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Strength Evaluation of M_{30} grade Rice Husk Ash concrete using Super plasticizer

(Sulphonated Naphthalene Formaldehyde)

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ABSTRACT

Effects of partial replacement of cement with rice husk ash on concrete properties are studied in this project. Cement is one of the most expensive constituents of concrete. The entire construction industry is searching a suitable and effective waste product that would minimize the use of cement and reduces the construction cost. In recent years the agricultural waste or by-products has received increasing attention in the economic, scientific, social and technological areas. Rice husk (RH) is a by-product of rice milling and rice husk ash (RHA) is obtained by burning of rice husk in boiler. RHA consists of large amount (approximately 85–95%) of amorphous silica. In past few years RH and its ash has been utilized extensively in different fields for synthesizing different materials and in wide variety of applications. The silica obtained from RHA provides a potential substitute to conventional silica for the synthesis of many value-added products.

This project is based on increasing compressive strength with the help of rice husk ash (RHA) as partial replacement. In this study rice husk ash was prepared by open control burning, grinded and replaced with cement at 0, 10, 20, 30% respectively, with a mix ratio of 1:2.3:3.4 at a constant water cement ratio of 0.55. The compressive strength and workability test of these concrete specimens were studied. Super plasticiser sulphonated naphthalene formaldehyde (SNF) was used 0.5% by the weight of cement in this study. Due to puzzolanic reactivity rice husk ash is used as supplementary cementing materials in concrete it has economical and technical advantages to be used in concrete.

Compressive strength was studied after 7 days, 14 days and 28 days specimens curing. The compressive strength of the concrete specimens decreases with an increase in the proportion of rice husk ash content. It was concluded that at 7th day of curing concrete specimen gave early strength gain while at 28th day of curing.

Keywords: Partial Replacement, Rice Husk Ash, Compressive Strength of concrete

1: INTRODUCTION

Rice Husk Ash (RHA) is an agricultural waste product while concrete today has assumed the position of the most widely used building material globally.

Concrete is composite material having properties of high compressive strength , low tensile strength low post cracking capacity, brittleness and low impact strength. These properties can be improved by addition of RHA in the concrete. The Rice Husk Ash dispersed and distributed randomly in the concrete during mixing and this improves certain properties like compressive strength, tensile strength, etc. Cement will remain the key material to satisfy global housing and modern infrastructure needs.
There is an increasing importance to preserve the environment in the present-day world. RHA from the parboiling plants is posing serious environmental threat and ways are being thought of to dispose them. The main aim of this research is to put Rice Hush Ash (RHA) into effective use a local additive. Rice Husk Ash (RHA) is an agricultural by-product and a good pozzolana.
One of the most suitable sources of puzzolanic material among agricultural waste components is rice husk as it is available in larger quantities and contains a relatively large amount of silica. When rice husk is burnt, about 20% by weight of the husk is recovered as ash in which more than 75% by weight is 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 has two roles in concrete manufacture as a substitute for Portland cement and reducing the cost as an admixture in the production of high strength concrete.

Objective of this Study:

The main objective of present investigation is to study the properties of rice husk concrete by replacing the cement at different percentages (0%, 10%, 20%, 30% with addition of super plasticiser sulphonated napthene formaldehyde (SNF) 0.5% by the weight of cement. The study was carried out on M30 grade concrete with 0.55 water cement ratio. The main objective of this paper is to study Rice Husk Ash (RHA), its property and potential to be used as a replacement of cement in concrete production

Scope of this Study:

The increasing demand for producing durable materials is the outcome of fast polluting environment supplementary cementations materials. To prove and to meet most of the requirements of the durable concrete, rice husk ash is found to be better than other supplement materials like silica fume and fly ash.

2. 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 researcher's experimental data.

Adewuyi and Ola (2005) have carried out research on the binary blends of O.P.C with different puzzolanic materials in making cement composite. Supplementary cementious materials have been proven to be effective in meeting most of the requirements of durable 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.

Ramezanianpour et al (2010) concluded that burning rice husk at temperature below 700°C produces rice husk ashes with high puzzolanic activity. Rice husk ash was obtained from fair food overseas rice millkatni hasbeen used in the analysis He also stated that with addition of 5% RHA content shows the best gain in compressive strength for curing duration of 7 and 28 days.

Ghassan Abode Habeeb et al. (2010) Detailed that the compressive quality of the mixed cement with 10% RHA has been expanded altogether, and for up to 20% substitution could be highly supplanted by concrete without unfavourably influencing the quality.

