International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 12, December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

USE OF RICE HUSK ASH AS PARTIAL REPLACEMENT WITH CEMENT IN CONCRETE

George Washington[1], Kshyana Prava Samal[2]
Zishane Haider[3], Polin Kumar Sahoo[4]
[1,3,4]B.Tech, School of Civil Engineering, KIIT,
Bhubaneswar, Odisha, India
[2]Associate Professor, School of Civil Engineering, KIIT,
Bhubaneswar, Odisha, India

ABSTRACT
In the ancient period construction work was mostly carried out with the help of mudstone from industry. Fly ash is a by-product of burned coal from power station and rice husk ash is the by-product of burned rice husk at higher temperature from paper plant. Considerable efforts are being taken worldwide to utilise natural waste and by-product as supplementary cementing materials to improve the properties of cement concrete.
Rice husk ash (RHA) and Fly ash (FA) are such materials. RHA is by-product of paddy industry. Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. It is finely divided produced by coal fired power station. Fly ash possesses pozzolanic properties similar to naturally occurring pozzolanic material. The detailed experimental investigation done to study the effect of partial replacement of cement with RHA and FA on concrete.
In this experiment the partial replacement i.e of RHA has been done at 10%, 20% and 30% respectively to make concrete and the results were compared with plain cement concrete which is without any replacement of RHA. The water requirement was found to be increased and compressive strength of concrete was found slightly decrease, Initial and Final setting time were also delayed, Slump value increased. The compressive strength of concrete was found to be 35.05Mpa for 10 %, 30.37Mpa for 20% and 24.6 for 30 % replacement respectively. From the Overall study, it was observed that it can be a good replacement of cement i.e. 10% and 20% which can be recommended for construction purposes .

I. INTRODUCTION
This research is aimed at putting into effective use of Rice Husk Ash (RHA) a local additive which has been investigated to be super pozzolanic in a good proportion to reduce the high cost of structural concrete. Rice Husk Ash (RHA) is an agricultural waste product, and how to dispose of it is a problem to waste mangers. While Concrete today has assumed the position of the most widely used building material globally. The most

expensive concrete material is the binder (cement) and if such important expensive material is partially replaced with more natural, local and affordable material like RHA will not only take care of waste management but will also reduce the problem of high cost of concrete and housing. There is an increasing importance to preserve the environment in the present day world. RHA from the parboiling plants is posing serious environmental threat and ways are being thought of to dispose them. This material is actually a super pozzolan since it is rich in silica and has about 85% to 90% silica content. A "pozzolan" is therefore defined as "a siliceous or aluminium material, Which itself possess little or no cementing property but will in a finely divided form and in the presence of moisture chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing Clementitious properties. A good way of utilizing this material is to use it for making "high performance concrete" which means high workability and very high early strengths, or consider high workability and long term durability of the concrete. Recycling of waste components contribute for energy savings in cement production, for conservation of natural resources and for protection of the environment. Furthermore, the use of certain components with potentially pozzolanic reactivity can significantly improve the properties of concrete. One of the most suitable sources of pozzolanic material among agricultural waste components is rice husk, as it is available in larger quantities and contains a relatively large amount of silica. When rice husk is burnt, about 20% by weight of the husk is recovered as ash in which more than 75% by weight is silica. Unlike natural pozzolan, the ash is an annually renewable source of silica. It is worth to mention that the use of RHA in concrete may lead to the improved workability, the reduced heat evolution, the reduced permeability, and the increased strength at longer ages. In Iran, rice production has increased during these years, becoming the most important crop. Rice husk are residue produced in significant quantities.

