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A STUDY ON MECHANICAL PROPERTIES OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH RICE HUSK ASH

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Abstract : Increase in the demand of conventional construction materials and the need for providing a sustainable growth in the construction field has prompted the developers to opt for `Alternative materials. For this objective, agricultural by-products like rice husk ash can be replaced instead of cement.

Rice Husk ash provides good compressive strength to the concrete, it is a by product, hence, it helps in cutting down the environmental pollution. The high silica content makes it is good supplementary Cementous material. It is highly porous and light weight, with a very high specific surface area .

Now we are going to measure and compare with 0%,5%,10%,15%,20% of replacement of rice husk ash with cement on strength aspects with some tests like compressive strength ,split tensile , flexural strength and workability tests (slump flow) were carried out on Cubes of size 150mm*150mm*150mm , cylinders of size 150mm*300mm,beams of size 500mm*100mm*100mm.These specimens were tested for compressive strength , split tensile strength , flexural strength respectively for 7 days and 28 days of curing period.

Keywords – Rice husk ash, Compressive Strength, Split Tensile Strength, Flexural Strength.

I. INTRODUCTION

Concrete is identified as the source of a nation's infrastructure due to its economic progress and strength, and indeed to the superiority of life. Over 5% of global CO2 emissions can be credited to Portland cement production. To reduce the limitations of cement (OPC), it can be partially replaced with green materials which have pozzolanic characteristics. Number of green materials has been studied for the replacement of cement partially like fly ash, ground nut shell ash, etc. which have been successful. Rice husk ash (RHA) fillers are derived from rice husks, which are usually regarded as agricultural waste and an environmental hazard. Rice husk, when burnt in open air outside the rice mill, yields two types of ash that can serve as fillers in plastics materials. The upper layer of the RHA mound is subjected to open burning in air and yields black carbonized ash.
The inner layer of the mound being subjected to a higher temperature profile results in the oxidation of the carbonized ash to yield white ash that consists predominantly of silica. The rapid increase in the natural aggregates consumption every year due to the increase in the construction industry worldwide means that the reserves are being depleted rapidly, particularly in desert countries such as Arabian Gulf region. The present paper focuses on the replacement of cement partially with Rice Husk Ash (RHA). India is one of the leading producers of Rice. Globally rice paddy of about 600 million tons is being produced, accounting for an annual production of 120 million tons Rice Husk. In most of the cases, the husk produced during the processing of the rice is either burnt or dumped as waste material. Rice husk ash contains 90%-95% of reactive silica.
It is estimated that the world rice harvest is about 588 million tons per year and India is the second largest producer of rice in the world with a production of 132 million tons per year annually. Extensive research has been carried out on the use of amorphous silica in the manufacture of concrete. Most of these studies have been performed in order to find the effectiveness of RHA as a pozzolan by concentrating on the amount of ash present in the and on the enhanced characteristics resulting from its use.Portland cement is by far the most common type of cement in general use around the world.
This cement is made by heating limestone (calcium carbonate) with other materials (such as clay) to 1450 °C in a kiln, in a process known as calcinations that liberates a molecule of carbon dioxide from the calcium carbonate to form calcium oxide, or quicklime-

which then chemically combines with the other materials in the mix to form calcium silicates and other cementations compounds. The resulting hard substance, called 'clinker', is then ground with a small amount of gypsum into a powder to make ordinary Portland cement, the most commonly used type of cement (often referred to as OPC). Portland cement is a basic ingredient of concrete, mortar, and most non-specialty grout. Rice husk is an agricultural residue which accounts for 20% of the 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling plants when used as a fuel also contributes to pollution and efforts are being made to overcome this environmental issue by utilizing this mate.

II. MATERIAL

Rice husk ash

Rice husk ash (RHA) fillers are derived from rice husks, which are usually regarded as agricultural waste and an environmental hazard. Agricultural waste, such as rice husk ash (RHA), can be used instead of cement in concrete making, producing efficient concrete with improved concrete properties like impermeability, workability, strength, and corrosion of steel reinforcement. For reasonable improvement of concrete, increasing the use of cement raw materials must be preserved.

RHA is an exceptionally responsive pozzolanic material used as an Ordinary Portland Cement substitution. It is a good option to utilize RHA in concrete because it will increase concrete workability. Burning the husk under controlled temperature below 800 °C can produce ash with silica mainly. Reported an investigation on the pozzolanic activity of RHA by using various techniques in order to verify the effect of incineration temperature and burning duration. He stated that the samples burnt at 500 or 700 °C and burned for more than 12 hours produced ashes with high reactivity with no significant amount of crystalline material. The effect of incineration conditions on the pozzolanic characteristics of the ash and a summary of the research findings from several countries on the use of RHA as a supplementary cementing pozzolanic material.

