EXPERIMENTAL INVESTIGATION OF ECO-FRIENDLY CONCRETE USING RICE HUSK ASH & EGG SHELL PARTIALLY REPLACEMENT WITH CEMENT & FINE AGGREGATE

L.Sathish[1], M.Lalith Kumar[2]

[1]Assistant Professor, Department of Civil Engineering, Adhi College of Engineering and Technology, Sankarapuram, Tamilnadu, India

[2]Assistant Professor, Department of Civil Engineering, Adhi College of Engineering and Technology, Sankarapuram, Tamilnadu, India

Abstract

Concrete has been accepted for its long-lasting and dependable nature. In addition to durability and dependability, concrete also has superior energy performance, is flexible in design, affordable, and relatively environmentally friendly. It is being expected that concrete will be need to increase industrialization and urbanization .Concrete can also be produced in ways that are environmentally friendly and architecturally moldable in esthetically pleasing forms. Unfortunately, India is not self-sufficient in the production of cement; the main ingredient of concrete and the demand for exceeds the supply which makes the construction activities very costlier. Hence the 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. Therefore, studies have been carried out on the uses of Rise Husk Ash and Egg Shell partially replaced in place cement & fine aggregate. This project aimed to determine the level of rice husk ash & eggshell replacement resulting in optimal compressive strength test. Where concrete specimen tested at 7, 14 and 28 days. OPC and F.A was replaced with R.H.A & E.S by weight at0%, 5%, 10%, and 15%.

Keywords: Concrete; Rise Husk Ash, Egg Shell powder. Replacement

I.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 hen egg 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 eggs created in the state every year. The next in the list

of prominent egg producing states in India comprise Maharashtra, Haryana, Punjab and West Bengal. Eggshell 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 and eggshell partially replacement in cement and fine aggregate at 5%, 10% & 15% replacement grade of M20.

II.REVIEWOF LITERATURE

Ashif M. Qureshi et al., [2010] (1) An Experimental investigation to check the effect of Egg shell powder and 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 (5) 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] (2) Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete this paper reports the results of experiments evaluating the use of egg shell powder from egg 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 (3) 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] Egg Shell as a Fine Aggregate in Concrete for Sustainable Construction (4) 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.

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.

Table 1 Test on Cement

Sl. No	Test on Cement	Value Obtained	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 test	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 minutes	Min 30 minutes	IS:4031 (part V) - 1996
6	final setting time	560 minutes	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

Table 2 Test Result on Fine Aggregate

Sl.No	Test	N.A	E.S	Permissible Value	IS Code
1	Specific gravity test	2.85	3.41	2-3	IS:2386(partIII)-1963
2	Water absorption test	1.65 %	1.18 %	≤20%	IS:2386(partIII)-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.No	Test	N.A	Permissible Value	IS Code
1	Specific gravity test	2.85	2.5-3	IS:2386 (part III) -1963
2	Water absorption	0.86	≤ 20%	IS:2386 (part III) -1963
3	Impact test	9.2%	≤ 10%	IS:2386 (part IV) -1963

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

Table 4 Mix Proportion of Concrete

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

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 in Walajabad and egg shell is obtained from market, which are used as replacement material.

Preparation of Materials

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

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.

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.

IV.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.

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 3.5 shows the apparatus used to determine the workability of fresh concrete.

Fig 1 Slump Cone Test

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 casting specimens of size 150x150x150mm cubes. Figure shows the machine used to determine the compressive strength of concrete.

Fig 2 Compression Test Machine

V.RESULTS AND DISCUSSIONS

SPECIMEN LABEL

Table 5 shows the various specimens casted and their labels for the reference.

SI.NO	SPECIMEN NAME	SPECIMEN LABEL
1.	Normal concrete	NC
2.	Concrete replaced with 5% of RHA & EGS	RHA&EGS 5
3.	Concrete replaced with 10% of RHA & EGS	RHA&EGS 10
4.	Concrete replaced with 15% of RHA & EGS	RHA&EGS 15

RESULTS OBTAINED

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

COMPARISON OF RESULTS

Comparison of results of NC with RHA&EGS at 7days

Table and graph shows the results obtained from the comparison strength of 7 days test.

Table 6 Compressive Strength Result of RHA & EGS and NC at 7 Days

Cube No.	NC (MPa)	EGS & RHA 5% (MPa)	EGS&RHA 10% (MPa)	EGS&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
Average	**15.48MPa**	**14.40MPa**	**16.25MPa**	**15.50 MPa**

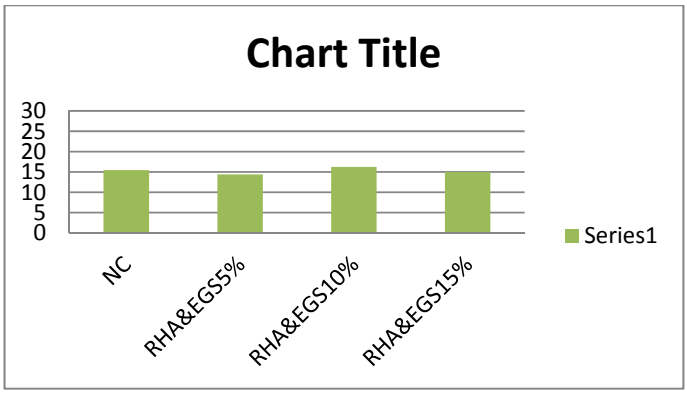


Fig 3 Graph of compressive strength of RHA&EGS at 7 days

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 & EGS 10%, the compressive strength was 4.97% higher than the NC. When compared to NC, RHA & EGS 15%, replacement showed 3.2% lesser compressive strength than NC