Obilade, i.o. (**Sept. 2014)** optimum addition of RHA as partial replacement for cement is in the range 0-20%. The compacting factor values of the concrete reduced as the percentage of RHA increased. The Bulk Densities of concrete reduced as the percentage RHA replacement increased. The Compressive Strengths of concrete reduced asthe percentage RHA replacement increased.

Sumit Bansal (04 June, 2015), Replacement of cement by rice husk ash showed in M30 grade concrete compressive strength improvement up to the replacement of 10% in all ages. Both concrete mixes at 10% rice husk ash level showed3 to 10% increase in compressive strength. Rice husk ash levels of 15 to 20% showed reduction in compressive strength in all ages.

Yogender Antil (04 June, 2015) (i) There was a significant improvement in Compressive strength of the Concrete with rice husk ash content of 10% for different grades namely M30 and M60 and at different ages i.e. 7 days and 28 days. (ii) The increase in Compressive strength was of the order of 4.23% to 10.93% for different grades and at different ages.

Alefiya Kachwala (05 Aug-2017) The optimum addition of RHA as partial replacement for cement for better performance is between the range of 0-20%.The compacting factor values of the concrete reduced as the percentage of RHA increased. The Bulk Densities of concrete reduced as the percentage RHA replacement increased. The Compressive Strengths of concrete reduced as the percentage RHA replacement increased.

3. Materials and Methodology

3.1: Materials

Cement: In this experimental investigation Portland pozzolana cement (PPC) was used for all concrete mixes, the cement used was fresh and without lumps. The testing of cement was done as per IS 8112-1989.The specific gravity ofcement was found to be 3.15.

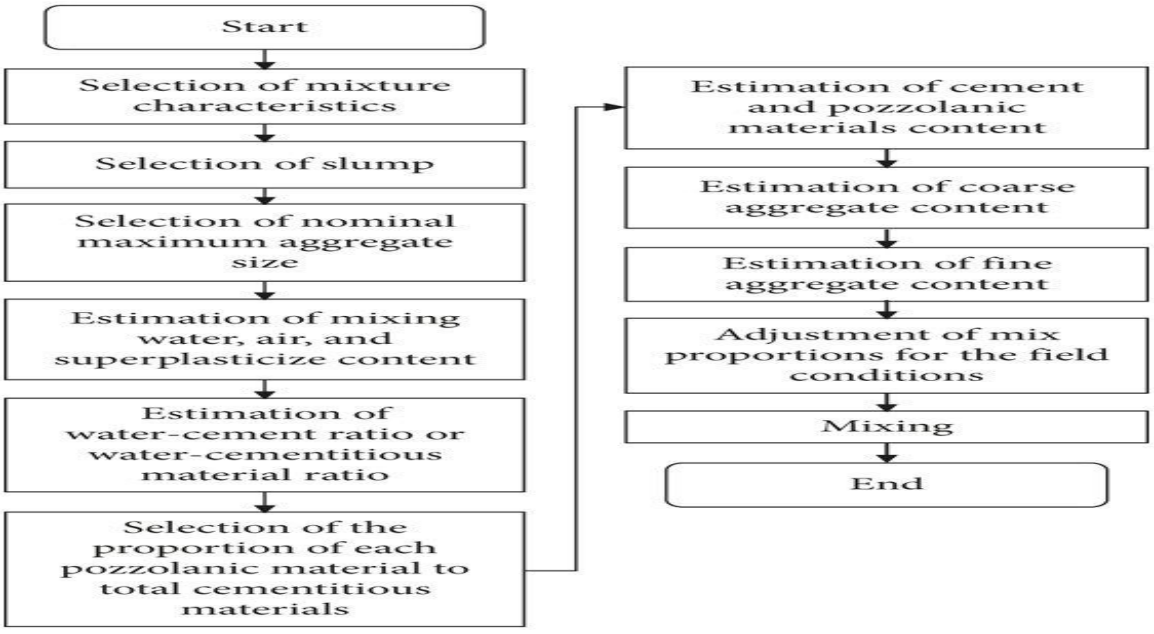
Water: Portable tap water is used for preparation of specimens and curing of specimens.

Fine aggregate: As per IS 383-1970, table- 4 sand used for experimental program was locally produced and wasconforming zone- II. The specific gravity of fine aggregate was found to be 2.64.
Coarse aggregate: Locally available coarse aggregate passing from 20mm sieve and conforming IS 383-1970 were used in present work. The specific gravity of coarse aggregate was found to be 2.74.
Rice Husk Ash: Rice husk ash used was obtained from rice mill located in Raipur. The Specific gravity of rice husk ash is 2.2 and bulk density is 105.9kg/m3 RHA, produced after burning of Rice husk (RH) has high reactivity and puzzolanic property. Indian Standard code of practice forplain and reinforced concrete, IS 456- 2000, Silica content in the ash increases with higher the burning temperature. Rice husk ash was slight black in colour.

