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A REVIEW PAPER ON STUDY OF EFFECT OF RICE HUSK ASH (RHA) ON MECHNICAL PROPERTY OF CONCRETE

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Abstract –*One of the biggest obstructions in rural development is the lack of resources. Thus, they totally depend on the locally available alternatives. One of such alternatives is rice hush ash (RHA) which can be used as a replacement for fine aggregate in concreting of less important structures. The rice husk is an agricultural waste which is obtained from milling process of paddy and approximately 22% of the weight of paddy is rice husk. The waste is used as fuel in producing stream in parboiling process. The 25 % the weight of husk is converted into ash which is known as rice husk ash (RHA) and is again a waste which is disposed. This ash consists of amorphous silica which can be used as pozzolana in making concrete and cement instead of disposing it without compromising on the properties of cement or concrete if replaced in specific proportion with other constituents of cement or concrete. Aim of our project is to study various proportions of the mix design, so that a more feasible and optimum alternative for our conventional concrete can be mad.*

Key Words: **Rice husk ash, concrete, compressive strength, high temperature, SiO2**

1. INTRODUCTION

Rice husk ash (RHA) is an agricultural waste byproduct, and its disposal presents a major challenge by waste managers. India, China is the major rice producing country, and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct Combustion and / or by gasification. About 20 million tons of RHA is produced annually by each Country. This RHA is a great environment threat causing damage to the land and the surrounding Area in which it is dumped. Lots of ways are being thought of for disposing it by making Commercial use of this RHA. In the present investigation, Portland cement was replaced by rice husk ash at various percentages to study compressive and flexural strength. To minimize the Environmental problem causes due to Rice husk ash so many experiments were performed, RHA used for constriction industry, fertilizer, insulation material, or fuel.

RHA from parboiling plants exerts critical environmental threat; thus, approaches for its reduction are urgently needed. RHA material is considered a real super pozzolan due to its richness in silica, the content of which is approximately 85–90%. With the emergence of high-rise buildings, fire prevention has become particularly important. In the event of a fire, the physical and mechanical properties of the aggregates of concrete structures and cement-gelled materials are degraded, resulting in a sharp drop in the load-bearing capacity of structures, which can even cause collapse of the building in serious cases. Therefore, the study of the mechanical properties of concrete under high temperature has great significance.

Normally, rice husk is piled in open air or occasionally discarded or burnt in the fields, which results in serious environmental pollution. The burning of rice husk can also cause fires. The highly active silica fume (SF) plays a significant role in the preparation of high-strength and high-performance concrete. However, because of the limited availability of SF, it is too expensive for many practical engineering applications. The use of highly active RHA to replace SF as the admixture for concrete can not only improve the performance of concrete and reduce costs, but also reduce the environmental pollution caused by rice husk.

RHA, the product of burning raw rice husk, has a greater content of SiO2 by more than 90 %. Compared with conventional mineral admixtures such as fly ash (FA) and slag, RHA has a huge specific surface area and high activity, which is preferable for active mineral admixture.

1.2 OBJECTIVE

1. Effect of Rice Husk Ash on workability.
2. Effect on Compressive strength of concrete.
3. Effect on flexural strength of concrete.

In this research work, methodology adopted to check the physical properties (workability, compressive and splitting tensile strength) of concrete at partial replacement of cement with RHA. For this reason, two types of concrete standard specimen's cube we have to cast in structural concrete and laboratory. Both types of specimens are cured at 7-, 14-, 28- and 56-days curing period. Three specimens at each W/C ratio and curing age are cast and tested for compressive and splitting tensile strength of concrete in Universal Testing Machine (UTM). Finally, the average of all three specimens at specific w/c ratio is taken as ultimate result of particular test.

2. LITERATURE REVIEW

1) Jerome Egbe, Investigation of rice husk ash (RHS) as a supplement in cement, in this Paper he studies that after adding the RHS in certain percentage the compressive strength increased. He suggested that RHS could be used as a substitute material for cement in many different kinds of structures.

2) Naraindas Bheel, Shanker Lal Meghwar [07 August 2018], Effect of Rice Husk Ashand Water-Cement Ratio on Strength of Concrete, This paper concentrated on research work conducted to investigate the effect of water-cement ratio on the strength of concrete at 10% partially replacement of Rice husk ash (RHA) by the weight of cement and tested at 1:2:4 mix ratio with various w/c ratios i.e. 0.45, 0.50.

3) Ghassan abood habeeb, Study of properties of rice husk ash and its use as cement replacement material, He suggested that adding 10% of RHS increased the strength significantly 20% replacement would be a cost-effective blend without much effects to strength.

4) P.V Rambabu U Chanakya Varma G.V Ramarao, Experimental study on RHS for optimum level of replacement of cement in concrete, this paper concentrated on at what percentage of RHS if added to the concrete is effective, He also suggested that replacing 6% of RHS with ordinary Portland cement enhances the properties of the mix.

