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The Use of Rice Husk Improving the Final Setting Time and Compressive Strength of Concrete

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***Abstract*— The present investigation was carried out to use agricultural waste as an alternative to Portland cement in cement concrete mixture. Cement is world's most widely used & marked as most expensive constitute of concrete mixture. The Entire construction industry is in search of a suitable and effective waste product that would considerably minimize the use of cements and ultimately reduce that construction cost. Rice husk ash could be an alternative for ordinary Portland cement in concrete production. It was observed that with the employment of rise husk in concrete mixture final setting time gets reduced with no other effect in overall compressive strength of the mixture.**

Keywords*— Compressive strength, Initial and Final setting time, OPC (Ordinary Portland cement), RHA (Rice Husk Ash).

INTRODUCTION

In developing countries, Agriculture waste disposal is a major problem. The use of waste materials in the construction has benefits not only in reducing the amount of waste materials requiring disposal but can also provides construction materials with significant saving over new materials. Rice Husk is produced in millions of tons per year as a waste material in agricultural processes. About 78, 48,401 metric tons (2013) Rice produced in Chhattisgarh only. By burning the rice husks under a controlled temperature and atmosphere a highly reaches rice husk ash is obtained. RHA is a highly pozzolanic material. The non crystalline silica and high specific surface are RHA are responsible for high pozzolanic reactivity. RHA has been used pozzolanic mixes and could be a suitable partial replacement for Portland cement. Many other researchers have confirmed rice husk ash a pozzolanic material that can be used to partially replace OPC in making cement composites.

The use of RHA as a partial replacement to cement will provide an economic use of the by product and consequently produce cheaper blocks for low cost building. Use of RHA with cement improves workability and stability reduces heat evolution, thermal cracking and plastic shrinkage. A good way of utilizing the material is to use it for making high performance concrete which means high workability and long-term durability of the concrete.

The objective of this study was to investigate the use of RHA is producing high strength concrete with the expected compressive strength at the age of 28 days to be higher than 37N/mm^2. Physical and chemical properties of the cementations material are tested. The effects of RHA as a cement replacement on concert properties such as compressive strength, initial and final setting time, fineness test were investigated.

MATERIAL USED

(I) Cement

Cement used in the experimental work is ORDINARY PORTLAND CEMENT conforming to IS: 1489 (Part1)-1991. The physical and chemical properties of the cement obtained on conducting appropriate tests as per IS: 269/4831 and the requirements as per IS 1489-1991 are given in Table 1 & Table 2.

Table 1: Physical properties of procured OPC

S. No.	Particulars	Test result
1	Specific gravity	3.15
2	Fineness (sieve analysis)	3.2%
3	Normal consistency	30%

Table 2: Chemical Properties of Procured OPC

S. No.	Particulars	Proportion
1.	Silicon dioxide(SiO_2)	19.71%
2.	Aluminium oxide(Al_2O_3)	5.20%
3.	Iron oxide(Fe_2O_3)	3.73%
4.	Calcium oxide(CaO)	62.91%
5.	Magnesium oxide(MgO)	2.54%
6.	Sodium oxide(Na_2O_3)	0.25%
7.	Potassium oxide(K_2O)	0.90%
8.	Sulphur oxide(SO_3)	2.72%
9.	Ignition loss(LOI)	0.96%

(*II) Rice Husk Ash-*

RHA produced after burning of Rice Husk has high reactivity and pozzolanic property Chemical compositions of RHA are affected due to burning process and temperature. As per study by RHA produced by burning rice husk between 600 to 700 ^{0}C temperature for 2 hours

Table 3: Physical properties of procured Rice Husk Ash

S. No.	Particulars	Properties
1	Colour	Grey
2	Shape Texture	Irregular
3	Particle size	< 45 micron
4	Odour	Odourless
5	Specific gravity	2.3
6	Appearance	Very fine

Table 4: Chemical properties of Rice Husk Ash.

