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Mix Design of Grade M35 by Replacement of Cement with Rice Husk Ash in Concrete

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ABSTRACT

The optimized RHA, by controlled burn or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production .The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the structural properties of concrete like compressive strength.

Keywords-- Migezrate, Building Materials, Ordinary Portland Cement

I. INTRODUCTION

Concrete is by far the most widely used construction material today. Concrete has attained the status of a major building material in all branches of modem construction because of following reasons.

It is possible to control the properties of cement concrete with in a wide range by using appropriate ingredients and by applying special processing techniques-mechanical, chemical and physical. It is possible to mechanize completely its preparation and placing process. It possess adequate plasticity for mechanical working.

It is difficult to point out another material of constructions which is as versatile as concrete. Concrete is by far the best material of choice where strength, durability, permanence, impermeability, fire resistance and abrasion resistance are required.

In present world, inflation is one of the main problems faced by every country. It has become essential to lower the construction cost without much compromise as far as strength and durability of the structure is concerned. The lowering of cost can be brought about in number of ways. Among all the methods available the most optimum at our disposal is the use of waste material as substitute.

The basic requirement of all mankind is shelter. Hence the shelter is based on the building construction in which the cement concrete is an essential requirement. The cement concrete is a well-known building material and has occupied an indispensable place in construction work.

From the materials of varying properties, to make concrete of stipulated qualities and intimate knowledge of the interaction of various ingredients, that go into the making of concrete is required to be known, both in plastic condition and in the harden condition.

The strength of concrete depends upon the components such as aggregate, quality of cement, water-cement ratio, workability, normal consistency of mix, proportion and age of concrete .New building materials are used to accelerate the construction work, in which the mixture plays an important role in characteristics of concrete .

The growth in various types of industries together with population growth has resulted in the enormous increase in the production of various types of industrial waste materials such as rice husk ash, foundry sand, blast furnace slag, fly ash, steel slag, scrap tires, waste plastic, broken glass, etc.

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II. STATEMENT OF PROBLEM

A comparative evaluation of strength characteristics of control concrete of grade M35 and RHA concrete produced by replacing cement by raw RHA in different percentage (0%, 5%, 10%, 15%).

Objectives of the Study

The primary aim of experimental work is to study the properties of rice husk ash. Preparation of mix design replacement of cement with RHA as different proportions with cement.

a) Effect of rice husk ash on workability
b) Effect on compressive strength of concrete
c) To determine the optimum dosage of the rice husk to be added to the concrete mix.
d) Comparison of result of different tests with varying proportion of RHA.

III. SCOPE OF THE STUDY

The increasing demand for producing durable materials is the outcome of fast polluting environment. Supplementary cementations materials prove to be effective to meet most of the requirements of the durable concrete. Rice husk ash is found to be greater to other supplementary materials like silica fume and fly ash.

3.1 Specification of Rice Husk Ash:

Specifications of Rice Husk Ash

S. No.	Parameter	Values
1	SiO_2-Silica	85% minimum
2	Humidity	2% maximum
3	Mean Particle Size	251.t
4	Color	Grey
5	Loss on Ignition at 800^0 C	4% maximum

IV. LITERATURE REVIEW

Many researchers have studied the effect of replacement of Cement by Rice Husk Ash which increases the mechanical and durability properties of concrete. Thus it can be mentioned below by following researchers experimented data.

Mehta and Pirth (2000) investigated the use of RHA (Rice Husk Ash) to reduce temperature in high strength mass concrete and concluded that RHA is very effective in reducing temperature of mass concrete compared to OPC concrete. RHA is obtained after burning of rice husk at a very high temperature.

Premalal(2002) have made comparison of the mechanical properties of rice husk powder and hence concluded that chemical compositions of RHA are affected due to burning process.RHA produced by burning rice husk between 600°C-700°C for 2 hours contains 90-95% Si02,1-3% K20 and <5% un burn carbon and RHA with cements improves workability and stability, reduces heat evolution, thermal cracking and plastic shrinkage.

Malhotra and Mehta (2004) reported that ground RHA with fine particle size than OPC improves concrete properties, including higher substitution amounts in lower water absorption values and the addition of RHA caused an increment in the compressive strength.

Adewuyi and Ola (2005) have carried out research on the binary blends of OPC with different pozzolanic material in making cement composites. Supplementary cementious materials have been proven to be effective in meeting most of the requirements of durable concrete.

Lee et al (2005) in their study concluded that some of the waste products like Rice husk which possess pozzoalanic properties and used in the blended cements include fly ash, silica fume, volcanic ash, corn cob ashence providing good strength properties to concrete.

Abdullahi et al (2006) and Prasad et al (2006) Dao Van Dong, (2008),Guilherme Chagas Cordeiro(2009) have got the same experimented data as shows that workability of the concrete was reduced with the increase of cement replacement by RHA.

Ghassan Abood Habeeb, Hilmi Bin Mahmud (2009), Habeeb and Fayyadh (2009)have investigated the influence of RHA average particle size on properties of concrete and found out that at early ages the strength was comparable, while at the age of 28 days, the finer RHA exhibited higher strength than the sample with coarser RHA.

