Experimental Investigation on Cement by Partial Replacement by using Rice Husk Ash

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Abstract— **In India rice milling produces a by product which is known as Husk. This husk is used as fuel in rice mills to produced steam for boiling process .This husk contain near about 75 % organic matter and the remaining 25% of this husk is modified into Ash during the firing process which know n as rice husk ash (RHA). The rice husk ash (RHA) contain near about 85 % to 90 % amorphous silica. By using rice husk ash in concrete , we can improve the properties of concrete. The current study and experimental investigation were taken to study the properties of concrete made with Rice husk ash . the replacement is done partially in the proportion of 0%,20% and its effect on workability of concrete made with rice husk ash were investigated for the 20% rice husk ash replacement ,the hardened properties such as compressive strength observed were good as compare to 0 % RHA . The compressive strength test was conducted at 0 % and 20 % rice husk ash replacement and the highest compressive strength at 20 % RHA replacement as compared to 0% RHA replacement at 14 ,21 and 28 days. The emission of CO2 has increased due to cement manufacturing and improper disposal of rice hush ash (RHA) leads to air pollution and land fill problem. To mitigate these issues, the RHA has been used as cement additive in concrete making. A Taguchi L27 fractional-factorial matrix was designed to assess the individual effects of key process variables like RHA loading, pozzolano activity, curing time, bulk density and RHA size.**

This Project presents the study of Rice Husk Ash and problems of disposal of the Marble of RHA are also sort out to some extent. Compressive strength test are conducted on RHA mortar. The cube with RHA in various percentage, then properties like compressive strength are studied. Compressive Strength Test will carry for all the mix proportions and for all the replacement For compressive strength test will testing for 7, 14 and 28 days for all the replacements. The study giving comparative results for mortar compressive strength test. In this project we use mortar proportion 1:3, 1:4 and 1:5 and its replaced with R.H.A 5%, 10%, and 15%.

Keywords— Concrete; Rise Husk Ash, Replacement, Compressive strength

INTRODUCTION

Concrete is the most widely used material on earth after water. Many aspects of our daily life depend directly or indirectly on concrete. Concrete is prepared by mixing various constituents like cement, water, aggregate, etc.In rice mill during the milling of paddy near about 78%of weight is received as rice, broken rice and bran. The rest 22 %of the weight of paddy is received as husk. This husk is also used as fuel in the rice mills for the boilers for processing paddy and also used in a small power plant for producing energy. Rice husk Contains about 75 % organic volatile matter which burns up and the balance 25 % of the weight of this husk is converted into ash during the firing process, which is known as rice husk ash (RHA).This RHA is a great environment threat causing damage to the land and the surrounding area in which itis dumped. Lots of ways are being thought of for disposing it by making commercial use of this RHA. It is estimated that roughly 90 million tons of RHA are generated throughout the world every year. In India 77.7 billion eggs are produced in the year 2010-2011. Tamil Nadu having share of around 20 %, is ranked second with almost 2,000 core Peddy husk ash created in the state every year. The next in the list of prominent RHA producing states in India comprise tamilnadu, karnataka, kerala and West Bengal. Rice husk ash is generally thrown away as a waste. The egg shell also creates some allergies when kept for a longer time in garbage. Disposal is a problem. It creates undesirable smell which can cause irritation. Rice husk partially replacement in cement fine at 5%, 10% & 15% replacement grade of M20.

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REVIEWOF LITERATURE

Ashif M. Qureshi et al., [2010] (1) An Experimental investigation to check the effect on Rice husk ash on property of concrete in this paper investigate entire construction industry is in search of an effective the waste product that would considerably minimize the use of cements and ultimately reduces the construction cost. The use of waste -products is an environmental friendly, method of disposal of large quantities of materials that would otherwise pollute land, water and air. In this investigation we use some cementing materials like Rice husk ash (RHA) and Egg shell powder (ESP) as a replacement of cement and found that the strength parameters of concrete (Compressive and Flexural) at different replacement levels at 7, 14 and 28 days of curing for M-25 grade is greater as compare to control concrete.

