

An Experimental Study on Rice Husk Ash as Partial Replacement for Cement in Concrete

Ashwini B.V¹, G.K Supriya¹, Sathish D.M¹, Vijay kumar¹, Ashish Dubay B²

UG Students, Department of Civil Engineering, Rajeev Institute of Technology, Hassan, India¹

Assistant Professor, Department of Civil Engineering, Rajeev Institute of Technology, Hassan, India²

ABSTRACT: Sustainable construction development requires efficient use of natural resources by recycling the waste products. The waste products generated by industries in various forms like rice husk ash. The objective of the study includes determination of specific gravity of RHA, effect of RHA on compressive strength of concrete and on properties of concrete such as density and workability. The water absorbing quality of RHA is a major physical property which affects workability. Rice husk ash is a supplementary material in cement and concrete it can improve the strength of concrete and durability.

Rice husk is a local raw material for construction industry which is produced daily as waste and it can be obtained at a much lower cost than the cement which it replaces. Also its usage should minimize the disposal problems faced by the producing companies and enhance environmental protection. The properties of Rice Husk Ash (RHA) when used as a partial replacement for Ordinary Portland cement (OPC) in concrete. Ordinary Portland cement (OPC) was replaced with Rice husk Ash (RHA) by weight at 0%, 10%, 20%, 30%, and 40%. On fresh concrete, compacting factor test was carried out and on hardened concrete cubes of 150mm Compressive Strength test was carried out after 3, 7, and 28 days of curing. As the percentage replacement of Ordinary Portland cement (OPC) with Rice husk Ash (RHA) increases, which indicate less workable concrete. The compressive strength of the hardened concrete also decreases with increasing Ordinary Portland cement (OPC) replacement with Rice husk Ash (RHA) and also flexural strength of concrete beams are to be conducted. The main object of the suitability of the RHA as a pozzolanic material for cement and concrete, and also to improve the strength and durability of concrete.

KEYWORDS: Concrete, Rice husk ash, Manufacture sand, Workability and Mechanical Properties.

I. INTRODUCTION

Concrete is by far the most widely used construction material today. Concrete has attained the status of a major building material in all branches of modern construction because of following reasons. It is possible to control the properties of cement concrete with in a wide range by using appropriate ingredients and by applying special processing techniques- mechanical, chemical and physical. It is possible to mechanize completely its preparation and placing process. It possess adequate plasticity for mechanical working. It is difficult to point out another material of constructions which is as versatile as concrete. Concrete is by far the best material of choice where strength, durability, permanence, impermeability, fire resistance and abrasion resistance are required. In present world, inflation is one of the main problems faced by every country. It has become essential to lower the construction cost without much compromise as far as strength and durability of the structure is concerned. The lowering of cost can be brought about in number of ways. Among all the methods available the most optimum at our disposal is the use of waste material as substitute.

The basic requirement of all mankind is shelter. Hence the shelter is based on the building construction in which the cement concrete is an essential requirement. The cement concrete is a well-known building material and has occupied an indispensable place in construction work. From the materials of varying properties, to make concrete of stipulated qualities and intimate knowledge of the interaction of various ingredients, that go into the making of concrete is required to be known, both in plastic condition and in the harden condition. The strength of concrete depends upon the components such as aggregate, quality of cement, water-cement ratio, workability, normal consistency of mix,

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

proportion and age of concrete .New building materials are used to accelerate the construction work, in which the mixture plays an important role in characteristics of concrete .The growth in various types of industries together with population growth has resulted in the enormous increase in the production of various types of industrial waste materials such as rice husk ash, foundry sand, blast furnace slag, fly ash, steel slag, scrap tires, waste plastic, broken glass, etc.

II. MATERIALS AND PROPERTIES

1. NATURAL COARSE AGGREGATES

Natural coarse aggregate were obtained in crushed form were of granite-type. The natural coarse aggregate is of angular shaped crushed granite with maximum size of 20mm passing and its fineness modulus and specific gravity are 6.8 and 2.9 respectively. Crushed stone and sand gravel are the two primary sources of natural aggregate.

2. RICE HUSK ASH (R.H.A)

It was burnt under guided or enclosed place to limit the amount of ash that will be blown off .and silica content in ash increases with a high burning temperature, and well finess. The ash was ground to the required level of fineness and sieved through 75 µm sieve in order to remove any impurity and larger size particles.

Table .1 Physical properties of rice husk ash

| DECRPTION | TEST RESULT |
|----------------------|------------------|
| Physical State Solid | – Non Hazardous |
| Appearance | Very fine powder |
| Color | Grey |
| Odour | Odour less |
| Specific Gravity | 2.3 |
| Finness | 6% |

2.1HISTORICAL BACKGROUND OF RICE HUSK ASH

Rice plant is one of the plants that absorbs silica from the soil and assimilates it into its structure during the growth. Rice husk is the outer covering of the grain of rice plant with a high concentration of silica, generally more than 80-85%. It is responsible for approximately 30% of the gross weight of a rice kernel and normally contains 80% of organic and 20% of inorganic substances. Rice husk is produced in millions of tons per year as a waste material in agricultural and industrial processes. It can contribute about 20% of its weight to Rice Husk Ash (RHA) after incineration. RHA is a highly pozzolanic material. The non-crystalline silica and high specific surface area of the RHA are responsible for its high pozzolanic reactivity. RHA has been used in lime pozzolanic mixes and could be a suitable partly replacement for Portland cement. RHA concrete is like fly ash/slag concrete with regard to its strength development but with a higher pozzolanic activity it helps the pozzolanic reactions occur at early ages rather than later as is the case with other replacement cementing materials.

