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Partial Replacement of cement with Rice Husk Ash in concrete Design of Grade M_{30}

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Abstract - *The optimized R.H.A by controlled burn or grinding has been used as a pozzolonic materials in cement and concrete use of R.H.A provides several advantages such as improved strength and durability properties and the R.H.A greatly reduced the environmental pollution related to the disposal of waste materials and to reduced co_2 emission up to now research has been done to investigate the use of R.H.A 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 pozzolonic materials for cement replacement in concrete .however it is expected that that the use of rice husk ash in a concrete improve in strength properties of concrete also it is an attempt made to developed the concrete using rice husk ash as a source materials for partial replacement of cement which satisfies the structural properties of concrete like compressive strength*

Due to pozzolonic reactivity rice husk ash is used as a supplementary cementing materials in concrete it has economical and technical advantages to be used in concrete. In this experiment cement is partially replaced by rice husk ash by 10% and weight of cement and compare it with normal concrete by using the grade M_{30} at the 3day, 7day, 28 day. This research therefore is an investigation of the performance of the concrete made of partially replacing OPC with RHA on the structural integrity and properties of RHA concrete.

Key Words: **pozzolonic, R.H.A, cement, concrete, structural**

1. INTRODUCTION

Rice husk is an agricultural residue widely available in major rice producing countries .The husk surrounds the paddy grain. During milling process of paddy grain about 78% of weight is obtained as rice, broken rice, and Bram remaining 22% of the weight of paddy is obtained as husk .this husk has been used as a parboiling process this husk contains about 75% organic volatile matter and the rest 25% of the weight of this husk is converted into ash during the firing process. This ash is known as rice husk ash R.H.A contains around 85% -90% amorphous silica.

Rice Husk is generated from rice in industries as a major agricultural by product in many parts of world. Especially in developing countries but only 20% of rice husk is transformed into Rice Husk Ash still there is no used application of R.H.A and is usually dumped into water ,streams as a landfills. Causing environmental pollution of air, water and soil .R.H.A consisted of non-crystalline silicon dioxide with high specific area and high pozzolonic reactivity this due to growing environment concern and the need to conserve energy and resources. Utilization of industries and biogenetic waste as supplementary cementing materials has become an integral part of concrete construction R.H.A pozzolonas improve strength because they are smaller than cement particles and can pack in between the cement particles and provides a finer pore structure R.H.A has two roles in concrete manufacture as a substitute for Portland cement . Reducing the cost and as an admixture in the production of high strength concrete

Concrete is by far most widely used construction materials today. Concrete has attained the status of a major building materials in all branches of modern 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 is difficult to point out another materials of construction which is as versatile as concrete. Concrete is by far the best material of choice where strength durability, permanence, im-permeability, fire resistance and abrasion resistance are required

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

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

The strength of concrete depends upon the component 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 plastic, broken glass, etc.

1.1 OBJECTIVE 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 R.H.A 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 R.H.A

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 supplement materials like silica fume and fly ash.

Table 1.1 Specification 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	Colour	Grey
5	Loss on Ignition at 800^0c	4% maximum

1.2 LITERATURE REVIEW

Many researches 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 experimental data.

Mehta and Pirth(2000) - investigated the use of R.H.A (rice husk ash) to reduce temperature in high strength mass concrete and conclude that R.H.A is very effective in reducing temperature of mass concrete compared to OPC concrete R.H.A 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 composition of R.H.A are affected due to burning process R.H.A produced by burning rice hush ash between 600^0-700^0c for 2 hours contains 90-95% sio_2 1-3%k20and 5% burn carbon and R.H.A with cements improves workability and stability reduces heat evolution, thermal cracking and plastic shrinkage.

Malhotra and Mehta (2004)-reported that ground R.H.A with fine particles size then O.P.C improves concrete properties, including higher substitution amount in lower water absorption values and the addition of R.H.A caused an increment in the compressive strength

Adewuyi and ola (2005) - have carried out research on the binary blends of O.P.C with different pozzolanic materials in making cement composite. 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 product like rice husk which posses pozzolanic properties and used in the blended cement include fly ash silica fume volcanic ash corn cob ashence providing good strength properties to concrete

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.

2. 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 IS 8112 the specific gravity of cement was found to be 3.15.