Super plasticiser: Super plasticiser sulphonated napthene formaldehyde (SNF) was used 0.5% by the weight of cement in this study.

3.2: Methodology:

3.2.1: Flow Chart of Concrete Mix Design:



3.2.2: Fresh Concrete Test

Slump Test:

Apparatus: Slump Cone: Dimensions:

Height: 300 mm

Diameter (Top):100 mm

Diameter (Bottom): 200 mm

Tamping Rod: 16 mm diameter and Height 600 mm

Procedure

- Inner surface of the cone was thoroughly coated with oil after cleaning the inner surfaces.
- Slump cone was put on a rigid surface.
- Slump cone was filled by fresh concrete in four layers equally.
- Each layer was compacted by tamping rod twenty five times.
- Mould was raised vertically and lifted from concrete slowly.
- The maximum height of subsided concrete was determined.
- Difference between height of slump cone and subsided concrete was obtained.
- This difference was called slump value and was measured in mm.

Compaction Factor Test:

Procedure

- Weight W was calculated which is the weight of empty cylinder.
- Fresh concrete sample was taken and was filled into the upper hopper.
- After opening the trap door, the sample was allowed to fall into the hopper which is lower.
- Lower hopper was opened and the concrete dropped into the cylinder.
- Weight W_1 was calculated (weight of cylinder + weight of partially compacted concrete)
- Same fresh concrete was refilled in 4 equal layers into the cylinder after emptied the cylinder.
- By tamping rod each layer was twenty five times tamped for full compaction of concrete.
- Weight W_2 was calculated which weight of cylinder with fully compacted concrete.

  Compaction Factor = (W1-W) / (W2-W)

3.2.3: Hardened Concrete Test

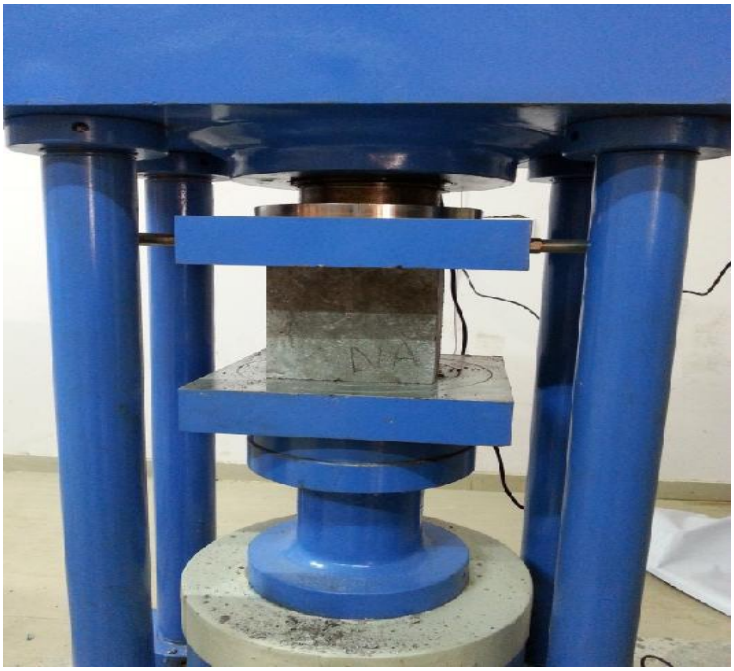
Compressive Strength Test

Cube casting

- The quantity of all the ingredients in concrete was calculated as per mix design.
- Dry ingredients were mixed properly and uniformly.
- Water was added as per mix design and mixed well to get uniform concrete mix.
- Cube specimen was filled by fresh concrete and it was compacted by tamping rod to get full compaction of concrete.
- Cube sample was demoulded after twenty four hours.

Curing

✓ Specimens were put into the water tank for curing.
✓ 30 minutes prior to the testing the specimens were removed from the water tank.



Testing:

➢ For testing the concrete cube was placed into the compression testing machine and was placed correctly on the machine plate.
➢ Load was applied axially after the specimen was aligned carefully.
➢ Compressive load was gradually applied till the breaking of cube sample in the form of cracks.
➢ The breaking load was noted on which the mould breaks or cracks.