Ashif M et al., [2015] Innovative use of Rice Husk Ash Fly Ash and Egg Shell Powder in Concrete (2) Throughout the world, concrete is being widely used for the construction of most of the buildings, bridges etc. Hence, it has been properly labeled as the backbone to the infrastructure development of a nation. Currently, our country is taking major initiatives to improve and develop its infrastructure by constructing express highways, power projects and industrial structures to emerge as a major economic power and it has been estimated that the infrastructure segment in our country is expected to see investments to the tune of Rs.4356 billion by the year 2009. To meet out this rapid infrastructure development a huge quantity of concrete is required.

D.Gowsika et al., [2014] (3) Experimental

Investigation of RHA Powder as Partial Replacement with Cement in Concrete this paper reports the results of experiments evaluating the use of Rice husk ash powder production industry as partial replacement for ordinary Portland cement in cement mortar. The chemical composition of the egg shell powder and compressive strength of the cement mortar was determined. The cement mortar of mix proportion 1:3 in which cement is partially replaced with egg shell powder as 5%, 10%, 15%, 20%, 25%,30% as weight of cement.

Obilade, I.O et al.,[2010] Use Of Rice Husk Ash As Partial Replacement For Cement In Concrete (4) This paper summarizes the research work on the properties of Rice Husk Ash (RHA) when used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with RHA by weight at0%, 5%, 10%, 15%, 20% and 25%. 0% replacement served as the control. Compacting factor test was carried out on fresh concrete while Compressive Strength test was carried out on hardened 150mmconcrete cubes after 7, 14 and 28 days curing in water.

S.A. Raji et al., [2015] Rice husk Ash as a Fine Aggregate in Concrete for Sustainable Construction (5) this work has investigated the potential use of used egg shell as a concrete material. The used egg shells were used as fine concrete aggregate. In the laboratory test, conventional fine aggregate was replaced at 100% replacement level. A total of 18 cubes were cast, cured and tested. The strength development of the concrete mixes containing egg shell aggregates was compared to that of conventional concrete with sand as fine aggregate.

III. MATERIALS AND METHODS BASIC MATERIALS USED

Concrete is made up of mixture of cement, fine aggregate, coarse aggregate and water. Since the basic constituents of concrete vary from place to place it is necessary to conduct the basic tests on the materials. The various tests on basic materials of concrete such as cement, replacement materials, fine aggregate and coarse aggregate.

I. CEMENT

Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. OPC 53 grade cement was used. The tests involved in cement for the properties given below.

Sl. N	Test on Cement	Value Obtaid	Permissible Value	IS Code
1	Specific gravity	3.25	3-4	IS 2720(part III) 1980
2	Fineness test	8%	10%	IS:4031(part I) - 1996
3	Soundness te	7 mm	Max 10 mm	IS:4031(part III) - 1996
4	Standard consistency test	31%	-	IS:4031(part IV) - 1996
5	Initial setting time	44 minute	Min 30 minut	IS:4031 (part V) - 1996
6	final setting time	560 minut	max 600 minutes	IS:4031 (part V) - 1996

FINE AGGREGATE

Fine aggregate is naturally sand or crushed stones and which is passed through the 4.75 mm sieve. For the mix, fine aggregate is the component which fills the voids occurred by coarse aggregate and cement which leads to higher strength of concrete. The various test conducted on fine aggregate to determined its properties are given below

II. TABLE 2 TEST RESULT ON FINE AGGREGATE

Sl.N	Test	N.A	E.S	Permissible Value	IS Code
1	Specific gravit test	2.8	3.4	2-3	IS:2386(partII)- 1963
2	Water absorption test	1.6 %	1.1 %	≤20%	IS:2386(partII)- 1963

COARSE AGGREGATE

Coarse aggregate are particles greater than 4.75mm. But generally range between 4.75mm

to 37.5mm in diameter. The various test conducted on coarse aggregate to determine its properties are given below.