2.Fine Aggregate Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms as per the specifications of IS 3812 (part I).the specific gravity of fine aggregate found to be 2.55

Table 1.2 Determination of specific gravity and water absorption of fine aggregate

s.no	description	Sample(gm)
1	Weight of sample	500
2	Weight of sample+sample+water(A)	1268
3	Weight of vassel +water(B)	933
4	Weight of saturated and surface dry sample(C)	535
5	Weight of oven dry sample(D)	510
6	Specific gravity	2.55
7	Water absorption (C-D)/D)*100 (%)	4.91

SPECIFIC GRAVITY OF COARSE AGGREGATE=D/C-(A-B)

=510/535(1268-933)

=2.55

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, coriaceous and elongated pieces should be avoided. The specific gravity of coarse aggregate found to be 2.68

Table 1.3 Determination of specific gravity and water absorption of coarse aggregate

s.no	description	Sample(gm)
1	Weight of sample	1000
2	Weight of sample+sample+water(A)	1518
3	Weight of vassel +water(B)	1158
4	Weight of saturated and surface dry sample(C)	564
5	Weight of oven dry sample(D)	548
6	Specific gravity	2.68
7	Water absorption (C-D)/D)*100 (%)	2.91

SPECIFIC GRAVITY OF COARSE AGGREGATE=D/C-(A-B)

= 548/564-(1518-1158)=2.68

CALCULATION: table shows the material required for cube 150x150x150mm using code 10262:2009

B-1 STIPLULATIONS FOR PROPORTIONING

(a) Grade Designation :M_{30}
(b) Type of cement :OPC 43 conforming to IS 8112
(c) Types of mineral admixture :fly ash conforming to IS 3812(part 1)
(d) Maximum nominal size of aggregate:20mm
(e) Minimum cement content :320kg/m^3
(f) Maximum water-cement ratio:0.45
(g) Workability: 100mm(slump)
(h) Exposure condition :severe(for reinforced concrete)
(i) Method of concrete placing : pumping
(j) Degree of supervision :good
(k) Types of aggregate :crushed angular aggregate
(l) Maximum cement (opc)content :450kg/m^3
(m) chemical admixture type : super plasticizer

B-2 TEST DATA FOR MATERIALS

(a) cement used: opc 43 grade conforming to IS 8112
(b) specific gravity of cement :3.15
(c) fly ash :conforming to IS 3812(part I)
(d) specific gravity of fly ash :2.2
(e) chemical admixture :super plasticizer conforming to IS 9103
(f) specific gravity of coarse aggregate :2.68
(g) specific gravity of fine aggregate:2.55
(h) water absorption coarse aggregate:0.5
(i) water absorption of fine aggregate : 1.0 percent
(j) free (surface) moisture coarse aggregate :nil
(k) free (surface) moisture fine aggregate : nil

B-4 SELECTION OF WATER CEMENT RATIO

From table 5 of IS 456, maximum water cement ratio (see note under 4.1) =0.5

Based on experience. Adopt water-cement ratio as 0.42

0.40<0.45, hence, ok

B-6 CALCULATION OF CEMENT AND RICE HUSK ASH CONTENT

Water-cement ratio (see note under 401) =0.42

Cementious materials (cement +rice husk ash) content=152.40/0.42=362.86/kg/m^3

Content for 'severe' exposure conditions= 320kg/m^3

362.86kg/m^3>320kg/m^3, hence o.k

Now .to proportion a mix containing fly ash the following steps are suggested:

(a) decide the percentage fly ash to be used based on project requirement and quality of materials
(b) in certain situations increase in cementious materials content may be warranted, the decision on increased in cementious material content and its percentage may be used on experience and trial

NOTE- this illustrative example is with increase of 10 percent cementious materials content
Cementious materials content=362.86x1.10=399.146kg/m^3
Water content=152.40kg/m^3

Fly ash @ 10% of total cementious material constant=385x10%=38.5
Cement OPC =399.146-38.5=360.646 kg/m^3
saving of cement while using fly ash =362.86-360.646=2.214
fly ash being utilized =39.9kg/m^3

B-9 MIX PROPORTIONS FOR TRIAL NUMBER

a) Cement= 399.146x0.034=13.57kg/m^3
b) Rise husk ash=39.9x0.034=1.356kg/m^3
c) Water =152.40x0.034=5.18kg/m^3
d) Fine aggregate =681x0.034=23.154kg/m^3
e) Coarse aggregate=716x0.034=24..344kg/m^3
f) Chemical admixture=7.7 x0.034=0.26kg /m^3
g) Water-cement –ratio=0.42

Table 1.4 material used in making cube

MATERIAL	WEIGHT(KG/M^3)
Cement	13.57
Water	5.18
Fine aggregate	23.154
Coarse aggregate	24.344
Chemical admixture	0.26
Water/cement ratio	0.43

Table 1.5 material used in making cube

MATERIAL	WEIGHT(KG/M^3)
Cement	12.22
Ash	1.356
Water	5.18
Fine aggregate	23.154
Coarse aggregate	24.344
Chemical admixture	0.26
Water/cement ratio	0.43

EXPERIMENTAL WORK

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.

