International Journal of Research in Engineering, Science and Management
Volume-1, Issue-10, October-2018
www.ijresm.com | ISSN (Online): 2581-5782

Partial Replacement of Cement with Rice Husk Ash in Concrete

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***Abstract*—This paper summarizes that in order to increase the demand of construction materials and need for providing a sustainable growth in construction field. For this objective, use of agricultural by product (rice husk ash) on the cement in order to mitigate the availability, affordability, quality and pollution issues. Solid cubes of size 150*150*150, cylinders and prisms of M20 grade were casted by three different levels of replacement of cement to RHA by weight at 0%, 10%, 20%. Specimens were made ready for testing after 7, and 28 days curing in water served as the control by IS methods. Testing was included for the strength (compressive, flexure and split tensile). The test results revealed that strength are slightly better than the standard concrete by satisfying the limits initiated endorsed by standard.**

***Index Terms*—Rice husk ash (RHA), CEMENT, Compression strength test, Split tensile Strength, flexural strength test, Cost**

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.

Fig. 1. Concrete

Fig. 2. Concrete bricks

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. The present paper focuses on the replacement of cement partially with Rice Husk 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 pozzolanic by concentrating on the amount of ash present in the mix and on the enhanced characteristics resulting from its use.

II. Methodology

A. Material Used and Specimen Preparation

1) Cement

Cement is the fine grey powder that acts as binding materials which is used for the construction. The cement that was used during experiment was Ordinary Portland Cement 43 grade confirming to IS 8112 impurities were removed before the process.

Fig. 3. Rice husk ash

2) Rice Husk Ash (RHA)

Rice Husk Ash is the ash that is obtained by burning the rice husk until it gets reduced by 25%. The Rice Husk for the research was obtained locally. These husk then were deliberated until fine ash is being produced. These ashes were sieved by the

600 micron where further impurities are being minimized.

3) Water

The water that is used for the research work was obtained locally that fulfill the requirement provided by Indian Standard. The water was clean and free from any visible impurities. Water is being supplied partially deliberating the proportionate ratio.

4) Fine Aggregate

The sand that was used for the research work was obtained locally that fulfills the requirement provided by Indian Standard 383 1970.The purity of the sand was analyzed glancing the code provided by Indian Standard.

5) Coarse Aggregates

The aggregates that are used for this research work are taken from the locally available natural rocks that are get retained on 4.75micron sieve after being crushed. These granite passes the requirement provided by Indian Standard 383 1970.

Highlights:

- Procurement of rice husk ash from the rice sellers.
- Lab testing of characteristics of rice husk ash specific gravity, physical state, particle size, odor, color, appearance etc.
- Preparation of design mix of M20 grade using relevant IS code.
- Preparation of different concrete mix using rice husk ash as partial replacement of cement by 0%, 5%, 10%.

Comparative study of compressive, flexural, split tensile strength of concrete mix thus prepared.