Table 3 Test Result on Coarse Aggregate

Sl.N	Test	N. A	Permissible Value	IS Code
1	Specific gravity test	2.8	2.5-3	IS:2386 (par III) -1963
2	Water absorptio	0.8	≤ 20%	IS:2386 (par III) -1963
3	Impact test	9.2	≤ 10%	IS:2386 (par IV) -1963

III. 3.3. MIX DESIGN

Water cement (w/c) ratio = 0.5

Weight of cement = 394 kg/m^3

Weight of fine aggregate = 734.27 kg/m^3

Weight of coarse aggregate = 1177 kg/m^3

IV. TABLE 4MIX DESIGN

Description	Water	Cement	Fine Aggregate	Coarse Aggregate
Quantity	198litrs	396 kg/m^3	736.27 kg/m^3	1178 kg/m^3
Mix ratio	0.5	1	1.86	2.98

V. METHODS

Sourcing of Materials

Various materials are collected for this project such as cement, fine aggregate, coarse aggregate. The crushed burn rice husk ashes are obtained from in rice mill is obtained from market, which are used as replacement material.

VI. PREPARATION OF MATERIALS

The rice husk ash are dried, crushed and prepared for the replacement of cement and fine aggregate.

VII. PROPORTIONED MIXING

The mix proportion was derived as per IS: 10262-1989 from which the amount of cement, water, fine aggregate, coarse aggregate for 1 m^3 is determined. With this mix ratio the specimens were prepared and tested.

VIII. SAMPLE PREPARATION AND CURING

The normal concrete and replaced concrete was prepared with the mix ratio of 1:1.86:2.98. The specimens were casted and cured for the development of the strength of the concrete. The curing period of the specimens was upto 7, 14,

28 days. The specimens were tested for compressive strength at 7, 14, 28 days.

II. TEST ON CONCRETE

Concrete has both fresh and hardened properties to determine the workability and strength of the concrete. The workability of concrete was determined by slump cone test, which is the simplest method. To determine the hardened concrete properties compressive strength was tested.

IX. SLUMP CONE TEST

According to IS: 1199-1959, the slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows. For roof and floor slabs a slump value must be 100mm and the mix design is carried out for this value of slump. Figure 1 shows the apparatus used to determine the workability of fresh concrete.

Fig no.1 Slump cone test

X. VEE BEE TEST

The values of Vee-Bee value obtained by experimentally were tabulated below and it is found that the value of Vee-Bee value goes on increases with incremental percentage of rice husk ash (RHA). Vee bee test results are shown in Table 4

Table 5 : Vee bee test results

S. NO	RHA Replacement	Vee-Bee Value (sec)
1	0%	9
2	5%	11
3	10%	21
4	15%	25

XI. COMPACTION FACTOR TEST

The experiment test conducted on various percentage of rice husk ash (RHA) for concrete mix M15 to find compaction factor is tabulated below. As per IS:456-2000 compacting factor for pavement is in range of 0.75 to 0.80. Compaction factor test results are shown in Table 6.

Fig no.2 Compaction factor test

Table 6 Compaction factor test

	RHA Replacemen	COMPACTION FACTOR (%)
1	0%	0.874
2	5%	0.853
3	10%	0.762
4	15%	0.743

COMPRESSIVE STRENGTH TEST

ACCORDING TO IS: 516-1959, COMPRESSIVE STRENGTH OF CONCRETE IS THE CAPACITY OF A MATERIAL TO WITHSTAND THE PREPARE YOUR PAPER BEFORE STYLING

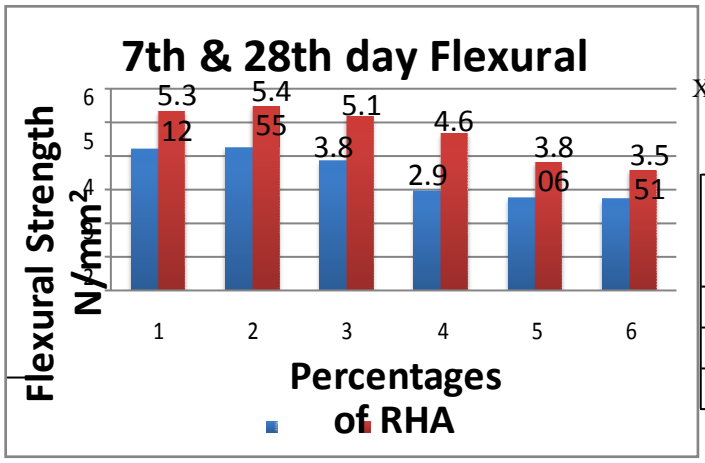
COMPRESSIVE STRENGTH TEST

According to IS: 516-1959, compressive strength of concrete is the capacity of a material to withstand the loads that are applied axially. It is tested by various replacement specimen 150x150x150mm cubes. Figure shows the machine used to determine the compressive strength of concrete