1. 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.

2. Casting

(i) Clean the mounds and apply oil

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

(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)

3. **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..

4. **Compression Test Aim**: To find out the compressive strength of 12 test specimens.

Apparatus: Compression testing machine

Specimen: 12 cubes of 15x15x15 cm size mix. M30

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.

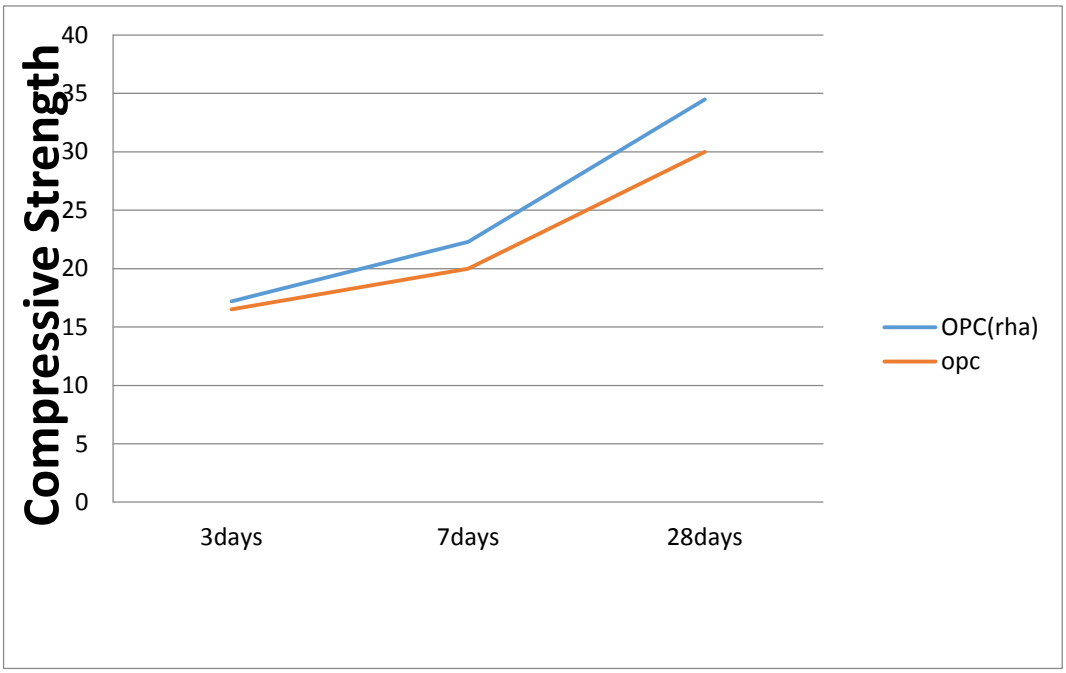
3. RESULTS AND GRAPH

(a) The strength is 16.5N/mm^2 at 3days
(b) The strength is 20N/mm^2 at 7days
(c) The strength is 30N/mm^2 at 28days
(d) The strength is 17.2N/mm^2 by replacement at 3days
(e) The strength is 22.3N/mm^2 by replacement at 7 days
(f) The strength is 34.5N/mm^2 by replacement at 28 days
The compressive strength of O.P.C by replacement is increasing at 3days, 7days and 28days as compared to normal concrete so replacement is beneficial as replacement id increasing the strength of concrete

Table 1.6 Compressive strength of cube samples

Description	Compressive strength of OPC(N/MM^2)			Compressive strength of OPC-43(RHA) (N/MM^2)		
Days	**3**	7	28	3	7	28
Cube	16.5	20	30	17.2	22.3	34.5

Charts shows the difference between compressive strength of OPC-43 and OPC-43(rha)



4. CONCLUSIONS

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

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