II. LITERATURE REVIEW

Some of the early researches have examined the use of rice husk ash (RHA) in concrete. RHA is highly pozzolanic material. The non crystalline silica and large specific surface area of the RHA is responsible for its high pozzolanic activity. The following researches are

Khalaf AL and Yusuf AT [1] (1984) have investigated the effect of rick husk on pozzolanic behaviour of rice husk ash. They studied the actual range of temperature required to burn rice husk to get the desired pozzolanic product. They investigated that up to 40% replacement of cement with RHA can be made with no significant change in the compressive strength as compared to the controlled mix, if the rice husk is burnt under optimum temperature condition. They found replacement is more effective when fineness of RHA is within 50%.

Ismail M.D and Waliuddin [2] (1996) had worked on effect of rice husk ash on high strength concrete. They studied the effect the rice husk ash (RHA) passing 200 and 325 micron sieves with 10-30% replacement of cement on strength HSC. Test result indicated that strength of HSC decreased when cement was partially replaced by RHA for maintaining same value of workability. They observed that optimum replacement of cement by RHA was 10-20%.

Ramezanianpour et al [3] 2009, 2010 concluded that burning rice husk at temperature below 700°C produces rice husk ashes with high pozzolanic activity. Rice husk ash obtained from fair food overseas rice millkatni has been used in the analysis He also stated that with addition of 5% RHA content shows the best gain in compressive strength for

curing duration of 7 and 28 days.

Meheta H and Pitt A [4] (1976) developed a process of converting rice husk in to energy and valuable industrial products. The x ray diffraction analysis they carried out showed that no crystalline phase of silica, the ash contains some residual carbon and a small amount if alkalis. They concluded that hydraulic cement with strength characteristics similar to OPC can be made from rice husk ash. They observed specific gravity to be within 1.8.

Nimityongskul Loo and Karasudhi H [5] (1984) presented a simple method of burning rice husk in a ferro-cement incinerator . Also, for grinding RHA a newly developed device is introduced. It is built to

The device is inexpensive and proved extremely efficient. The procedure is well suited for adoption in the rural areas of developing countries.

Yamamoto and Lakho [6] (1982) studied the effect of existence of carbon in RHA. They revealed that carbon, in its free form, can be removed by further burning and further grinding. The removal of this carbon enhanced considerably the activity of the ash. They also stated that rapid cooling also improved the activity of the ash.

Johnson Peter [7] (1981) concluded that the compressive strength of RHA concrete at various ages and with different cement contents was reduced when the RHA is present in large amount in lean mixes. However there is increase in the amount of water needed to meet a specified consistency which in effect increases the water/cement ratio. Thus, RHA is particularly useful in lean mixes.

Thorpe M [8] (1977) compared the durability of OPC concrete to RHA concrete. Two cylinders, one of OPC concrete and other of RHA concrete were submerged continuously in a 5% HCL solution for a period of 63 days. He found that OPC concrete registered 35% weight loss during the test period, and RHA concrete showed only 8% weight loss. He found with 10% replacement the compressive strength was increased but with 20% and 30% replacement the compressive strength reduced significantly.

Jain S and Pirtz D [9] (1978) showed that for a 28 days period, with 30% weight replacement of OPC by RHA it is possible to reduce the temperature by approximately 20%. These mean that a considerable amount of money could be saved in two areas. One, the cement content is reduced and two the cooling cost of concrete is also reduced or eliminated, both of which would lead to considerable saving in mass concrete construction.

Azam Abdul [10] (1982) stated that the pozzolanic activity index depends very much on the fineness of RHA. It increases with increased fineness of the ash. For 75% and 85% fineness the pozzolanic activity index is lower than the minimum limits specified for ASTM class N, F and C pozzolona. For 85% to 95% fineness, it is higher than the ASTM minimum requirement for the three classes of pozzolona.

III. EXPERIMENTAL SETUP

(MATERIALS)

CEMENT

Cement has different properties and characteristics which depend upon their chemical compositions. By changing in fineness of grinding, oxide compositions cement have exhibit different properties and different kind of cement. The use of additives, changing chemical composition, and use of different raw materials have resulted the availability of many types of cements.