Fig 3 Compression Test Machine

FLEXURAL STRENGTH OF CONCRETE

In this test, a plain concrete beam is subjected to flexure using symmetrical two point loading until failure occurs. Because the load point is placed at 1/3rd of the span, the test is also called as third point loading test. The theoretical maximum tensile stress reached in the bottom fiber of the test beam is called modulus of rupture. Flexural strength test are shown in Figure.



Results of 28th day Split tensile strength for different percentage of RHA.Split tensile strength decreases with the increases in RHA. Split tensile strength test are shown in Fig.

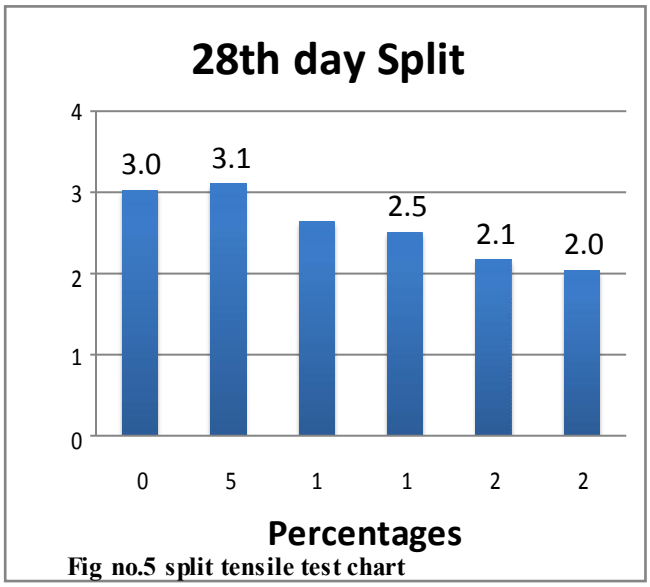


Fig no.5 split tensile test chart

SPECIMEN LABEL

Table 7 shows the various specimens casted and their labels for the reference.

SI.N	SPECIMEN NAME	SPECIMEN LABEL
1.	Normal concrete	NC
2.	Concrete replaced with 5% of RHA	RHA 5
3.	Concrete replaced with 10% of RHA	RHA 10
4.	Concrete replaced with 15% of RHA	RHA 15

RESULTS OBTAINED

The results obtained from the compressive strength of concrete replaced with RHA and for various percentages at 7, 14 and 28 days of curing are noted

COMPARISON OF RESULTS

XII. TABLE8 COMPRESSIVE STRENGTH RESULT OF RHA AND NC AT 7 DAYS

Cube No.	NC (MPa)	RHA 5% (MPa)	RHA 10% (MPa)	RHA 15% (MPa)
1.	15.11	13.70	15.33	14.44
2.	15.33	14.40	16.40	15.15
3.	16.00	15.01	17.02	16.42

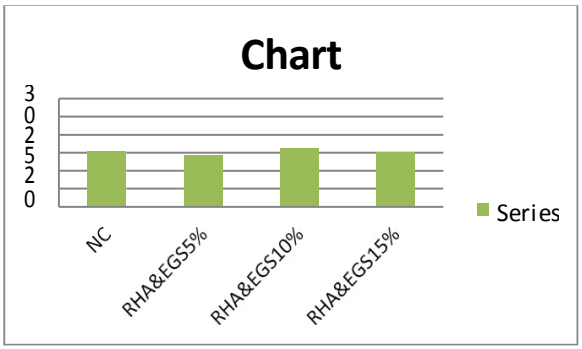


Fig 6Graph of compressive strength of RHA at 7 days

From the graph, it was found that by the replacement of RHA & EGS 5%, the compressive strength was 7.5% lesser than NC. It is depicted that by addition of RHA 10%, the compressive strength was 4.97% higher than the NC. When compared to NC, RHA & 15%, replacement showed 3.2% lesser compressive strength than NC.