5) M.U Dabai C. Muhammad A. Masa [2009], Studies on the Effect of Rice Husk Ash as Cement Admixture, they studied Effective use of RHA as Admixture. Compressive strength tests were carried out on six mortar cubes with cement replaced by rice husk ash (RHA) at five levels (0, 10, 20, 30, 40 and 50%). For curing period of 3,7,14 and 28 days. They notice that strength increased with age of curing but decreased with increase in RHA content for all mixes.

6) Ankit Gautam, Rahul Batra, Nishant Singh [01 April 2019], A study on use of rice husk ash in concrete, they studied the cost analysis and they compare it the conventional concrete. They Notice that the price for 1m3 concrete without RHA is INR 5555.07 and for 1 m3 concrete with RHA is INR 5309.67 hence total saving in 1 m3 concrete is INR 245.4 (4.417%)

7) Makarand suresh kulkarni, S.N tande (1 August 2014), Effect of rice husk Ash on properties of concrete, Adding Rice Husk Ash, concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete. It also increases workability of concrete. The bulk density of RHA concrete is reducing. From the entire experimental work & studies it is concluded that mix M2 (M0+20% RHA) is the best combination among all mixes, which gives max, tensile, flexure & compression strength over normal concrete.

8) Jaspal sing, Sarvesh kumar (26 th June 2018), The effects of utilizing RHS on some proportions of concrete, As the percentage of rice husk ash (RHA) increases in the mix, there is considerable decrease in the workability due to which good super plasticizer is mandatory to achieve the required workability.As RHA percentage increases in the concrete, chloride ion penetration and permeability decreases because of voids refining ability of RHA.

9) Prof shiram h mature Dr V.M Monilker (7 TH July 2014), Effects of RHS on fresh and hardened properties of self-compacting concrete ,The study showed Required compressive strength, flexural strength and split tensile strength, flow ability and adequate self-compatibility were obtained. The slump flow value was in acceptable limit Hence, as per the requirements of fresh state properties of SCC the Addition of 20% RHA can be allowed.

10) M.B.G Sameer Kumar, Dr. Santosh Pushparaj, P.R.D Prasad, K. Bipin, Chandra Phani G. Ramu of (GITAM Institute of Technology GITAM University Visakhapatnam), A stud on use of rice husk Ash in concrete, 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 to 56 days. At the initial ages, with the increase in the percentage replacement of both Rice husk ash, the flexural strength of Rice husk ash concrete is found to be decrease gradually till 7.5% replacement. However, as the age advances, there is a significant decrease in the flexural strength of Rice Husk ash concrete.

11) John Kamau, Ash Ahmed, Fraser Hyndman, Paul Hirst And Joseph Kangwa, Influence of Rice Husk Ash Density on the Workability and Strength of Structural Concrete, the study concluded that the low density of RHA significantly increased the volume of mixes, increased the water demand, and consequently reduced the workability of the resultant concrete.

12) Alireza Naji Givi 1, Suraya Abdul Rashid 2, Farah Nora A. Aziz 3, Mohamad Amran Mohd Salleh 2, Contribution of Rice Husk Ash to the Properties of Mortar and Concrete: A Review, RHA blended concrete can decrease the temperature effect that occurs during the cement hydration. RHA blended concrete can improve the workability of concrete compared to OPC.It can also increase the initial and also final setting time of cement pastes. Additionally, RHA blended concrete can decrease the total porosity of concrete and significantly reduce the Permeability

3. MATERIAL

1) Rice Husk Ash (RHA)

- The RHA used for this experiment work was locally available.
- The sample was allowed to dry under the sun for three days.
- The dried husk was ashed in muffle furnace for 2 hours at 1100 C to obtain a finely divided ash which is then sieved & kept ready for the analysis.
- The pozzolanic behaviour of RHA depends upon the silica crystallization phase content & size and surface area of ash.
- The amount of carbon content in RHA should be smallest. If the carbon contain is more RHA the strength of concrete will be less.

2) Chemical properties

Table no = 1
Chemical & Physical properties of OPC & amp; RHA

Oxide composition (%by mass)	OPC	RHA
SiO_2	20.99	88.32
Al_2O_3	6.19	0.46
Fe_2O_3	3.86	0.67
CaO	65.96	0.44
MgO	0.22	0.44
Na_2O_3	0.17	0.12
K_2O	0.60	2.91
LOI	1.73	5.81
Specific Gravity	2.94	2.11

3) Cement

- Ordinary Portland Cement (OPC) conforming to ASTM150 type. It was used for this study, its Chemical & physical properties are given in table no 1.
- The cement was tested for its mineral Content and the loss on ignition using X – ray Fluorescence (XRF) analysis.
- The average particle Size distribution was determined by laser particle analysis using the Master Size Laser Particle Analysis with obscuration 12.3% & beam length 2.40 mm.
- The specific gravity (SG) of cement was Determined according to British Standard (BS 1377: Part 2) using the small pycnometer method.
- The fineness of the cement was determined by conducting the Blaine surface area test according to ASTM C204-9a.