- The Rice husk ash used in this study was collected from ricemill in Gudlavalleru. Rice husk ash (RHA) fillers are derived from rice husks, which are usually regarded as agricultural waste and an environmental hazard. Rice husk, when burnt in open air outside the rice mill, yields two types of ash that can serve as fillers in plastics materials.
- It was swept off the floor and air dried prior to use. The rice husk ash was then sieved with 90 micron sieve to imitate the actual size of cement without changing its properties.
- Rice husk ash has been added to concrete to 5,10,15 and 20 percent by weight of cement aggregate. If 10 percent is added there is a possibility for the concrete to become very strong and brittle, the partial replacement of cement with 10% of rice husk ash increases mechanical properties.

S.No	Particulars	Properties
1	Specific gravity	2.27
2	Colour	grey
3	P_H	6.9

Table 1. Properties of Rice husk ash

III. MIX DESIGN

Cement	Fine aggregate	Coarse aggregate	Water
418.60Kg/m^3	621.07Kg/m^3	1121.607Kg/m^3	180 lit/m^3
1	1.48	2.67	0.45

Table 2. Mix design

IV. METHODOLOGY

The methods adopted to find the different properties of binary blended concrete mixes as per IS/ASTM standards were presented. The properties include workability, CS, FS and STS.

I. Workability: The slump test is used to find the workability of concrete .Slump test is the most commonly used method & measuring consistency of concrete which is employed either in laboratory or at site work. For the present work, slump tests were conducted as per IS: 1199 -1959 for all mixes. Concrete slump value is used to find the workability, which indicates water-cement ratio, but there are various factors including properties of materials, mixing methods, dosage, admixtures etc. also affect the concrete slump value. The equipment used for this test is slump cone, non-porous base plate, tamping rod. The mould for the test is in the form of a cone having height 30 cm, bottom diameter 20 cm and top diameter 10 cm. The tamping rod is of steel 16 mm diameter and 60cm Jong and rounded at one end. The mould is then filled in four layers, each approximately ¼ of the height of the mould. Each layer is tamped 25 times by the tamping rod taking care to distribute the strokes evenly over the cross section. Remove the excess concrete and level the surface with a trowel. Raise the mould from the concrete immediately and slowly in vertical direction. This allows the concrete to subside. This subsidence is referred as slump of concrete. The difference in the level between the height of the mould and that of the highest point of the subsided concrete is measured. The difference in height is taken as slump of concrete.

II. Compressive strength: Compressive strength or crushing strength is the main property observed in testing the cubes. Cubes are tested to calculate compressive strength by applying gradual loading in compression testing machine. The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied during the test by the cross sectional area calculated from mean dimensions of the section and shall be expressed to the nearest N/mm Among many test applied to the concrete, this is given utmost important which has an idea view about all the characteristics of concrete. The cubes of size 150x150x150mm were casted.After 24 hours, the specimens are removed from the moulds and subjected to curing for 7 days and 28 days in portable water. After curing, the specimens are tested for compressive strength using compression testing machine of 2000 KN capacity (IS: 516-1959). The maximum load at failure is taken.. To test CS, concrete cubes 150x150x150 mm in size are produced. The cubes are replaced in a manner to transmit load on opposite faces, as defined in IS 516–1959. The applied load is axial without any disruption, as stated in IS 516–1959. To compute the CS, the highest load applied to the specimen was recorded.

III. Split tensile strength: Split tensile strength is the most important property of concrete. Concrete generally weak in tension.So to improve tensile behavior of concrete, split tensile strength is important. The cracking takes place is a form of tension failure. It is also important in reducing formation of cracks in concrete. Cylinders are casted for calculating split tensile strength. The cylindrical specimens are also tested in compression testing machine. The cylinders are placed in axial direction by facing cylindrical face to the loading surface. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. The674ylinderrs are having a size of 150 mm diameter and 300mm length. After 24 hours, the specimens are removed from the moulds and subjected to curing for 7 days and 28 days in portable water. After curing, the specimens are tested for split tensile strength using compression testing machine of 2000 KN capacity (IS: 516 – 1959). The maximum load at failure is taken.

IV. Flexure strength : Modulus of rupture is defined as the normal tensile stress in concrete, when cracking occurs in flexure test (IS 516-1599).The symmetrical two points loading creates a pure bending zone with constant bending moment in the middle third span and thus the modulus of rupture obtained is not affected by shear, as in the case of single concentrated load acting on the specimen. The concrete test specimen is a prism of cross section 100 mm 100 mm and 500 mm long. It is loaded on a span of 400 mm.At each desired curing periods the Prism specimens were taken out of water and kept for sur- face drying. The prisms were tested in Flexure testing machine by arranging two-point loading system. Each Specimen is carefully placed in position. Load is applied without shock and rate of increase in loading is maintained. Maximum load applied on the specimen is recorded at the pout of failure of the specimen and flexural strength is calculated.