Comparison of results of NC with RHA&EGS at 14 days

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

Cubes No	NC (MPa)	EGS&RHA 5% (MPa)	EGS&RHA 10% (MPa)	EGS&RHA 15% (MPa)
1.	21.33	18.22	21.64	25.77
2.	22.89	19.30	23.11	27.78
3.	24.40	20.57	24.89	28.67
Average	**22.87MPa**	**19.36MPa**	**23.31MPa**	**27.40MPa**

Table 7 Compressive strength result of RHA&EGS and NC at 14 day

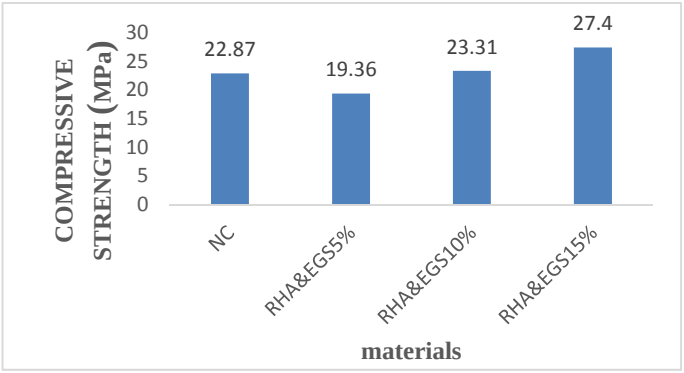


Fig 4 Graph of compressive strength of RHA&EGS at 14 days

From the graph, it was found that by the replacement of RHA & EGS 5%, the compressive strength was 18.13% lesser than NC. It is depicted that by addition of RHA & EGS 10%, the compressive strength was 1.92% higher than the NC. When compared to NC, RHA & EGS 15%, replacement showed 19.8% higher compressive strength than NC.

Comparison of results of RHA&EGS at 28 days

Table and graph shows the results obtained from the comparison strength of 28 days test.

Table 8 Compressive strength result of RHA&EGS and NC at 28 days

Cube No	NC (MPa)	EGS&RHA 5% (MPa)	EGS&RHA 10% (MPa)	EGS&RHA 15% (MPa)
1.	25.11	21.78	25.77	23.02
2.	25.40	22.84	27.78	23.95
3.	26.22	24.75	28.67	25.40
Average	**25.57MPa**	**23.12MPa**	**27.40MPa**	**24.14MPa**

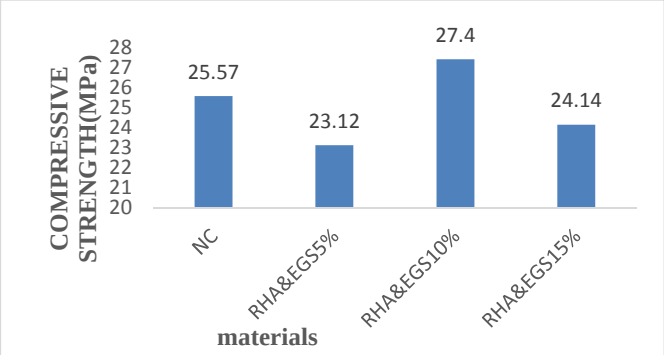
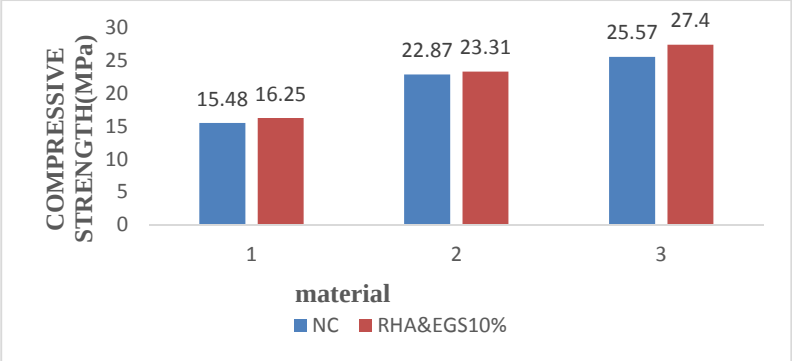


Fig 5 Graph of compressive strength of RHA&EGS at 28 days

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 & EGS 10%, the compressive strength was 7.15% higher than the NC. When compared to NC, RHA & EGS 15% replacement 5.92% lesser compressive strength than NC.

Optimum percentage determination

From the above results, it is evident that 10% replacement of RHA&EGS 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 replacement material to be used in concrete.



VI CONCLUSIONS & SUGGESTIONS

The optimum percentage of replacement of cement with rice husk ash and fine aggregate with eggshell 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&EGS10%.Workability is not good after 15% replacement of RHA&EGS.

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&EGS in concrete leads to decrease the environmental pollution & reduce the quantity of cement and fine aggregate. It is depicted that by addition of RHA & EGS 10%, the compressive strength was 4.97% higher than NC at 7 days.

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

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

Here in this project we suggest that,

From our studies it is concluded that the replacement of 10% RHA&EGS shows good result.

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