International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 363-367 www.ijaem.net ISSN: 2395-5252

Replacement of Cement in Concrete with RiceHuskAsh

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Submitted: 01-08-2022 Revised: 07-08-2022 Accepted: 10-08-2022

ABSTRACT— Increase in the demand of conventional construction materials and the need for providing a sustainable growth in the construction field has prompted the designers and developers to opt for 'alternative materials' feasible for use in construction. For this objective, the use of industrial waste products and agricultural byproducts are very constructive. These industrial wastes and agricultural by products such as Fly Ash, Rice Husk Ash, Silica Fume, and Slag can be replaced instead of cement because of their pozzolanic behavior, which otherwise requires large tract of lands for dumping. In the present investigation, Rice Husk Ash has been used as an admixture to cement in concrete and its properties has been studied. An attempt was also done to examine the strength and workability parameters of concrete. For normal concrete, mix design is done based on Indian Standard (IS) method and taking this as reference, mix design has been made for replacement of Rice Husk Ash. Four different replacement levels namely 5%, 10%, 15% and 20% are selected and studied with respect to the replacement method.

Key Words: Concrete, Rice Husk Ash, Compressive Strength.

I. INTRODUCTION

Concrete is a most broadly utilized construction material. It is, all in all, a mixture of cement (binding material), aggregate (filler materials), admixture and water. It very well may be formed in any necessary shape, simple to deal with and has a wide range of design strength. It is therefore utilized in approximately all benevolent construction work. Cement is the main element of concrete as to act as a binding material. Be that as it may, the production of concrete causes so numerous natural risks, like cement dust, air contamination, solid waste pollution, noise pollution, ground vibrations and resource depletion because of crude material extraction. The primary components of the gases produced from cement enterprises are CO_2, N_2, O_2, SO_2, water vapors and micro components for example CO and NOx. The cement industry is one of the two biggest producers of carbon dioxide (CO_2), making up to 8% of overall man-made emanation of this gas, of which half is from chemical process and 40% from consuming fuel. The CO_2 produced from structural concrete is assessed at 410 kg/m3. Around 900 kg of CO_2 are discharged for the creation of every 1 ton of concrete. The CO_2 is major greenhouse gas. In this way cement assembling contributes greenhouse gases both straightforwardly through the decay of calcium carbonate and furthermore through utilization of energy, especially from the combustion of fossil fuel. Thus, we are expected to discover other discretionary material for concrete instead of cement. In the event that we ready to supplant few percent of cement from concrete, it will supportive to lessen CO_2 emission. From different exploration works, some mechanical squanders are discovered which can diminish the measure of concrete in cement without bargaining its essential properties (like strength). Granulated blast furnace slag, silica fume, rice husk ash, ecospheres and fly ash are some industrial wastes that can be utilized as strengthening cementitious materials. Rich husk ash is an agricultural by product which is obtained from rice mill and then burned and very high temperature as fuel. which gives some extra advantages when utilized in cement. Before additional conversation about RHA let us quickly examine about concrete.

II. LITERATURE REVIEW

Some of the early researches have examined the use of rice husk ash (RHA) in concrete.

Ramezanianpour &khani: Investigated the effects of rice husk ash on mechanical properties and durability of sustainable concretes. RHA replaced with cement by weight are 7%, 10% and 15%. Result shows that concrete incorporating with RHA had higher compressive strength, splitting tensile strength and modulus of elasticity at various ages compared with that of the control cement concrete. In addition, results show that RHA as an artificial pozzolanic material has enhanced the durability of RHA concretes and reduced the chloride diffusion.

Malleswara & Patnaikuni: Studied the performance of RHA concrete exposed to sea water. It can be concluded that for M20 grade, RHA concrete is subjected to seawater exposure for 28 days and 90 days. The 7.5% replacement showed better compressive strengths. Seawater exposure to 90 days is shown better compressive strength than normal concrete.

Maurice & Godwin: Investigated the effects of partially replacing OPC with RHA. It is concluded that Adding RHA to concrete resulted in increased water demand, increase in workability and enhanced strength compared to the control sample. These results show that an addition of RHA from 5-10% will increase the strength.