4) Aggregates

a) Fine Aggregate

- The river sand passing through 4.75 mm sieve retained on 600 micro m sieve conforming to Zone 2 as per IS 383-1970 was used as fine aggregate in the present study.
- The sand is free from clay, slit and organic impurities. The aggregate was tested for its physical.
- Such as gradation, fineness modulus and specific gravity and bulk modulus in accordance with IS: 2386-1963.

b) Coarse Aggregate

- A Machine crushed angular granite metal of 20mm nominal size from the local source is used as Coarse aggregate.
- It is free from impurities such as dust, clay particles and organic matter etc.

5) Water –

- The water used for the study was obtained free flowing stream.
- The water was clean and free from any visible impurities.
- The PH value should not be less than 6.

4. METHODOLOGY

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 various structural properties of concrete like compressive strength and Flexural strength. It is also expected that the final outcome of the project will have an overall beneficial effect on the utility of rice husk ash concrete in the field of civil engineering construction work. Following parameters influences behavior of the rice husk ash concrete, so these parameters are kept constant for the experimental work.

- Percentage replacement of cement by rice husk ash
- Fineness of rice husk ash
- Chemical composition of rice husk ash
- Water to cementations material ratio (w/b ratio)
- Type of Curing

Also, from the literature survey, it is observed that the parameters suggested by different researchers and their results are not matching with each other. It was due to variation in properties of different materials considered in the work. Therefore, the percentage replacement of cement

by rice husk ash and method of mix design is fixed after preliminary investigation. The primary aim of experimental work is to study the properties of Rice Husk Ash. Preparation of mix design and Replacement of cement with RHA as different proportions with cement.

4.1) Compressive Strength Test

We have to determine the compressive strength of the block samples accordance with the standard procedure for pre-cast concrete blocks. The weights of the block samples have always to be taken before the compressive strength test was conducted. Three sample blocks have always to crushed each at 1, 3, 7, 14, and 28 days after casting at different replacement levels using the compressive testing machine. Standard cubes of 100 mm X 100mm X 100mm size have to prepare to give Compressive strength.

The compressive strength of three cubes with its average value is reported in that with the increase in replacement of cement with RHA the compressive strength decreased at all ages of test. For 0%, 10%, and 20% replacement of cement with RHA better results have to obtain and for replacement of 20% cement with RHA target strength for M: 30 grade of SCC was obtain. The compressive strength of M: 30 grades of SCC have to monitor up to 90-day showed an increase of 13 to 14 %, over its 28-day strength. The results from three cubes have to average to determine the compressive strength of each concrete mixture. The compressive strength test was
Conducted at five different ages. The increasing percentage of compressive strength have to refers to the interaction of SiO2 in the RHA with free calcium hydroxide, thereby reducing the internal air voids in concrete structure. The RHA contains a higher ratio of SiO2 (approximately five times) than cement.

4.2) Tensile strength

Tensile strength is the resistance of a material to fail under tension. As the compressive strength increase with curing period, so do tensile strength. Cylindrical specimens have to test to determine
the tensile strength of concrete mixtures using RHA and FA as replacements of cement content. The concrete mixtures containing RHA recorded a higher tensile strength than that incorporated with FA. The tensile strength ratio from the compressive strength has to show that the increment ratio of tensile strength decreased as the cementitious materials increased. . Another study was conducted by Saraswathy and Song with 15%, 20%, 25% and 30% RHA replacement in concrete on cylindrical samples and observed that split tensile strength of various percentages RHA concrete were 4.92, 4.60, 4.58 and 3.67 N/mm2 respectively.

4.3) Split tensile strength test

The split tensile strength test is the indirect measurement of the tensile strength by placing a cylindrical specimen horizontally between the loading surfaces. This method is consisting of applying a diametric compressive force along the length of a cylindrical specimen.

4.4) Flexure strength test

Flexure strength test is the ability check of a beam or slab to resist failure in bending. Generally, flexure strength value is about 2 to 20 percent of compressive strength. The flexure strength of the specimen is expressed as the modulus of rupture.

5) PROBABLE CONCLUSIONS

1. The cubical compressive strength of concrete for with 10% RHA gets increased as compared to normal concrete at 56 days curing time.

2. The cylindrical compressive strength of concrete for with 10% RHA gets increased to as compared to normal concrete at 56 days curing time.

3. We will get the better result for 10% replacement at long days curing period

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