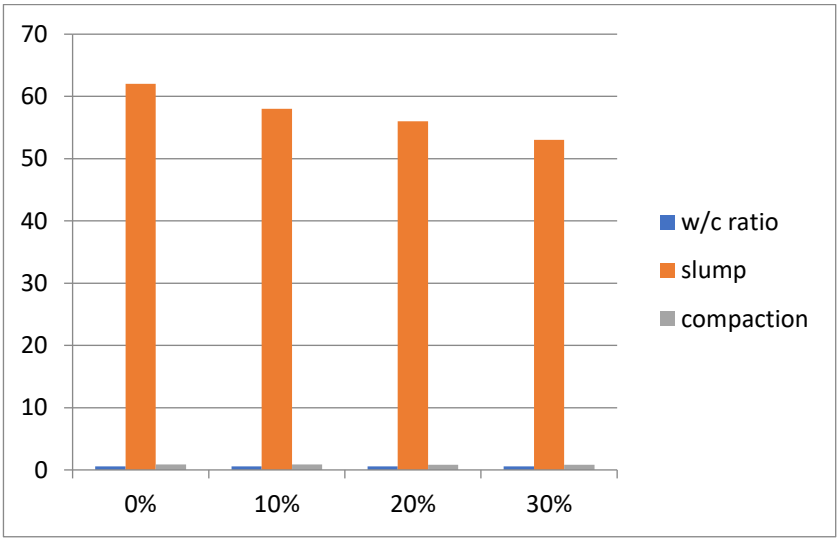
Compressive Strength = Breaking load / Area of Cross section of specimen

4. RESULTS

4.1: Workability Test of Fresh Concrete:

Replacement %	Water Cement Ratio	Slump (mm)	Compaction Factor
0 %	0.55	62	0.88
10 %	0.55	58	0.86
20 %	0.55	56	0.85
30 %	0.55	53	0.82

Graph-1:

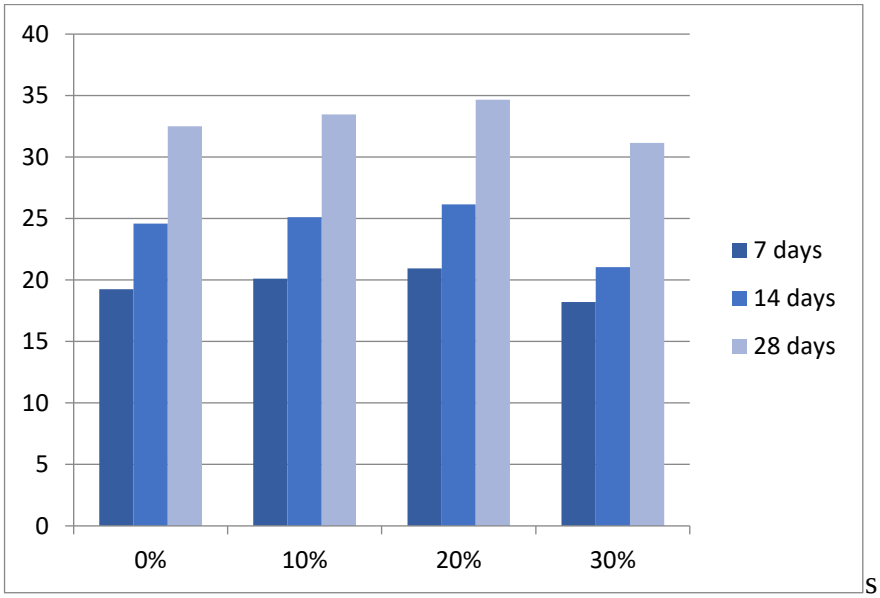


4.2: Compressive Strength of Rice Husk Ash Concrete with and without RHA

(Super plasticizer added 0.5 % by the Weight of cement)

Replacement %	Compressive strength (N/mm2)		
	7 days	14 days	28 days
0 %	19.25	24.60	32.51
10 %	20.10	25.10	33.48
20 %	20.95	26.14	34.67
30 %	18.20	21.05	31.14

Graph-2:



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5: CONCLUSION

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

- As the rice husk ash is a waste material, it reduces the cost of construction.
- The optimum replacement level of RHA is found to be 20 % for M_{30} grade of concrete.
- The replacement of cement with RHA is much lower than that of cement.
- The slump values of the concrete reduced as the percentage of RHA increased.
- By using this Rice husk ash in concrete as replacement the emission of greenhouse gases can be decreased to a greater extent.
- 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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