test conducted for the plane concrete resulted in 22.5 cm height which is the highest among all other percentages of RHA taken and the lowest occurred in 5% mix of RHA. The overall result shows that the workability of the concrete mix is high which can be considered as sound and can be used in any type of construction.

B.Compressive strength

The maximum compressive stress that the cubes can withstand or sustain without fracture is known as the compressive strength of the concrete. Here the compressive strength of the concrete cubes with different percentage of RHA was measured at the end of 1st, 7th, 14th and 28th day of curing and the result is being shown in the table 4.

Table 4:- compressive strength of the concrete mix

% OF RHA	CURING PERIOD			
	1 DAY	7DAYS	14DAYS	28 DAYS
0	9.8	14.2	16.2	25.2
5	10.1	13.4	18.5	27.2
10	10.9	14.8	20.8	29.6
15	10.6	13.3	16.1	25.3
20	10.4	13.7	16.4	23

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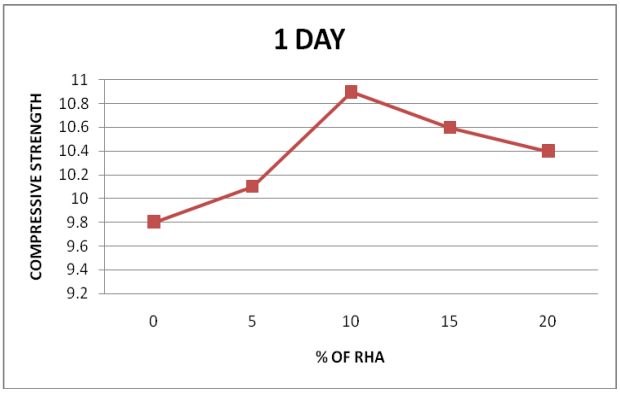
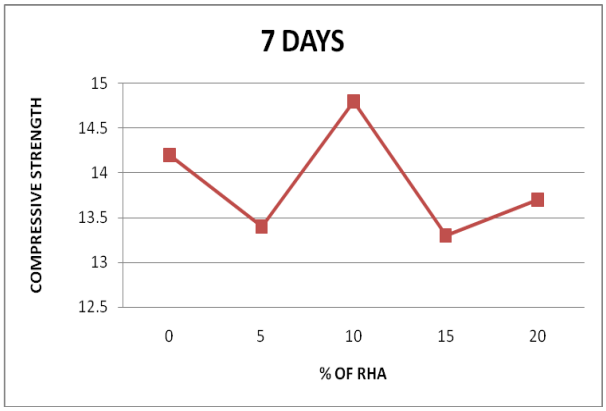
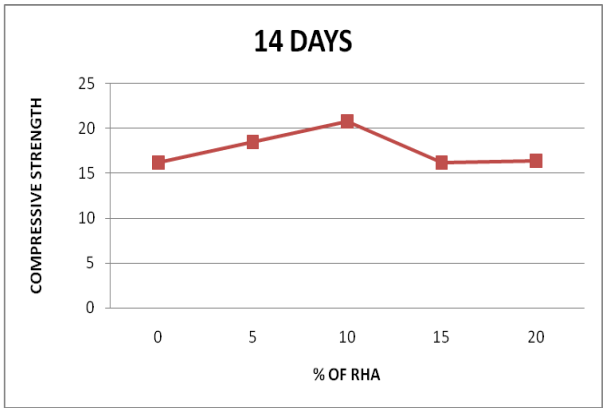
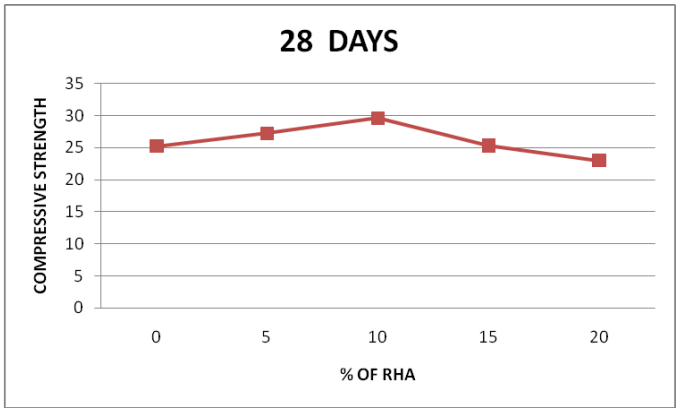
Here we got the compressive strength of the concrete mix in different percentage and in different curing periods. So, from the above table we found that 10% of RHA results in maximum compressive strength in all curing periods. On the first day 0% RHA bears the lowest compressive strength and the highest was of 10% of RHA. Similarly the test result of the seventh day shows the lowest in the 15% of RHA and highest in the 10% of RHA, then on the fourteenth day lowest was in the 15% of RHA and highest was 10%of RHA. Finally on the 28th day which is the last curing day and it has been seen concrete gets its total bearable strength on this day and the result we got is 20% of RHA shows the lowest and 10% the highest. From the above table we can clearly view that the strength increases with the increase in the percentage of RHA up to 10% and the again gradually falls which can be seen in the graphs given bellow.



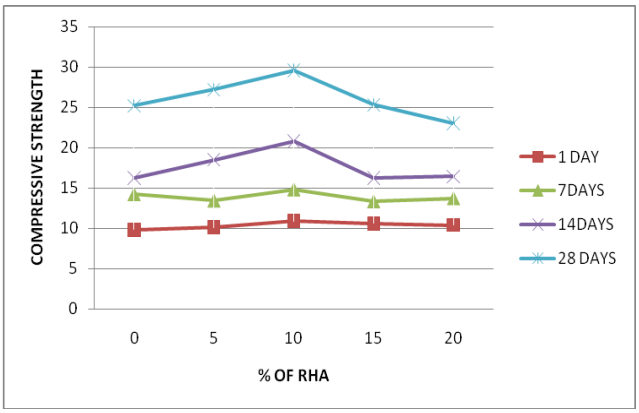






Graph 1:- Graphical representation of compressive strength for different days of curing

Here we have got the different graphs as per the data given in the table no 4. In the present work according to the graph the 10% of RHA results in highest compressive strength in all the curing periods and the lowest values varies.



Graph 2: Combined Graphical representation of compressive strength for different days of curing

V.CONCLUSION

By getting through the total work we came to the outcome that we can use RHA as the partial replacement of the cement as:-

- It contains a heavy amount of silica which truns into a binding material when gets in contact with water.
- 10% of RHA gives better result than all other percentages of RHA including normal concrete.
- It is having an cost effectiveness as rice husk is a waste product and is dumped as waste.
- The concrete where RHA is used is highly workable and can be used in all sorts of construction works.

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