iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** II **Month of publication:** February 2015

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Experimental Study of RHA Concrete

Chandraul Kirti[1] , Singh Manindra Kumar [2] , Saxena Anil Kumar[3] , Arora T. R.[4]
[1] M.Tech. Student, [2] M.Tech. Student, [3] Associate Professor, [4]Head Of Department
[1,2,3,4]*Lakshmi Narayan College of Technology, Department of Civil, Bhopal*

Abstract - This paper summarizes the research work on the properties of Rice Husk Ash (RHA) when used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with RHA by weight at 0%, 5%, 7.5%, 10%, 15% and 20%. 0% replacement served as the control. Slump cone test was carried out on fresh concrete while Compressive Strength test was carried out on hardened 150mm concrete cubes after 7, 14 and 28 days curing in water. The results revealed that the slump cone increased as the percentage replacement of OPC with RHA increased. The compressive and tensile strength of the hardened concrete also increase with increasing OPC replacement with RHA. It is recommended that further studies be carried out to gather more facts about the suitability of partial replacement of OPC with RHA in concrete.
Keywords: Concrete, Rice Husk, slump cone test, Compressive strength, tensile strength.

I. INTRODUCTION

The need to reduce the high cost of Ordinary Portland Cement in order to provide accommodation for the populace has intensified research into the use of some locally available materials that could be used as partial replacement for Ordinary Portland Cement (OPC) in Civil Engineering and Building Works. Supplementary cementitous materials have been proven to be effective in meeting most of the requirements of durable concrete and blended cements are now used in many parts of the world. Various research works have been carried out on the binary blends of Ordinary Portland Cement with different plans in making cement. Rice Husk Ash (RHA) which is an agricultural by-product has been reported to be a good pozzolona by numerous researchers. Malhotra and Mehta (2004) reported that ground RHA with finer particle size than OPC improves concrete properties, including that higher substitution amounts results in lower water absorption values and the addition of RHA causes an increment in the compressive strength. Cordeiro, Filho and Fairbarn (2009) carried out elaborate studies of Brazilian RHA and demonstrated that grinding increases the pozzolanicity of RHA and that high strength of RHA. Habeeb and Fayyadh (2009) investigated the influence of RHA average particle size on the properties of concrete and found out that at early ages the strength was comparable, while at the age of 28 days, finer RHA exhibited higher strength than the sample with coarser RHA.

This research work examined the use of Rice Husk Ash as partial replacement for Ordinary Portland Cement in concrete. It involved the determination of workability and compressive strength and tensile strength of the concrete at different percentage of replacement.

Fig 1. Rice husk and rice husk ash

ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Table1. Chemical Properties of RHA.

S. No	Parameters	Test Value	Method of Test
1	Silica as SiO2 % w/w	83.6	IS:1727:1967
2	Calcium Oxide as CaO % w/w	0.84	IS:1727:1967
3	Magnesium Oxide MgO % w/w	0.4	IS:1727:1967
4	4 Alumina as Al2O3 % w/w	0.76	IS:1727:1967
5	Ferric Oxide as Fe2O3 % w/w	0.64	IS:12423:1988
6	Loss on Ignition % w/w=]	14.2	IS:1727:1967
7	Sulphuric Anhydride as SO3 % w/w	0.69	IS:1727:1967

A. Properties Of RHA

1) *Strength:* RHA has the potential to be used as a substitute silica fumes or micro silica as a much lower cost, without compromising on the quality aspect. Adding RHA to the concrete mix even in low replacement will dramatically enhance the workability, strength and impermeability of concrete mixes, while making the concrete durable to chemical attacks, abrasion and reinforcement corrosion, increasing the compressive strength by 10% - 20 %.

2) *Water Proofing:* RHA has excellent water resistance (impermeability) properties and is used in waterproofing compounds to give amazing results. It reduces the water penetration by as much as 60 %.

3) *Concrete in Marine environment:* Adding RHA to concrete and paints helps to reduce the chloride ion penetration by as much as 50 % into the structure, thus improving life of the building.

4) *Heat of Hydration:* Adding RHA to concrete lowers the heat of hydration by as much as 30 % and prevents formation of cracks during casting.