Rice husk ash (RHA) is a by-product from the burning of rice husk. Rice husk is extremely prevalent in East and South-East Asia because of the rice production in this area. The rich land and tropical climate make for perfect conditions to cultivate rice and is taken advantage by these Asian countries. The husk of the rice is removed in the farming process before it is sold and consumed. It has been found beneficial to burn this rice husk in kilns to make various things. The rice husk ash is then used as a substitute or admixture in cement. Therefore the entire rice product is used in an efficient and environmentally friendly approach.

2.2 BURNING PROCESS:The rice husk ash is a highly siliceous material that can be used as an admixture in concrete if the rice husk is burnt in a specific manner. The characteristics of the ash are dependent on the components, temperature and time of burning. During the burning process, the carbon content is burnt off and all that remains is the silica content. The silica must be kept at a non-crystalline state in order to produce an ash with high pozzalanic activity. The high pozzolanic behaviour is a necessity if you intend to use it as a substitute or admixture in concrete. It has been tested and found that the ideal temperature for producing such results is between 600 °C and 700 °C. If the rice husk is

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

burnt at too high temperature or for too long the silica content will become a crystalline structure. If the rice husk is burnt at too low temperature or for too short period of time the rice husk ash will contain too large an amount of unburnt carbon.

3 FINE AGGREGATE:(MANUFACTURED SAND) produced from crushing of granite stones in required grading to be used for construction purposes as a replacement of river sand.

4 CEMENT: Ordinary Portland cement (OPC) of 53-grade conforming to IS8112:1989 is used throughout this investigation. Cement is a most important constituent in concrete and well known binding material has occupied an indispensable place in the construction work such as concrete and bituminous road material.

5 WATER: Water is very actively participated in the chemical action with cement. Potable fresh water with pH value of 7 available from local sources free from deleterious materials was used for mixing and curing of the mix

III. METHODOLOGY

Experimental investigation is carried out to study the properties of concrete by partially replacing fine cement with certain percentage of rice husk ash, for mix design for M-25 grade (IS 10262 – 2009). To achieve optimum mix, trial mix is done by varying cement, coarse and fine aggregate and water. Once getting the optimum mix, rice husk ash is added to determine the suitability and adaptability, rice husk ash is added in proportions (0%, 10%, 20%, 30%, and 40%) in the mix design.

Experimental programme are carried out in two phase.

- In the First Phase, for each mix tests are conducted to assess fresh workability property (slump flow) of concrete.
- In Second Phase, fresh concrete are cast into cubes and beams. Specimens are cured in water till testing (3, 7, 28 days), than are used to determine Mechanical characteristics (Compressive Strength and Flexural Strength).

IV. EXPERIMENTAL RESULTS

1. Workability-Slump Cone Test

Table 2: Slump value for mix proportions

| SI No | Mix Proportion | Slump (mm) |
|-------|----------------|--------------|
| 1 | M25 - 0 % | 72 |
| 2 | M25 - 10% | 89 |
| 3 | M25 - 20% | 97 |
| 4 | M25 - 30% | - |
| 5 | M25 - 40% | - |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

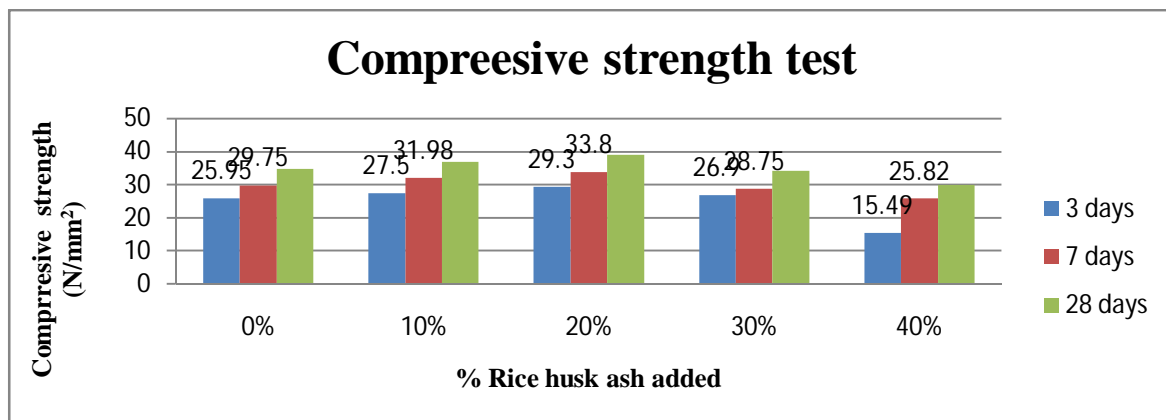
2. Mechanical Properties of Concrete

a. Compressive Strength Tests

Table 3:Compressive Strength of Cubes

| Percentage of rice husk ash added | Compressive strength (N/mm ²) | | |
|-----------------------------------|---|--------|---------|
| | 3 days | 7 days | 28 days |
| 0% | 25.95 | 29.75 | 34.75 |
| 10% | 27.50 | 31.98 | 36.90 |
| 20% | 29.30 | 33.80 | 39.00 |
| 30% | 26.90 | 28.75 | 34.23 |
| 40% | 15.49 | 25.82 | 29.86 |