V. RESULTS

SLUMP TEST

Five mixes of concrete cubes of size 150 x150x 150mm are prepared. These mixes are prepared with different percentage replacement of cement i.e.,0%,5%,10%,15% and 20%. Workability of the these mixes, Mix is gradually decreased with increase in percentage of rice husk ash. At 10% replacement of cement with Rice husk ash gives maximum workability

COMPRESSIVE STRENGTH TEST

The experimental results obtained after the curing of 7 days and 28 days are shown in the table. The compressive strength of the mix containing 10% of rice husk ash was increased by when compared to conventional concrete. The compressive strength was increased by **8.59%** when compared to conventional concrete.

Rice Husk Ash%	7 days	28 days
0%	27.34	38.39
5%	28.62	39.42
10%	29.89	41.69
15%	27.83	38.52
20%	26.21	37.38

Table 3. Compressive strength at 7&28 days

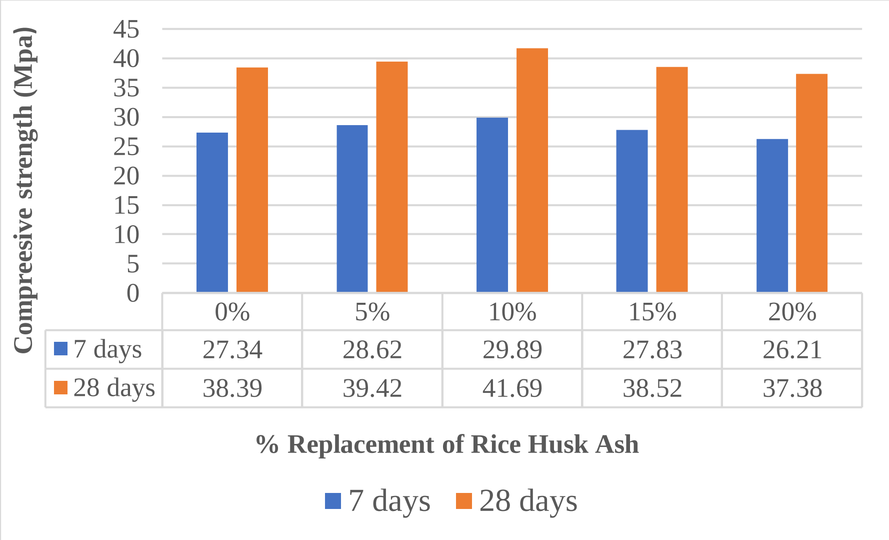

Figure 1. Compressive strength at 7&28 days

SPLIT TENSILE STRENGTH TEST

The experimental results obtained after the curing of 7 days and 28 days are shown in the table. The split tensile strength of the mix containing 10% of rice husk ash was increased by **5.41%** when compared to conventional concrete.

Rice Husk Ash %	7 days	28 days
0%	2.59	2.77
5%	2.64	2.82
10%	2.79	2.92
15%	2.61	2.80
20%	2.37	2.56

Table 4. Split tensile strength at 7&28 days

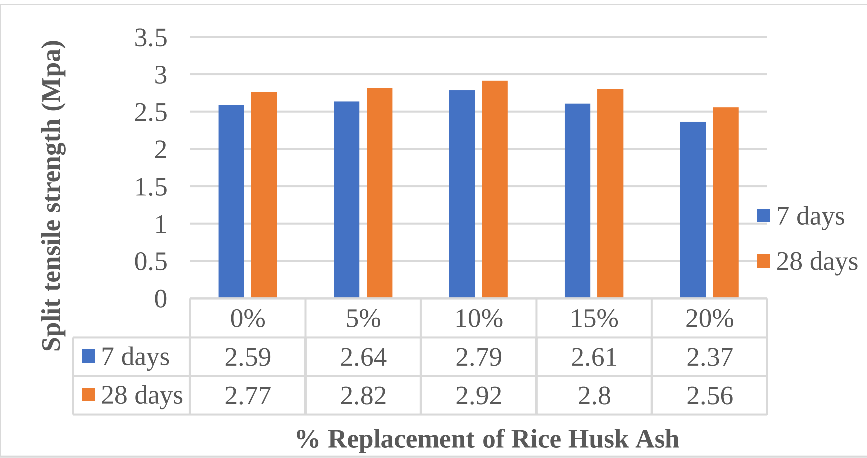

Figure 2. Split Tensile Strength at 7&28 days

FLEXURAL STRENGTH TEST

The flexural strength of the mix containing 10% Rice husk ash was increased by **30.43%** when compared to conventional concrete.