S. No.	Particulars	Proportion
1.	Silicon dioxide(SiO_2)	86.94%
2.	Aluminium oxide(Al_2O_3)	0.2%
3.	Iron oxide(Fe_2O_3)	0.1%
4.	Calcium oxide(CaO)	0.3 – 2.2%
5.	Magnesium oxide(MgO)	0.2 – 0.6%
6.	Sodium oxide(Na_2O_3)	0.1 – 0.8%
7.	Potassium oxide(K_2O)	2.15 – 2.30%
8.	Ignition loss(LOI)	3.15– 4.4%

Fig.1:- Rice Husk

Fig.2:- Rice Husk Ash

(III) Aggregates

1. Fine Aggregate-

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

2. Coarse Aggregate-

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

Super plasticizers are usually highly distinctive in their nature, and they make possible the production of concrete which, in its fresh or hardened state, is substantially different from concrete made using water-reducing admixtures.

(IV) 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 in to very carefully. Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions.

METHOD

In this project we are partially replaced the Cement with Rice Husk Ash. So the different types of test are performed.

(I) FINENESS TEST OF CEMENT AND RICE HUSK ASH

In this method the test sample material (Cement and Rice Husk Ash) 800 gm, IS: 90 micron sieve and sieve shaker are used to find the percentage weight of residue over the total sample reported for 15minutes. The percentage residue should not exceed 10%.

Fig.3:- 90 micron sieve

Fig.4:- Sieve Shaker

Table 5: Particle size analysis

Fineness Test	Cement	10% Replacement of cement by RHA
For 15min	Weight of residues = 2.12%	Weight of residues = 3.85%

(II) CONSISTENCY TEST OF CEMENT AND RICE HUSK ASH

In consistency test of 300gram material are used and vicat apparatus conforming to IS:5513-1976, balance of capacity 1kg and sensitivity to 1gram, Gauging trowel conforming to IS: 10086-1982, and plunger.

Fig.3:- Mixing & filling of cement paste in mould

Fig.5:- consistency test of cement

Table 6: Value of cement and cement + 10% RHA in consistency test

Consistency Test	Cement (300gram)	10% Replacement of cement by RHA (270gram cement + 30gram RHA)
Weight of water added standard consistency (%)	30%-32%	38%

(III) INITIAL SETTING AND FINAL SETTING TIME OF CEMENT AND RICE HUSK ASH

For this test Vicat apparatus, Needle and stop watch is used. Take 300 gm of cement and (270gm cement + 30gm RHA) in a pan. For initial setting and final setting time of cement and RHA.

Fig.6:-Initial Setting Time

Fig.7:- Final Setting Time

Table 7: Value of Initial and Final Setting Time

Setting Time	Cement	10% Replacement of cement by RHA
Initial Setting Time	37min	48min
Final Setting Time	9 hrs and 10min	6hrs and 40min

(IV) COMPRESSIVE STRENGHT TEST OF CEMENT MORTAR AND RICE HUSK ASH

In Compressive test 7.05cm cubes moulds, mixing tools for mortar, vibrator, and compressive testing machine are used. Test should be conducted for 3 cubes and report the average value as the result for 3day, 7day and 28day compressive strength.

Fig 8:- Compressive strength testing machine

Table 8: Value of Compressive Strength in different days

Compressive Strength Test	Cement	10% Replacement of Cement by RHA
3day	9.46N/mm^2	9.05 N/mm^2
7day	15.08N/mm^2	14.88 N/mm^2
28day	37.96N/mm^2	37.04 N/mm^2

RESULT AND DISCUSSION

(1) The physical property of RHA that influence the activity in gaining strength is its fineness. RHA required having equal or finer than OPC for its good cementing efficiency. The fineness of the 43 grades OPC in this research are found to be 2.12% residue on 90 micron sieve size respectively. Fineness of RHA is found to be 3.85% This shows that RHA is of almost equal size to cement particles. Thus, it is expected to have appreciable influence on the strength development on concrete.

