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RICE HUSK AS A FILLER MATERIAL IN HIGH STRENGTH CONCRETE

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Abstract - *Based on the test and investigation Rice husk ash (RHA) can be used as a filler material in high-performance concrete, To improve properties of concrete with less heat transmit. This experimental replacement of RHA in place of cement shows a good strength almost 30 N/mm2 after 28days. This is possible because of the pozzolanic reaction of silica present in RHA with water and CAO or Ca(OH)2 or other pozzolanic reactions to form a strong cementation matrix. Not only strength criteria but also construction cost can be reduced to a certain amount, by this locally available material (rice husk ash), This research is conducted because usage of natural resources is increasing day by day. Natural resources are used in higher quality in the construction industry to minimize the usage of natural resources like limestone, aggregate, sand, clay, wood, etc. We have taken this concept (RHA). This will promote the utilization of agricultural by-products as replaceable or renewable construction material In the construction industry*.

Key Words: high-performance, heat transmit, pozzolanic, cementation matrix, strength criteria, renewable, material

1. INTRODUCTION

From the last decades, the world's population expands and developing Nations become wealthier, raised expectations of the lifestyle of the public. Due to this demand for construction activities increased. The construction industry is a major use of world non-renewable resources. Many materials used in construction are obtained from the finite resource which, exploded they can never be replaced, such as limestone, sand, wood, etc. in order to maintain sustainability, increase demand for non-renewable resources may be partially offset by discovery of new sources.

In order to introduce a new source of building materials, this concept is taken to study the rice husk ash (RHS). Rice is grown in more than 100 countries, with a total harvested area is approximately 150 million hectares, producing more than 700 million tones annually. Nearly 640 million tones of rice is grown in Asia only (representing 90% of global production). India is one of the world's largest producers of rice (20% offer global Rice production). The husk is a by-product of rice that is formed during the milling of seed or grain of rice to produce rice. Each kg of rice milled white rice results in roughly 0.28 kg of rice husk.

The chemical composition of husk is depended upon combustion conditions, when it is burned at high temperature above 700 degree Celsius only crystalline silica remains, which can be used in ceramic and steel industries. However, when crystalline silica is exposed to air it can be hazardous to human health. if it is burnt less than 700 degrees Celsius it produces silica which is used as a supplementary cementitious material in construction materials. The husk is highly reactive pozzolanic material; it has been successfully used to replace 5 to 10% of the cement in concrete.

2. Materials and methods

2.1 materials:

2.1.1cement:

Cement is one of the important materials used in concrete, its properties will not give any strength to concrete. cement acts as a binding material in concrete. So it is used in concrete to bind or hold fine aggregates and coarse aggregates. There are many types of cement OPC 33 grade 43-grade 53-grade cement. In this test OPC53 grade cement(IS:12269-1987) is used and conducted tests as per IS standards.

Table 1 (different types of tests on cement as per IS: 12269-1987)

Test	Observations	Recommended standards as per; IS 12269:1987
Specific gravity	3.15	3.15 to 3.25
Soundness	3.5mm	Not more than 10 mm
Consistency	31.5%	Not more than 33%
Initial setting time	35 minutes	Not less than 30 minutes
Final setting time	211 minutes or 3.57 hours	Not more than 600 minutes or 10 hours

Table 2 (chemical composition of cement as per IS: 12269-1)

Chemical components	Observation percentage	Percentage recommended by IS: 12269-1987
Cao	66.67	60 to 67
SiO_2	18.19	17 to 25
$Fe2O_3$	4.94	3 to 8
$Al2O_3$	4.91	0.5 to 6
SO_3	2.5	1.3 to 3.0
MgO	0.87	0.1 to 4.0
K_2o and NaO_2	0.57	0.4 to 1.3

2.1.2 Aggregates:

Aggregates are one of the important materials in concrete. They give body to the concrete. They are classified into two types based on their size fine and coarse aggregates. Particles passing through 4.75 mm sieve are called as fine aggregate and particles retained on 4.75 mm sieve called as coarse aggregates. Aggregates used in these tests are taken from local. The specific gravity of coarse aggregates is 2.85 and the fine aggregate is 2.6

2.1.3 Husk:

The husk is the by-product of rice it is formed during milling of Seed or grain of rice to produce rice each kg of milled white rice results in roughly 0.28 kg of rice husk. It has burnt less than 700 degrees Celsius to produce silica which is used as supplementary cementations materials in concrete.