XIII. COMPARISON OF RESULTS OF NC WITH RHA& AT 14 DAYS

Table and graph shows the results obtained from the comparison strength of 14 daystest

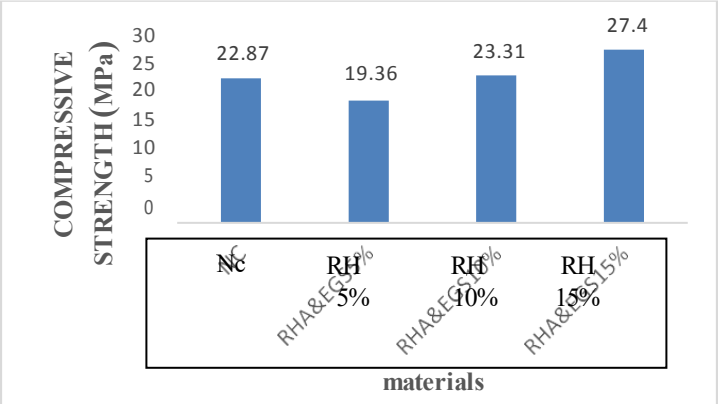


Fig.COMPARISON OF RESULTS OF NC WITH RHA& AT 14 DAYS

Fig 8 Graph of compressive strength of RHA at 28 days

From the graph, it was found that by the replacement of RHA & EGS 5%, the compressive strength was 10.59% lesser than NC. It is depicted that by addition of RHA 10%, the compressive strength was 7.15% higher than the NC. When compared to NC, RHA replacement 5.92% lesser compressive strength than NC.

XIV. OPTIMUM PERCENTAGE DETERMINATION

From the above results, it is evident that 10% replacement of RHA in concrete was found to be the optimum percentage of replacement. It was found that the compressive strength gradually increased.

Figure 6 shows the optimum percentage of

XV. VI CONCLUSIONS & SUGGESTIONS

The optimum percentage of replacement of cement with rice husk ash and fine aggregate with was found to be 10%. The compressive strength was found to be approximately equal to the compressive strength of normal concrete. The trial cubes were tested with optimum percentage replacement with RHA 10%.Workability is not good after 15% replacement of RHA.

Initially the compressive strength of 15% replacement showed higher value when compared to normal concrete but at 28 day the compressive strength of 10% replacement showed higher results when compared to other percentage of replacement. By use natural organic waste like RHA in concrete leads to decrease the environmental pollution & reduce the quantity of cement and fine aggregate. It is depicted that by addition of RHA 10%, the compressive strength was 4.97% higher than NC at 7 days.

When compared to NC, RHA 10%, replacement showed 1.92% higher compressive strength than NC at 14 days. When compared to NC, RHA 10% replacement 7.19% higher compressive strength than NC at 28 days.

Finally, RHA replacement at 5%, 10%, 15% in which 10% replacement give higher compressive strength than NC.

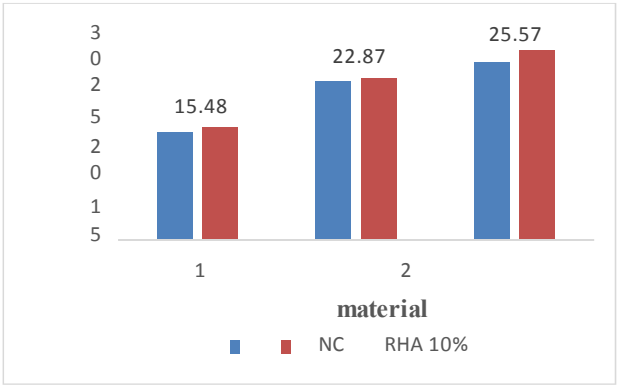


FIG 9.OPTIMUM PERCENTAGE DETERMINATION

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HERE IN THIS PROJECT WE SUGGEST THAT,

From our studies it is concluded that the replacement of 10% RHA shows good result Table and graph shows the results obtained from the comparison strength of 14 daystest