Rice Husk Ash%	7 days	28 days
0%	4.5	5.06
5%	5.15	6.15
10%	6.1	6.6
15%	5.0	5.7
20%	4.7	4.95

Table 5. Flexural strength at 7&28 days

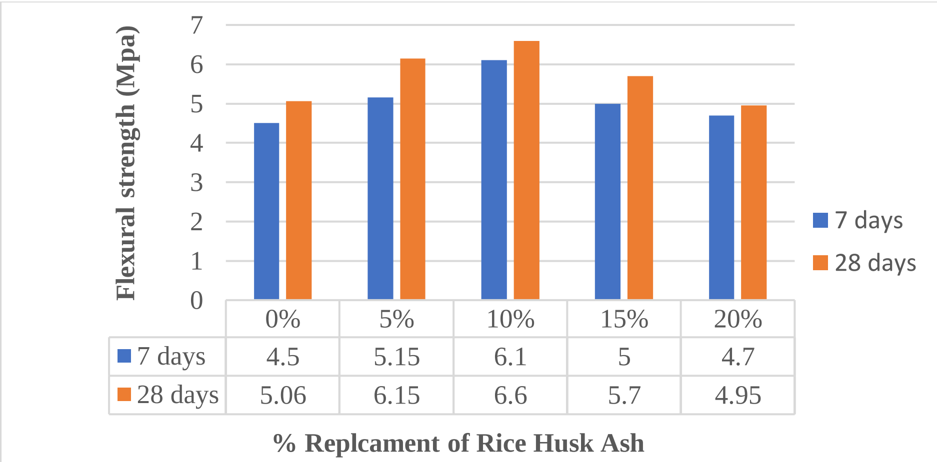

Figure 3. Flexural Strength at 7&28 days

VI. CONCLUSIONS

1. The workability of concrete mixes is increases up to 10% of the partial replacement of cement with Rice husk ash ,on further increasing of rice husk ash the workability will be decreased ,when compared to conventional concrete.
2. The compressive strength of the mix containing 10% Rice husk ash was increased by **8.59%** when compared to conventional concrete.
3. The flexural and split tensile strength of the mix containing 10% rice husk ash was increased by **30.43%** and **5.41%** when compared to conventional concrete.
4. In the present study an effort has been made to experimentally understand the feasibility of using rice husk ash as partial replacement of cement in concrete and to analyze and compare the results obtained with the properties of conventional concrete.
5. Based on the current experimental investigations the following conclusions were made It has been observed that upon increasing the Rice husk ash percentage replacement with cement the workability, compressive strength, split tensile strength and flexural strength of the concrete decreases after 10% of replacement.
6. Based on the above discussions it was decided to consider 10% of partial replacement as an optimum value.
7. It can be concluded that the utilization of Rice husk ash in concrete as partial replacement of cement provides additional environmental as well as technical benefits for all construction related industries.

REFERENCES

[1] Bui D D, Hu J and Stroeven P 2005 Particle size effect on the strength of rice husk ash blended gap-graded portland cement concrete Cement & Concrete Composites 27 pp 357–366.

[2] Ganesan K, Rajagopal K and Thangavel K 2008 Rice husk ash blended cement: Assessment of optimal level of replacement for strength and permeability properties of concrete Construction and Building Materials 22 pp 1675–1683.

[3] Gemma Rodriguez de Sensale 2006 Strength development of concrete with rice husk ash Cement & Concrete Composites 28 pp 158-160.

[4] Hwang Chao-Lung, Bui Le Anh-Tuan and Chen Chun-Tsun 2011 Effect of rice husk ash on the strength and durability characteristics of concrete Construction and Building Materials 25 pp 3768–72.

[5] Ravande K, Bhikshma V and Jeevana Prakash P 2011 Proc. Twelfth East Asia-Pacific Conf. on Structural Engineering and Construction — EASEC12 vol 14 Study on strength characteristics of high strength rice husk ash concrete Procedia Engineering pp 2666–72.

[6] Tashima M M, Carlos A R da Silva, Jorge Akasaki L and Michele Beniti B 2004 Proc. Conf. (Brazil) The possibility of adding the rice husk ash to the Concrete

[7] Rama Rao G V and Sheshagiri Rao M V 2003 High performance concrete with rice husk ash as mineral ad-mixture ICI Journal pp 17-22.

[8] Ferraro R, Nanni A, Rajan K, Vempati R and Matta F 2010 Carbon neutral off-white rice husk ash as a partial white cement replacement Journal of Materials in Civil Engineering 22 pp.