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Optimum Replacement of Cement by Rice Husk Ash in conventional Concrete

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***Abstract*—In every year approximately 12 million tonne of peddy produced in India this gives around 24 milliontonnes of rice husk and 4.4 million tonnes of rice husk ash every year, major 3 use of rice husk ash in steel, cement & refractory bricks industries. this r.h.a is a great environment threat causing damage to the land and the surrounding area in which it is dumped lots of way are being through of for disposing them by making commercial use of this r.h.a. R.H.A is a good pozzolan. this super pozzolana can be used in a big way to make special concrete mixes .these is a growing demand for fine amorphous silica in the production of special cement and concrete mixes, high performance concrete, high strength, low permeability concrete .concrete for use in bridge, marine environments nuclear power plants etc.in this project evaluate how different contents of RHA added to concrete may influme its physics of mechanical properties. sample cube were tasted with different percentage of rha and different w/c ratio ,replacing in mass the cement properties like compressive strength ,water absorption and slump retention were evaluated.**

***IndexTerms*—Rice Husk Ash, Cement, Green Concrete, Replacement**

I. INTRODUCTION

Green Concrete as the name suggests is eco friendly and saves the environment by using waste products generated by industries in various forms like rice husk ash micro silicate. to make resource-saving concrete structures .Use of green concrete helps in saving energy, emissions, waste water Green concrete is very often also cheap to produce as it uses waste products directly as a partial substitute for cement, thus saving energy consumption in production of per unit of cement . Over and above all green concrete has greater strength and durability than the normal concrete.The cement industry contributes over 6% to global CO_2emissions, thus making cement production an important sector for CO_2emission mitigation strategies, such as increasinguse of pozzolanic additions. The work presented herein involves two laboratory studies on mortar where cement was partially replaced by rice husk ash (RHA), a waste material made available from the rice industry. As cement industry contributes significantly to global CO_2emissions, making cement production greener is currently a very urgent challenge. Reducing the rate of clinker production by using mineral replacements.

Rice husk is an agro-waste that creates great environmental problems due to its abundance. Normally rice husk will be burnedin open air or land fill but both approaches emit large quantity of $CO_2$to the atmosphere. Concrete technologists are finding solution to reduce the CO_2emission generated from cement production and application of supplementary cementitious materials (SCM) to replace cement. From previous studies, rice husk can be converted into rice husk ash (RHA) by burning process. RHA fulfils the physical characteristics and chemical composition of mineral admixtures. RHAcontains around 85-90 % of silica which is mostly in amorphous state and it is a highly reactive pozzolanic material in the production of concrete due to its high silica content and high surface area. It has been reported that optimum quantity of RHA can increasethemechanicalproperties of concrete. The optimum combustion temperature for obtaining highly reactive RHA is 600 °C. Rice husk as an agro-waste if being utilized correctly not only reduce the environment problems but also reduce the CO_2emission to the atmosphere by bringing down the production ofcement.

Rice Husk Ash was burnt for approximately 72hours in air in an uncontrolled burning process. The temperature was in the range of 400-600 degree C .The ash collected was sieved through BS standard sieve size 75μm and its colour was grey.

II. MIX DESIGN

Mix design of concrete

Replacement of cement by 20% of RHA Grade of concrete – M25

Type of cement – OPC 53 grade

Type of material admixture -Rice Hsk Ash (RHA) Maximum nominal size of aggregate – 20mm Minimum cement content – 320kg/m3

Maximum water cement ratio – 0.45 Workability – 100mm (slump) Exposure condition – Severe Degree of supervision –Good

Types of aggregate – Crushed angular aggregate Maximum cement – 450 kg/m3

Specific gravity of Cement - 3.17 Specific gravity of RHA – 2.28

Replacement of cement 20% by RHA Replacement of sand 0%

Target strength for mix proportion

fck „ = fck + 1.65 S

fck = compressive strength @ 28 days =20 S= 4 (Table no.1 IS 10262:2009)
fck" = 20 + 1.65 * 4= 26.6 N/mm2

Selection of w/c Ratio
Max W/C RATIO = 0.45 [from IS-456(2000)]
Adopt = 0.4

Selection Of Water Cement
Max water content for 20mm aggregate = 186 litre (for 20 to 50mm slump range) Water content for 100mm slump = 186 + 6/100*186= 186 + 11.1= 197.1 ~ 197L

COMPATIBILITY OF ECO FRIENDLY CONCRETE USING RICE HUSK ASH

Assuming 29% reduction due to use of Super Plasticizer
W.C = 197 – 197*29/100= 140 (approx)

Calculation of Cement Content

Water cement ratio = 0.40
Cement content = 140/0.4 = 350kg/m3
From table No.5 of IS456 (2000) minimum cement content for severe exposure conditions= 320kg/m3
350kg/m3 > 320kg/m3 Hence ok

Volume of coarse and fine aggregate for zone 1
Volume of C.A = 0.6
Volume of F.A = 1-0.6 =0.4 [IS 10262:2009]
Cementious Matrial Content = 350*1.10= 385kg/ m3
Water content = 140 kg/ m3
So water cement ratio 140/385 = 0.364 RHA @20% Of Total Cementious