Graph 1:Compressive Strength for mix proportions



b. Flexural Strength Test

Table 4:Flexural Strength of beams

| Percentage of rice husk ash added | Flexural strength for 28 days, (N/mm ²) |
|-----------------------------------|---|
| 0% | 5.13 |
| 10% | 5.20 |
| 20% | 5.40 |
| 30% | 4.70 |

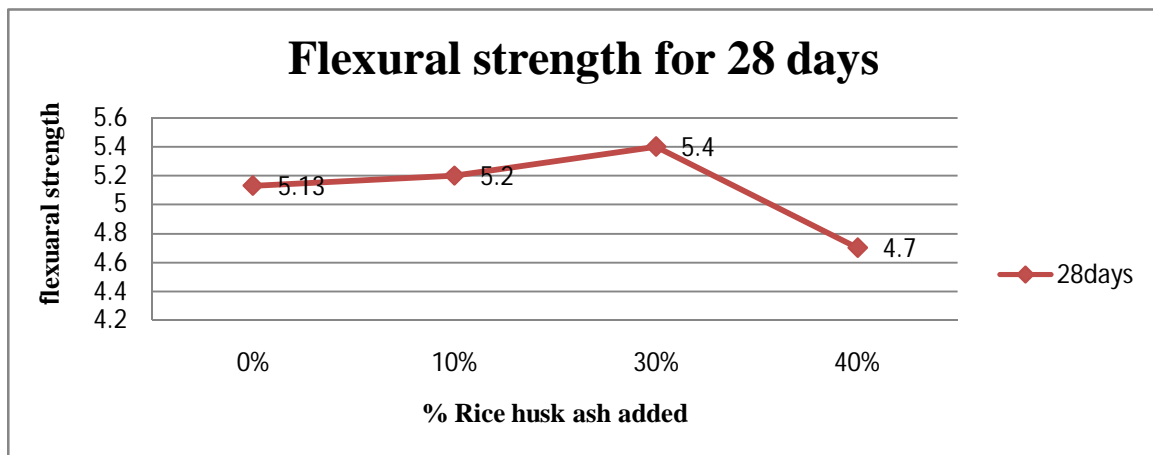
International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

Graph 2 Flexural Strength for mix proportions



IV. CONCLUSION

1. According to the results of the compressive strength, addition of 20% of RHA shows a better result in compressive strength.
2. According to the result of the flexural strength, addition of 20% RHA shows a better result in flexural strength.
3. Rice husk ash is generated as a waste material in cities and adds to the waste content. Using it as a replacement to cement in concrete makes it a useful material.
4. The pozzolonic activity of the rice husk ash is not only effective in enhance the concrete strength, but also in improving the impermeability characteristics of concrete.
5. The technical and economic advantage of incorporating rice husk ash in concrete should be exploited by the constructions and rice industries, more so far the rice growing nations.
6. As the rice husk ash is waste material, it reduces the cost of construction.
7. Hence we conclude that the partial replacement of such a RHA can be done by replacing the cement percentage wise without altering the strength of concrete.

REFERENCES

- [1] Rama Rao G.V, SeshagiriRao M.V, "High Performance Concrete MixDesign using Husk Ash As Mineral Admixture", proceedings of natural conference on materials and structures, Warangal, pp. 65-70, 2004.
- [2] Rama Swamy, Dr. Viswa. S, "Durable To Properties Of Rice Husk Ash Concrete", ICI journal Indian concrete institutepp. 41-50, 2009.
- [3] A.A. Boateng, D.A. Skeet, "Incineration of Rice Hull for use as a Cementations Material: The Guyana Experience", Cement and Concrete Research, Vol. 20, 2011, pp. 795-802.
- [4] Arpana, "Rice Husk Ash-Admixture to concrete", 2nd National conference on Advances in concrete Technology, February 26-27, 2004, pp. 93-98.
- [5] Deepa G. Nair, K.S Jagadish, Alex Fraaij, "Reactive Pozzolanas from Rice Husk Ash: An alternative to cement for rural housing", Cement and Concrete Research 36, 2006 pp. 1062-1071.
- [6] G.V.RamaRao, M.V.SheshagiriRao,"High performance Concrete with Rice Husk Ash as Mineral Admixture", ICI Journal, April-June 2003, pp.17-22.
- [7] Gemma Rodriguez de Sensale, "Strength Development of Concrete with Rice- Husk Ash", Cement & Concrete Composites 28, 2006, pp. 158-160.