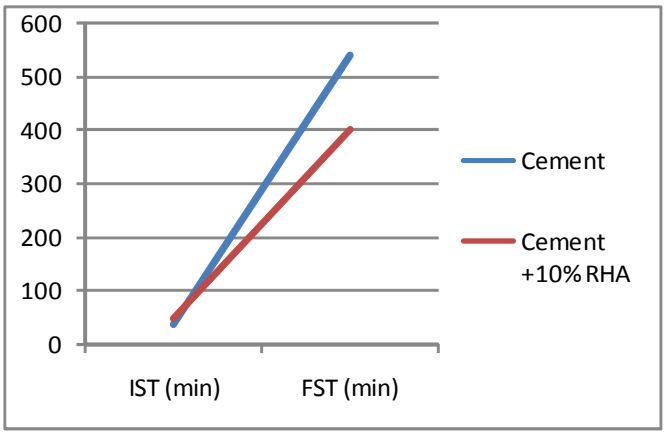
(2) Variation of setting time (IST) is increased & final setting time is decreased with increasing RHA content. This behavior may be due to the low rate of hydration in the paste containing RHA. Variation of normal consistency for different grade of OPC using different percentage of RHA. The normal consistency of 43 grade cement is higher by 9% as compare to that of 33 grade cement. The slump and compacting factors test decrease upon the inclusion of RHA as partial replacement of OPC. Thus, it can be inferred that to attend the required workability mixes.

- The requirement of **initial setting time** of cement should be more, and 'cement+ 10% RHA' has comparatively more than the cement.

- The requirement of **final setting time** of cement should be less, and 'cement+ 10% RHA' has comparatively less than the cement.

Table 9: Comparison chart of setting time

Setting Time	Cement	Cement + 10%RHA
Initial Setting Time(IST)	37min	48min
Final Setting Time (FST)	540min(9hr and 10min)	400min (6hr and 40min)



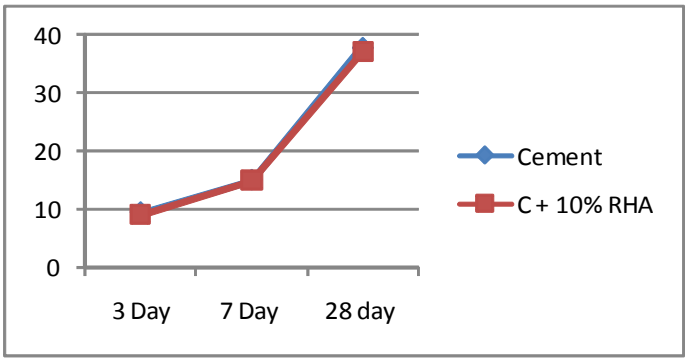
Graph 1:- Variation of Setting Time

(3) The compressive strength of concrete in all grades of OPC at early age is significantly higher than that of concrete produced with RHA. It was also observed that compressive strength continued to increase with age but decrease with RHA contents in all grade of OPC.

The number of Test taken with number of variation out of which following result with 10% replacement of cement with RHA for 3 day and 7 day of curing proved as a most economical and having good compressive strength. 9.05 N/mm^2 and 14.88 N/mm^2 respectively.

Table 10: Value of compressive strength in different day

Compressive Strength	Cement	C + 10% RHA
3 day	9.46 N/mm^2	9.05 N/mm^2
7 day	15.08 N/mm^2	14.88 N/mm^2
28 day	37.96 N/mm^2	37.04 N/mm^2



Graph 2:- Variation of compressive strength

COST ESTIMATION

- Cost of 1bag of cement = 300
- Weight of 1 bag cement = 50 kg
- Replacement of cement = 10%
- Received weight = 5kg
- Rate of 5kg cement = 30 /- (Rs.)

Hence we are saving 30/- in per bag of cement.

CONCLUSIONS

Based on the experimental results obtained in the study, the following conclusions may be drawn:-

- This method can solve two major problems i.e. higher concrete cost & managing agricultural waste.
- By using 10% rise husk in concrete mixture, final setting time reduced with no other effect in overall compressive strength of the mixture.
- Rice Husk Ash is easily available agricultural waste it gives durable concrete.
- By using this mixture net weight of the concrete gets reduced.

From all the tests performed and result interpretive it can be concluded that the partial replacement of cement with RHA is advantageous and adoptable.

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