Cement used in the experimental work is Ordinary Portland Cement of 43 grades conforming to IS:8112/1989.

AGGREGATES

Aggregate are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. The fact that the aggregates occupy 70-80 percent of volume of concrete, it has some impact on various characteristics and properties of concrete. Earlier, aggregates were considered as chemically inert material but now it has been recognised that some of the aggregate are chemical active and also certain aggregates are exhibit chemical bond at the interface of aggregate and paste. In this particular work aggregates of size 10 mm and 20 mm has been used.

COARSE AGGREGATE

Aggregate whose sizes are greater than 4.75 mm are coarse aggregate. Crushed granite of 10 mm and 20 mm size are used as coarse aggregate. The sieve analysis of aggregates confirms to the specifications of IS: 383-1970.

FINE AGGREGATE

Aggregate whose sizes are lesser than 4.75 mm are fine aggregate which satisfied the required properties for experimental work and conforms to zone as per the specification of
IS: 383-1970.

RICE HUSK ASH

Rice husk ash has pozzolanic and high percentage of silica which helps in strengthening the concrete and making it corrosion resistant. It is used as an admixture in foreign country but in India it is considered as a waste product. Locally collected burnt RHA grinded and sieved through 90 micron sieve is used in this experiment.

PROPERTIES OF RICE HUSK ASH

PHYSICAL PROPERTIES

Table 1. Physical Properties of Rice Husk Ash

S NO	PARTICULARS	PROPERTIES
1	Colour	Gray
2	Shape texture	Irregular
3	Mineralogy	Non crystalline
4	Particle size	< 45 micron
5	Odour	Odourless
6	Specific gravity	2.3
7	Appearance	Very fine

CHEMICAL PROPERTIES

Table 2. Chemical Properties of Rice Husk Ash

S NO	PARTICULARS	PROPORTION
1	Silicon dioxide	86.94 %
2	Aluminium oxide	0.2 %
3	Iron oxide	0.1 %
4	Calcium oxide	0.3 - 2.2 %
5	Magnesium oxide	0.2 - 2.6 %
6	Sodium oxide	0.1 - 0.8 %
7	Potassium oxide	2.15 - 2.30 %

IV. ANALYSIS AND DISCUSSION

COMPRESSIVE STRENGTH TEST OF CEMENT CONCRETE WITH AND WITHOUT RHA

Table 3. Compressive strength of cement concrete with and without RHA

% Replacement	Compressive Strength (Mpa)		
	7 Days	14 Days	28 Days
0	35.59	44.14	47.26
10	21.45	29.03	35.05
20	21.18	24.01	30.37
30	19.67	21.56	24.6

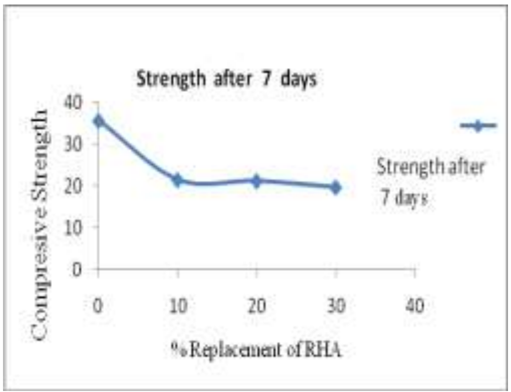

Figure 1.: Graph showing the compressive strength of cubes after 7 days

International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 12, December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