Fig.1 Rice husk

Fig.2 Rice husk ash(RHA)

2.1.4 Water

Water is an important ingredient of concrete as its activity participates in the chemical reaction with cement. We have to take care of the quality and quantity of water because the quality of water affects the hydration process and the quantity of water affects the strength of the concrete. As per Is code provisions the pH value of water should not be less than 6.

2.2 methods

The main aim of conducting these experiments is to introduce a new source of building materials into the construction industry due to the high usage of natural resources and non-renewable resources. Usually, Concrete subjected to constant loading, there is a need to check the Concrete strength towards compression and tension. Compression strength tests and split Tensile tests are conducted. Based on the mix design, proportions of cement(cement is replaced with RHA as 5,10,15,20% in weight of cement) fine aggregate and coarse aggregate are mixed and cast in standard moulds as per code recommended. Remolding is down after 24 hours for the time of casting. The strength of concrete depends upon the hydration reaction. Hydration is the reaction taken between cement and water in order to bind aggregates. During the hydration process, some amount of heat is generated it is known as the heat of hydration. In order to cool down the heat generated during the hydration process continuous during curing is required. If proper curing is not down, heat generator during the hydration process may form cracks on the surface of the concrete and strength may reduce. After remolding specimens are placed in curing tank and Curing is down for 7,14,28 days. Concrete is subject to constant loading depending upon the purpose of work concrete may subject to compression or tension loading. Compression strength test and split tensile strength test is conducted for the concrete at the age of 7, 14, 28days. The strength gained by RHA replaced concrete compared with the highest strength concrete. as per the experimental investigation carried out, it is clear that strength gained by high strength concrete is equal to the strength gained by the concrete replace them with 5% and 10% RHA, explained below.

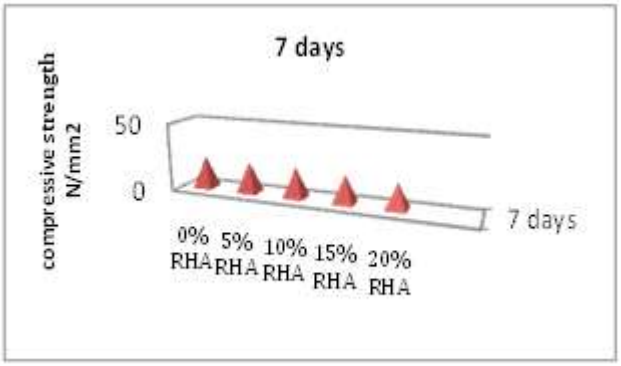
2.2.1 COMPRESSIVE STRENGTH TEST

The compression test is one of the important and common tests conducted for different kinds of materials. Compression strength is the resistance offered by the material due to the compression load on it. This test down mainly to concrete because it should with stand loads as per the designed amount. By the experimental investigation, it is clear that the strength of concrete is increased with an increase in the age of concrete; this is due to the pozzolanic reaction between silica present in RHA and CAO or $Ca(OH)_2$ or other pozzolanic materials present in cement. This experiment is down as per IS 516: 1959. Size of the specimen for compression testing is 150 X 150 X 150mm

Compression strength = $\frac{load}{area}$

Age of concrete	7 days N/mm²	14 days N/mm²	28 days N/mm²
M30 grade of concrete	23.3	28.8	38.9
M30 grade of concrete with 5% rice husk ash	22.2	26.4	36.6
M30 grade of concrete with 10% rice husk ash	21.8	26.7	33.2
M30 grade of concrete with 15% rice husk ash	19.9	25.8	31.4
M30 grade of concrete with 20% rice husk ash	18.1	23.5	29.7

Fig.3 Compression testing machine



2.2.2 Split tensile strength:

Concrete is strong in compression and weak in tension, so the concrete will fail in tension as compared with Compression. This test is conducted as per IS 5816 – 1970. The size of the specimen is 300mm X 150mm diameter. Assuming the specimen behaves as an elastic body, uniform lateral stress of FT acting along the vertical plane causes the failure of the specimen, which can be calculated from the formula given below.