Dahiya et al (2015) carried out partial replacement of grade 42.5 Portland cement with 20% RHA. In their result, they discovered that the initial setting increased from 30 minutes to 60 minutes. The concrete samples were cast using 150mm × 150mm × 150mm mould, and the target strength was M20. The compressive strength of M20 (0% RHA) concrete at 3, 7 and 28 days are 14.50, 20.50and 30.3 respectively. Whereas on replacing cement with 20% of RHA it comes out to be 133.40, 21.60 and 30.70 respectively. In the highlight of his research, water demand increased from 0.6 to 0.8 to achieve a slump 75mm – 100mm, but strength gain was almost the same at 20% replacement.

III. OBJECTIVES OF RESEARCH

The primary objective of the study is:

• The practicability of utilizing the Rice Husk Ash in concrete production as partial replacement of cement.

• To determine the amount of RHA that can be partially replaced with cement.

• To examine the gainful use of modern waste as the cement substitution in construction work.

• To evaluate the optimum proportion of rice husk ash as a beneficial replacement with cement in cement concrete

IV. MATERIALS USED

The present investigation focuses on assessment of the suitability of Rice husk ash a cementitious material by conducting various physical and chemical analysis and hence to understand the influence of RHA on concrete properties (fresh state and hardened state). It was also proposed to determine the optimum level for replacement of RHA to attain maximum compressive strength and to understand the application of RHA in concrete beams.

4.1 Cement

For this research work, PCC cement of ACC cement company is used, that is available in our nearest construction material shop. While adding cement in concrete mix, it is ensured that cement is moisture free and no lumps are found in the cement bag.

Table-01 ChemicalCompositionofCement(PPC)

Compound	PPC (%)
Fe_2O_3	40
SiO_2	28
CaO	8.3
Al_2O_3	3.8
MgO	1
L.O. I	4.3

4.2 Rice husk ash (RHA)

RHA is the result of burning of rice husk. A large portion of the evaporable parts of rice husk are gradually lost during consuming and the essential deposits are the silicates. The attributes of the debris are subject to (1) arrangement of the rice husks, (2) consuming temperature, and (3) consuming time. Each 100 kg of husks consumed in a heater for instance will yield around 25 kg of RHA. For this experimental work, the Rice Husk Ash is purchased from a reliable source ‘Sarveshwar Rice Mill’ situated at Bari Brahmana,

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Jammu (J&K).

Table-02 Chemical CompositionofRiceHuskAsh

Constituent	Compression (%)
Fe_2O_3	0.95
SiO_2	67.30
CaO	1.36
Al_2O_3	4.90
MgO	1.81
L.O. I	17.78

4.3 Fine aggregates

Fine aggregates are the material going through an IS sieve 4.75 mm and hold on to 150µm gauge. Locally accessible sand is utilized as fine aggregates in this a\experimental investigation. Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone. The quality and fine aggregate density strongly influence the hardened properties of the concrete.

4.4 Coarse aggregate

The aggregates which may infiltrate 75mm IS strainer and held on 4.75mm IS sieve is called coarse aggregate. Size of coarse aggregate may change from 10mm to 40mm. Locally accessible coarse aggregate is utilized for test, that accessible on closer construction material shop. Concrete Mix is produced by many ingredients or components but is mostly made up of a material called Coarse Aggregates and they are one of the essential components of concrete and occupy large volumes in the concrete mix.

4.5 Water

Generally, water having pH value 6.0 to 8.0 is used, it is potable water i.e., not containing any type of alkalinity and salinity.

V. METHODOLOGY

5.1 Proportioning

The standard proportion according to IS:456-2000, for M15 grade concrete is 1:2:4. Here extent is embraced 1:2.1403:4.028 which is determined by mix design method. Concrete is supplanted with RHA at different rates for example 0%, 5%, 10%, 15%, and 20%. The measure of every fixing utilized per cubic meter is as follow: - Fine total = 674 kg; Coarse total = 1120kg

5.2 Casting of samples

Total 30 samples are casted out 6 cubes without RHA and rest of the samples are prepared with RHA. Concrete mix is filled in moulds in three layers. Each layer is compacted by tampering rod with 35 number of blows.