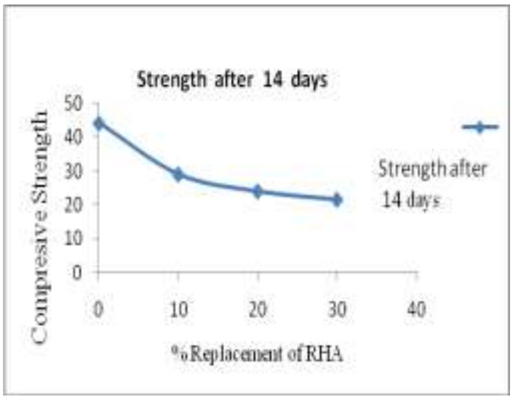

Figure 2.: Graph showing the compressive strength of cubes after 14 days

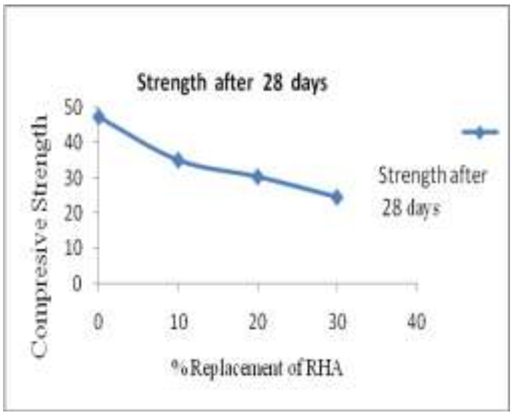

Figure 3.: Graph showing the compressive strength of cubes after 28 days

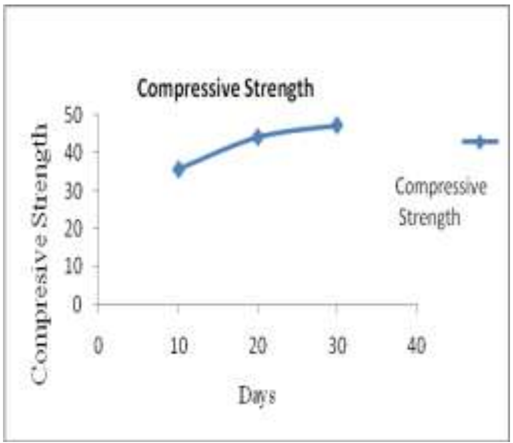

Figure 4.: Graph showing the highest compressive strength in 7, 14 and 28 days

International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 12, December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

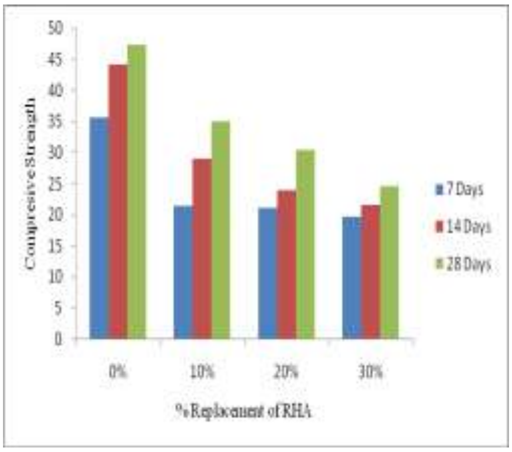

Figure 5.: Graph showing the compressive strength with and without RHA after 7, 14 and 28 days

According to IS code, the compressive strength obtained after 28 days of curing period is considered as the peak compressive strength of concrete. After 28 days the strength increase but slowly.

As per IS code 516:1959,the minimum compressive strength for M20 grade concrete should be 20Mpa. For factor of safety 1.5 is multiplied with compressive strength (20*1.5=30Mpa).

While taking 30% replacement, the compressive strength after 28 days was found to be 24.6Mpa,which is less than 30Mpa.

Therefore we conclude that replacement of RHA up to 20% is suitable.