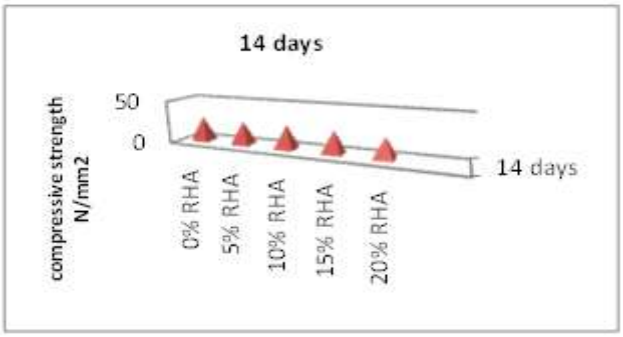
Split tensile strength = $\frac{2P}{\pi DL}$

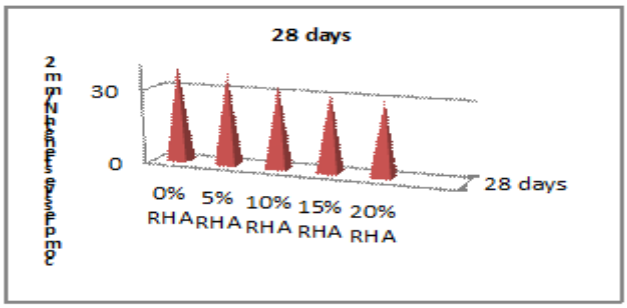
Where

P = load

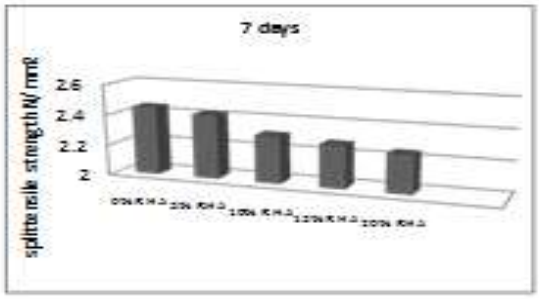
D = diameter of specimen (150mm)

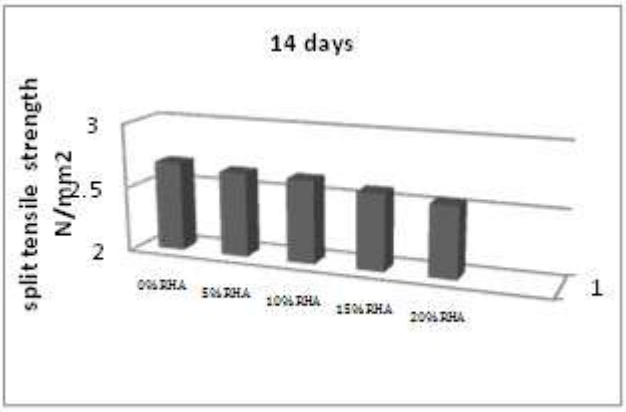
L = length of specimen (300mm)





Age of concrete	7 days N/mm²	14 days N/mm²	28 days N/mm²
M30 grade of concrete	2.45	2.69	2.80
M30 grade of concrete with 5% rice husk ash	2.42	2.65	2.78
M30 grade of concrete with 10% rice husk ash	2.31	2.64	2.72
M30 grade of concrete with 15% rice husk ash	2.28	2.59	2.70
M30 grade of concrete with 20% rice husk ash	2.25	2.55	2.65





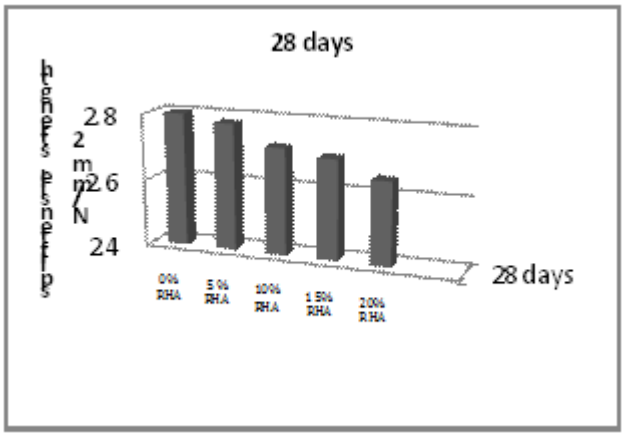


Fig .4 Split tensile testing specimens

3. Discussion

- The main aim of this study is to check whether the rice husk ash(RHA) can be replaced in cement or not.
- By the help of this experiment, it is clear that up to 10% of RHA can be replaced in concrete.
- Target mean compressive strength is fixed as $30N/MM^2$, the compressive strength of different mix proportions (5% 10% 15% 20%) are compared with compressive strength of high strength concrete
- Due to the pozzolanic reaction between silica present in RHA and CaOH or Ca(oH_2) or other pozzolanic reactive materials present in cement, strength will increase with an increase in the age of concrete.

4. Conclusion

Experiments are conducted to the concrete replaced with RHA are preferred to use only in minor construction due to its late gaining of strength

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