Material content cement = 385-385*20/100= 308 kg/m3
Saving of cement while using RHA= 350 – 308= 42 Kg/ m3
RHA being utilized = 77 kg/m3

(a) VOLUME OF CONCRETE = 1 m3
(b) VOLUME OF CEMENT = MASS OF CEMENT/S.G OF CEMENT * 1/100= 308/3.17 * 1/1000= 0.0971 m3
(c) VOLUME OF RHA = Mass of RHA/s.g of RHA * 1/1000= 77/2.28 * 1/1000= 0.0337 m3
(d) VOLUME OF WATER = 140 * 1/1000 = 0.140 m3

COMPATIBILITY OF ECO FRIENDLY CONCRETE USING RICE HUSK ASH

(e) VOLUME OF ALL IN AGGREGATE = [a- (b+c+d)]= [1-(0.98+0.0337+0.14)]= 0.7293 m3
Mass of C.A = e * volume of C.A * sg of CA * 1000= 0.7293 * 0.6 * 2.6 * 1000= 1126.78 ~ 1127 kg
MASS OF F.A = e * volume of F.A * sg of F.A * 1000= 751.19 ~ 751 kg
Mix proportion for 1 m3 Cement = 308 kg/ m3
RHA = 77 kg/ m3 WATER = 140 kg/ m3
F.A = 751 kg/ m3
C.A = 1127 kg/ m3 W/C Ratio = 0.45
RATIO = 1 :1.1:1.9
VOLUME OF 1 CUBE = 0.15 * 0.15 *0.15= 0.003375 m3
TOTAL CUBE IN 1 M3 = 296.2 ~ 297 MASS OF CEMENT IN 1 CUBE = 308/297= 1.03 KG
MASS OF RHA IN CUBE = 77/297= 0.259 KG
VOLUME OF WATER IN 1 CUBE = 140/297= 0.47 KG
MASS OF F.A = 751/297= 2.52 KG
MASS OF C.A = 1127/297= 3.79 KG
Grade designation: M25 Grade ratio: 1:1.1:1.9
Cement used: Ordinary Portland cement Grade of cement used: 53
Density of cement: 2400kg/m3

III. TEST PROCEDURE

Slump Test :

i. The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil.
ii. The mould is placed on a smooth, horizontal, rigid and nonabsorbent surface.
iii. The mould is then filled in four layers with freshly mixed concrete each approximately to one- fourth of the height of the mould.
iv. Each layer is tamped 25 times by the rounded end of the tamping rod (strokes are distributed evenly over the cross section).
v. After the top layer is rodded, the concrete is struck off the level with a trowel.
vi. The mould is removed from the concrete immediately by raising it slowly in the vertical direction.
vii. The difference in level between the height of the mould and that of the highest point of the 30subsided concrete is measured.
viii. This difference in height in mm is the slump of the concrete.

Compression Test

i. Remove the specimen from water after specified curing time and wipe out excess water from the surface.
ii. Take the dimension of the specimen.
iii. Clean the bearing surface of the testing machine
iv. Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
v. Align the specimen centrally on the base plate of the machine.
vi. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
vii. Apply the load gradually without shock and continuously at the rate of 140KG/cm2/minute till the specimen fails
viii. Record the maximum load and note any unusual features in the type of failure.

Fig . 1 Compression Test Setup

IV. RESULTS

Table 1.Slump Test Result

RHA %	Average Slump Value
10	80

20	82
30	84

Table 2. Compressive strength at different curing days

	Average Compressive Strength (n/mm2)	
DAYS	**(0% R.H.A)**	**(20% R.H.A)**
7	22.38	20.27
14	27.52	28.34
21	32.45	33.67
28	36.5	37.6

V. CONCLUSION

Based on the limited study carried out on the strength behavior of Rice Husk ash, the following Conclusions are drawn.

i. Fly ash and Rice husk ash is found to be superior to other supplementary materials like slag, and silica fume. RHA used in this study is efficient as a pozzolanic material; it is reach in amorphous silica. Due to low specific gravity of RHA which leads to reduction in mass per unit volume, thus adding it reduces the dead load on the structure.
ii. Compressive strength increases with the increase in the percentage of Fly ash and Rice Husk Ash up to replacement (20% RHA) of Cement in Concrete for different mix proportions.
iii. The percentage of water cement ratio is reliant on quantity of RHA used in concrete. Because RHA is a highly porous material
iv. The workability of concrete had been found to be decrease with increase RHA in concrete.
v. At all the cement replacement levels of Rice husk ash; there is gradual increase in compressive strength from 3 days to 7 days. However there is significant increase in compressive strength from 7 days to 28 days followed by gradual increase from 28 days.
vi. 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.4.
vii. 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.
viii. RHA based sand cement block can significantly reduce room temperature. Hence air conditioner operation is reduce resulting in electric energy saving.
ix. Moreover with the use of rice husk ash, the weight of concrete reduces, thus making the concrete lighter which can be used as light weight construction material.
x. The pozzolonic activity of rice husk ash is not only effective in enhance the concrete strength, but also in improving the impermeability characteristics of concrete.
xi. As the Rice Husk Ash is waste material, it reduces the cost of construction..

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