V. CONCLUSION

Based on the limited study carried out on the strength behavior of Rice Husk ash, the following conclusions are drawn

1. At all the cement replacement levels of rice husk ash ;there is gradual increase in compressive strength from 7 days to 14 days. However there is significant increase in compressive strength from 7 days to 28 days followed by gradual increase after 28 days.
2. The minimum compressive strength for M20 grade concrete should be 20Mpa. For factor of safety 1.5 is multiplied with compressive strength (20*1.5=30Mpa).While taking 30% replacement, the compressive strength after 28 days was found to be 24.6Mpa,which is less than 30Mpa. Therefore we conclude that replacement of RHA up to 20% is suitable.
3. By using this Rice husk ash in concrete as replacement the emission of greenhouse gases can be decreased to a greater extent. As a result there is greater possibility to gain more number of carbon credits.
4. The technical and economic advantages of incorporating Rice Husk Ash in concrete should be exploited by the construction and rice industries, more so for the rice growing nations of Asia.
5. RHA based sand cement block can significantly reduce room temperature. Hence use of air conditioner will be less resulting in electric energy saving.

6. Moreover with the use of rice husk ash, the weight of concrete reduces , thus making the concrete lighter which can be used as light weight construction material.
7. As the Rice Husk Ash is waste material, it reduces the cost of construction.
8. Use of RHA shows a drastic increase in the amount of water required during the preparation. Standard mixes of concrete uses less amount of water as compared to RHA.
9. Rice husk ash mix mortar is a reduction weight of structure.

VI.FUTURE STUDY

1) Other levels of replacement with Rice Husk Ash can be researched.
2) Some test relating to durability aspects such as water permeability, resistance to penetration of chloride ions, corrosion of steel reinforcement, resistance to sulphate attack, durability in marine environment etc. with Rice husk ash and Silica fumes need investigation.
3) The study may further be extended to know the behaviour of concrete whether it is suitable for pumping purpose or not as present day technology is involved in RMC where pumping of concrete is being done to large heights.
4) For use of Rice Husk Ash concrete as a structure material, it is necessary to investigate the behaviour of reinforced Rice husk ash concrete under flexure, shear, torsion and compression.

REFERENCE

[1] Mehta P.K., "High-performance, high-volume fly ash concrete for sustainable development". Proceeding of the International Workshop on Sustainable Development and Concrete Technology, Beijing, China, May 20-21,2004.

[2] Mehta P.K.,"Mineral admixture for concrete-an overview of recent development "Advances in cement and concrete, Proceeding of an Engineering Foundation Conference, University of Newham shire,ASCE,pp,243-256,1994.

[3] A.Ramezanianpour, F.Gafarpour, M.H.Majedi., The use of rice husk ash in building industry. Building and Housing Research Centre(BHRC),winter 1995.

[4] A.Ramezanianpour, G.Bina,H.Rahimi "The role of rice husk ash in production of lightweight structural panels", Proceeding 3rd International Conference on Concrete, May 2000 Teheran, Iran

[5] P.K. Mehta, P.JM Montero, Concrete, Microstructure, Properties and Material, Translated into Persian by A.Ramezanianpour, P.Ghoddousi, E.Ganjian, Amirkabir University of Technology Press, summer 2004.

[6] A.A.Ramezanianpour, A.M. Ramezanianpour, Chloride diffusion in silica fume concrete mixture", International Symposium on Concrete, Toronto,Canada,17 October 2005.

[7] M.Nehdi,J.Duquette, A.EI Damatty, "Performance of rice husk produced using a new technology as a mineral admixture in concrete", Cement and Concrete Research(2003) PP.1203-1210

[8] M.Zhang, V.M. Malhotra, "High-Performance Concrete Incorporation Rice Husk Ash as a Supplementary Cementing Material", ACI Material Journal, November-December 1996, Title no:93-M72,PP.629-636.

[9] A.Ramezanianpour, F.Gafarpour, M.H.Majedi, Use of rice husk in the production of masonary cements, Building and Housing Research Centre(BHRC), September 1997.

[10] Khoddam Rzavi, SR “Rice husk ash a mineral admixture for high performance concrete”, Msc Thesis, Amirkabir University of Technology Press,2005.

[11] Ghassan Abood Habeed, Hilmi Bin Mahmud, "Study on properties of rice husk ash and its use as cement replacement material", Materials Research vol. 13 no.2 Sao Carlos April/June 2010.