V. METHODOLOGY

Materials Used

1. Cement

In this experiment 43 grade ordinary Portland cement (OPC) with brand name ultra tech was used for all concrete mixes. The cement used was fresh and without any lumps. The specific gravity of cement was found to be 3.0225.

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Determination of specific gravity of cement

S.No.	Description	Sample (gm)
1	mass of empty bottle (w1)	46
2	mass of empty water+bottle (w2)	146
3	mass of Kerosene+ bottle (w3)	139
4	mass of cement + (w5)	65
5	mass of bottle + cement + Kerosene (w4)	170
6	specific gravity	3.0225

2. Fine Aggregate

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone II as per the specifications of IS 10262:2009.

3. Coarse Aggregate

The aggregate which retained on 4.75mm size sieve are categorized in coarse aggregate. In this investigation we use two single sized aggregate 10mm (ranging from 12.5to 2.36) and 20mm (ranging from 20mm to 4.75mm).

Aggregate will consist of naturally occurring (crushed and uncrushed) stones, gravel and sand or combination thereof. The will be hard, strong, dense, durable, clear and free from veins and adherent coating and free from injurious amount of disintegrated pieces, alkali, vegetation matters and other deleterious substances. As for as possible flaky, scoriaccous and elongated pieces should be avoided.

Determination of specific gravity and water absorption of fine aggregate

S.No.	Description	Sample (gm)
1	weight of sample	500
2	weight of vassel + sample + water(A)	1245
3	weight of vassel +water(B)	910
4	weight of saturated and surface dry sample(C)	515
5	weight of oven dried sample(D)	497
6	specific gravity	2.76
7	water absorption ((C-D)/D)*100 (%)	3.62

Specific gravity of fine aggregate $= \frac{D}{C-(A-B)}$

$$= \frac{497}{515-(1245-910)}$$

$= 2.76$

4. Coarse Aggregate

Locally available coarse aggregate having the maximum size of 20 mm were used in the present work. The specific gravity of coarse aggregate was found to be 2.81.

Determination of specific gravity and water absorption of coarse aggregate

S.No.	Description	Sample (gm)
1	weight of sample	1000
2	weight of vassel + sample + water(A)	1507
3	weight of vassel +water(B)	1156
4	weight of saturated and surface dry sample(C)	542
5	weight of oven dried sample(D)	538
6	specific gravity	2.81
7	water absorption ((C-D)/D)*100 (%)	0.74

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Specific gravity of coares aggregate = $\frac{D}{C-(A-B)}$

$= \frac{538}{542-(1507-1156)}$

= 2.81

Material	Quantity
Cement	458.14Kg/m^3
Water	197Kg/m^3
Fine Aggregate	752.7Kg/m^3
Coarse Aggregate	1064.37Kg/m^3
Water Cement Ratio	0.43
Ratio	1:0.43 : 1.64:2.32 (cement : water :F. A : C.A.)

Volume of Rice husk ash
(5%, 10%, 15% by mass of cement)
(Specific gravity of RHA = 2.31)

$= \frac{22.9}{2.31} x \frac{1}{1000} + \frac{45.81}{2.31} x \frac{1}{1000} + \frac{68.72}{2.31} x \frac{1}{1000}$

= 0.0594 m^3

Mass of Total RHA = 0.0594 x 2.31 x 1000
= 137.214 Kg

Mass of Cement = 458.14 - 137.214
= 320.926 Kg

The fallowing values is given in the table are calculated above(with RHA)

Material	Quantity
Cement	320.926 Kg/m^3
RAH	137.214 Kg/m^3
Fine Aggregate	752.7 Kg/m^3
Coarse Aggregate	1064.37 Kg/m^3
Water Cement Ratio	0.43
Ratio	2:0.43 : 2.35 : 3.32 (cement : RHA :F. A : C.A.)

Volume of 1 cube = 0.15 x 0.15 x 0.15
= 0.003375 m^3

Total cube in 1 m^3 = $\frac{1}{0.003375}$ = 296.29
= 297

Mass of cement in 1 cube = 458.14/297
= 1.54 Kg

At 5% RHA
Mass of cement = 458.14 - 458.14 x 5/100
= 435.233 Kg
Mass of RHA = 22.907 Kg
Mass of cement in 1 cube = 435.233 / 297
= 1.465 Kg
Mass of RHA in 1 cube = 22.907 / 297
=.077kg

At 10% RHA
Mass of cement = 458.14-458.14x 10/100
= 412.326 Kg

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Mass of Cement in 1 cube = 412.326/297
= 1.388 Kg
Mass of RHA = 45.814 Kg
Mass of RHA in 1 cube = 45.814/ 297
= 0.154 Kg

At 15% RHA

Mass of Cement = 458.14 - 458.14x 15/100
= 389.419 Kg
Mass of Cement in 1 Cube = 389.419/297
= 1.311 Kg
Mass of RHA = 68.721 Kg
Mass of RHA in 1 Cube = 68.721/297
= 0.231 Kg