III. Results and Conclusion

A. Graphical Representation

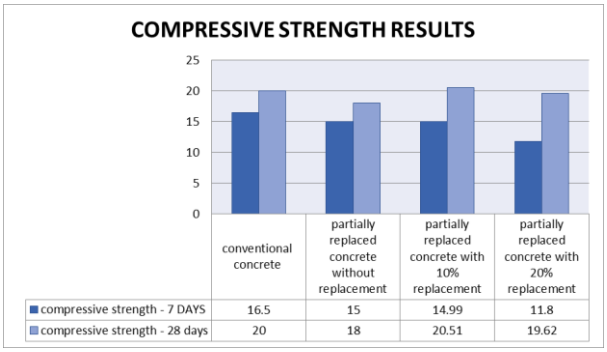

Fig. 4. Compressive strength results

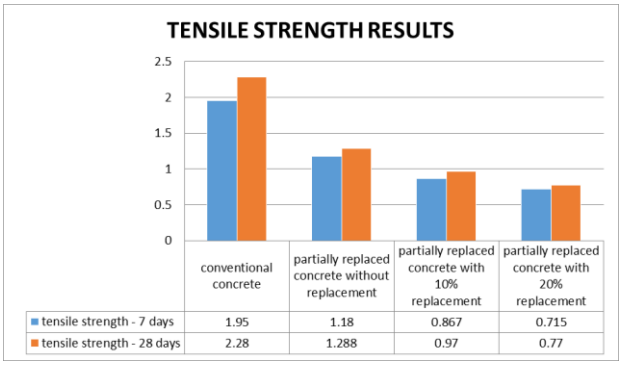

Fig. 5. Tensile strength results

TABLE I
7 Days Test Results of Specimen in N/MM^2

S. No.	7 Days Test	Conventional Concrete (Fine aggregate as River Sand)	Partially Replaced Concrete (Fine aggregate as M-SAND) 0% Replacement	Partially Replaced Concrete (Fine aggregate as M-SAND) 10% Replacement	Partially Replaced Concrete (Fine aggregate as M-SAND) 20% Replacement
1	Compressive Strength For Cubes	14	12.5	13.5	11.22
2	Tensile Strength For Cylinders	1.95	1.18	0.821	0.705
3	Flexural Strength For Prisms	12.78	8.25	7.5	5.495

TABLE II
28 Days Test Results of Specimen in N/MM^2

S. No.	7 Days Test	Conventional Concrete (Fine aggregate as River Sand)	Partially Replaced Concrete (Fine aggregate as M-SAND) 0% Replacement	Partially Replaced Concrete (Fine aggregate as M-SAND) 10% Replacement	Partially Replaced Concrete (Fine aggregate as M-SAND) 20% Replacement
1	Compressive Strength For Cubes	20	18	17.05	16.48
2	Tensile Strength For Cylinders	2.28	1.288	0.86	0.76
3	Flexural Strength For Prisms	1.08	10.5	8.05	7.15

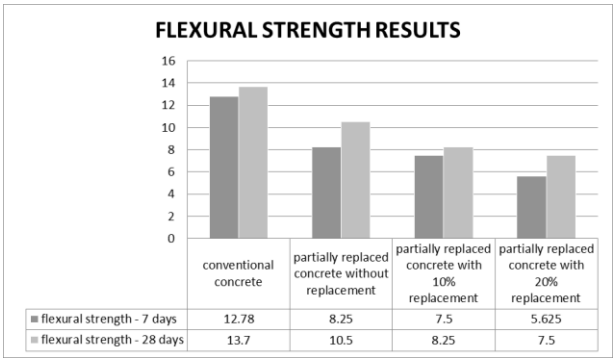

Fig. 6. Flexural strength results

IV. Conclusion

1. Compressive strength

- Initially at 7 days compressive strength test, with the increase in replacement percentage the strength decreases.
- Later at 28 days test, it is observed that the strength increases with the increase in replacement percentage of cement with glass powder.
- The max strength is obtained at 10% replacement.
- Referring to the earlier conclusion, the max strength increases when replacement is carried out in concrete mix if fine aggregate as river sand.
- 10% replacement with glass powder gives highest strength further increase in percentage of replacement reduces strength in concrete of M-sand as fine.
- The results are good and coming to the cost and environment they are convincing and satisfactory.

2. Tensile strength

- At 7 days, it is observed that strength decreases with the increase in replacement percentage.
- Later on 28 days test, the strength increased when compared to 7 days and the max strength is at 0% replacement (M-sand as aggregate).
- It may show better result, if the replacement is carried on river sand aggregate mix design concrete.
- The results are convincing.
- Considering cost and environment it is satisfactory.

3. Flexural strength

- At 7 days strength test, observed that with the increase in replacement percentage the strength decreases.
- Later at 28 days test, the strength increased gradually compared to 7 days
- The max strength is obtained at 0% (M-sand as aggregate).
- It may show better result, if the replacement is carried on river sand as aggregate in concrete mix.
- The results are satisfactory.
- A 10% replacement of cement with glass powder was found convincing, considering cost and environment it is satisfactory.

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