5.3 Curing

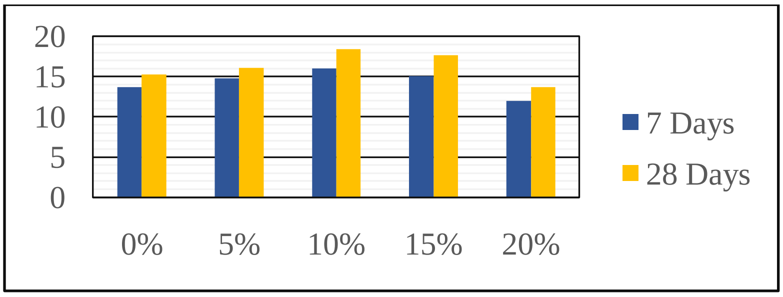
The sample specimens are set apart inside 2 to 3 hours of casting and are kept in vibration free place, in almost 90% relative damp air and at temperature of 270 ± 20 C for 24 ± ½ hours. After this period, the specimens are put in submerged condition in fresh water in a tank and are kept there only before to test. The duration of curing of sample is according to their schedule of testing.

5.4 Testing of samples Compressive strength test The IS code followed for testing IS: 516 – 1959. The concrete cubes are casted of size 150mm ×150mm × 150mm. These samples are tested in UTM (Universal Testing Machine) of capacity 2000KN. at pace of 140 kg/cm2/min. The compressive strength test is performed at 7 days and 28 days.

VI. RESULTS AND DISCUSSIONS

Table-03 Average Compression Test results of cube specimens

S.NO.	%Replaced	7Days (N/mm^2)	28 Days (N/mm^2)
1	0%	13.73	15.3
2	5%	14.8	16.1
3	10%	16.03	18.42
4	15%	15.1	17.7
5	20%	11.96	13.73



Compressive Strength v/s % of RHA in Concrete Mix
Graph-01: Compression Test Analysis

VII. CONCLUSION

Compressive strength of concrete Mixes made with and without Rice Husk Ash has been determined at 7, & 28 days ofcuring. The strength gained has been determined of RHA added concrete with 0%,5%,10%, 15% and 20% for M15 grade as a partial replacement of cement in conventional concrete. Fromthe results it is concluded that the RHA aresuperior replacements of cement. Therateofstrengthincrease inRHAconcreteis high. Afterperformingallthetests andanalyzingtheirresult,thefollowingconclusionsha ve beenderived.Theresultsachieved fromtheexisting studyshows that RHA has great potential for the utilization in concrete as replacement of cement. Maximum compressivestrengthwasobservedwhenRice Husk Ashreplacement isabout10%.

VIII. FUTURE SCOPE

- After doing various tests on the concrete made by partial replacement ofcement bybiomaterials like RiceHuskAshand,theresultsarecomparedwithth econventionalconcretethat we use at present.
- Whilegoingthroughtheresultsdrawnout fromtheresearchesofvariousresearcherswehave foundthattheresultsshownbythereplacedconcret earequitepromisingwhencomparedtotheconven tional concrete.
- Themainobjectiveofthefutureresearchersregard ingthistopicwillbetofindouttheoptimumconcent rationofthereplacementstogetthebestresults.
- Also,theyhavetocheckthevalidityoftheresultsfo rbeamsandRCCstructures.
- Afterdoingthatand iftheresearchisasuccess,wehaveto immediatelystart itsutilizationinplaceof conventional concrete.

IX. ACKNOWLEDGEMENT

We would extremely like to thanks to our mentors Prof. Rajnish Magotra and Prof. Shivam Sharma, for his constant support and motivation during the course of our thesis work. We truly appreciate and value his esteemed guidance and encouragement from initiation to the completion of the thesis. Their valuable guidance will be remembered lifelong. special thanks to God for everything and family members for always encouraging us to push the limits.

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