Volume of Water in 1 Cube = 197/297
= 0.663 Kg
Mass of Coarse Aggregate in 1 Cube = 1064.37/297
= 3.594 Kg
Mass of fine aggregate in 1 Cube = 752.7/297
= 2.534 Kg

Similarly all of the following values given in the table are calculated as above

(a)Without RHA Replacement

Material	1 Cubes (Kg)	12 Cubes (Kg)
Cement	1.54	18.48
F.A. (Sand)	2.534	30.408
C.A.	3.594	43.128
Water	0.663	7.956

(b)With RHA Replacement

Material	1 Cube (Kg)				3 Cube (Kg)				Total (Kg)
	0% RHA	5% RHA	10% RHA	15% RHA	0% RHA	5% RHA	10% RHA	15% RHA	
Cement	1.54	1.465	1.388	1.311	4.62	4.395	4.164	3.933	17.122
RHA	0	0.077	0.154	0.231	0	0.231	0.462	0.693	1.386
F.A. (Sand)	2.534	2.534	2.534	2.534	7.602	7.602	7.602	7.602	30.408
C.A.	3.594	3.594	3.594	3.594	10.782	10.782	10.782	10.782	43.128
Water	0.663	0.663	0.663	0.663	1.989	1.989	1.989	1.989	7.956

VI. EXPERIMENTAL WORK

1. Preparation of materials

Mixing:

Mix the concrete by hand.

Hand mixing:

(i)Mix the cement and fine aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform color.

(ii)Add the coarse aggregate and mix with cement and fine aggregate until the coarse aggregate.

2. Slump Test

Procedure to determine workability of fresh concrete by 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.

3. Casting

(i) Clean the mounds and apply oil

(ii) Fill the concrete in the moulds in layers approximately 5cm thick

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(iii) Compact each layer with not less than 35strokes per layer using a tamping rod (steel bar16mm diameter and 60cm long, bullet pointed at lower end)

4. Curing

The first batch of 12 test specimens are stored in moist air for 24hours and after this period the specimens are marked and removed from the molds and kept submerged in clear fresh water until taken out prior to test..

5. Compression Test

Aim:

To find out the compressive strength of 12 test specimens.

Apparatus:

Compression testing machine

Specimen:

12 cubes of 15 cm size mix. M35

Procedure:

(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.

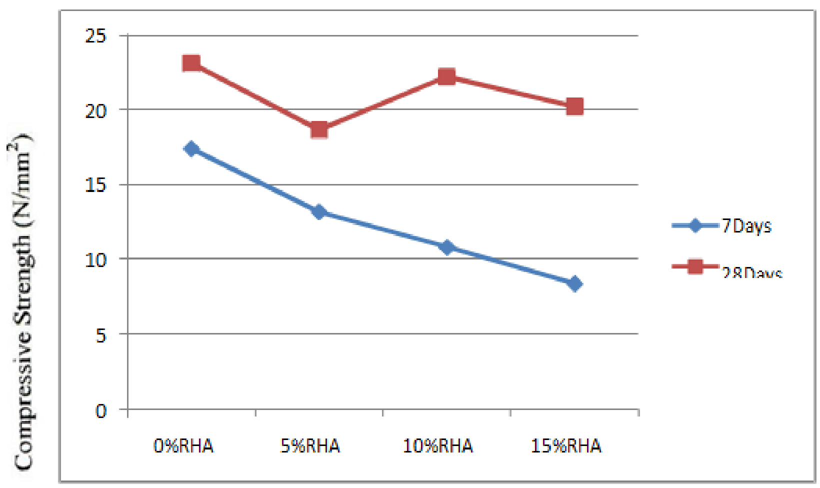
VII. RESULTS AND GRAPHS

a. The strength of 0% is 17.4 N/mm^2 at 7 days
b. The strength of 5% replacement by RHA is 13.185 N/mm^2 at 7 days
c. The strength of 10% replacement by is 10.81 N/mm^2 at 7 days.
d. The strength of 15% replacement by is 8.37 N/mm^2 at 7 days.
e. The strength at 7 days decreases gradually. But it may increase at curing period of 28 days. According to literature views.

Compressive strength at different %age of RHA

	Compressive Strength (N/mm^2)			
Days	0% RHA	5% RHA	10% RHA	15% RHA
7 28	17.4 23.11	13.185 18.67	10.81 22.21	8.37 20.24

Table6.1



1.

Fig 6.1 Graph shows variation in compressive strength at 7 days

VIII. CONCLUSION

Based on the limited experimental investigation concerning compressive and split tensile strength of concrete with rice husk ash as a partial replacement of cement, the following conclusion can be drawn.

1. As the rice husk ash is a waste material, it reduces the cost of construction.
2. The optimum replacement level of RHA is found to be 0-15% for M30 grade of concrete.
3. The replacement of cement with RHA is much lower than that of cement.
4. The slump values of the concrete reduced as the percentage of RHA increased.
5. 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.
6. The technical and economic advantages of incorporating Rice Husk Ash in concrete should be

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exploited by the construction and rice industries, more so for the rice growing nations.

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