5) *Other Uses Of Rice Husk Ash*

a) RHA acts as a very good insulator.
b) RHA is also used for insulation of molten metal in tundish and ladle in slab caster.
c) The temperature of molten metal in the ladle is around 1400 degrees centigrade and above. When this metal flows from ladle to tundish, the temperature drops to around 1250 degrees. This reduction in temperature leads to choking and causes breakdown in the slab caster.
d) It acts as a very good insulator and the temperature is maintained and does not cool down quickly, hence reducing the breakdown time of the casting.

ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

II. MATERIAL AND METHODOLOGY

Ordinary Portland Cement confirming the requirements of IS: 1489 (Part1)-1991.is used for the present experimental work With OPC 43 Grade cement is used. Fine aggregate was purchased which conforms the zone II as per the specifications of IS 383:1970. Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates.

A. Rice Husk Ash

RHA, produced after burning of Rice husks (RH) has high reactivity and pozzolanic property. Indian Standard code of practice for plain and reinforced concrete, IS 456- 2000, recommends use of RHA in concrete but does not specify quantities. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature. As per study by Houston, D. F. (1972) RHA produced by burning rice husk between 600 and 700°C temperatures for 2 hours, contains 90-95% SiO_2, 1-3% K_2O and < 5% unburnt carbon. Under controlled burning condition in industrial furnace, conducted by Mehta, P. K. (1992), RHA contains silica in amorphous and highly cellular form, with 50-1000 m^2/g surface area. So use of RHA with cement improves workability and stability, reduces heat evolution, thermal cracking and strength.

B. Methodology

The mix design for M20 grade was done and got the ratio 1:1.51:3.06. Cubic specimens of concrete with size 150 x 150 x 150 mm were cast for determination of all measurements. Six mixes were prepared using different percentages of 0, 5, 7.5, 10, 15, and 20% RHA. The concrete was mixed, placed and compacted in three layers. The water cement ratio was 0.5%. The samples were demoulded after 24 hours and kept in a curing tank for 7, 14 and 28 days as required. The Slump Cone apparatus was also used to determine the Slump Cone values of the fresh concrete and hardened strength of concrete were also determined by compressive and tensile strength.

III. TESTING

The testing of concrete is performed by replacing cement with rice husk ash. Before testing concrete the ingredients are tested. The properties of RHA are determined as per IS:2386(partIII-1963. Then the compressive and tensile strength were determined as per IS:516-1959 and IS:516-1999 respectively on 7^{th} day, 14^{th} day and 28^{th} day with w/c ratio 0.5. The strength property of concrete having RHA is analysed. The strength property of concrete was improved by the addition agricultural waste.

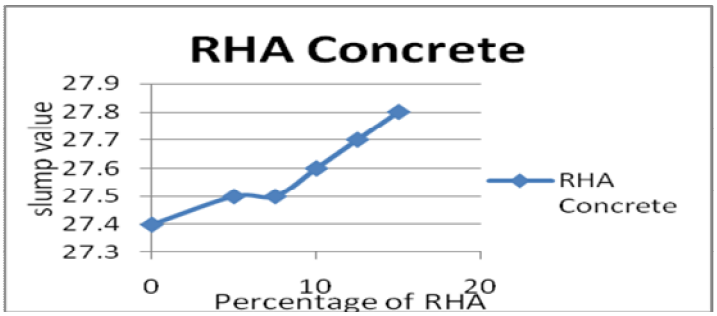
IV. RESULTS AND DISCUSSION

A. Slump cone (workability test):

Table2. Slump Cone Value Of RHA Concrete

% of RHA	Slump Value	Slump
0	27.4	2.6
5	27.5	2.5
7.5	27.5	2.5
10	27.6	2.4
12.5	27.7	2.3
15	27.8	2.2

ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

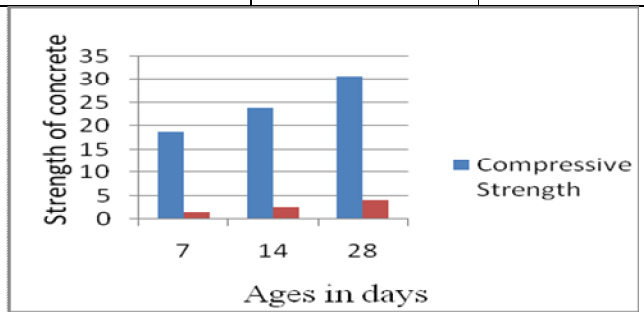
Graph1. Slump Cone Value Of RHA Concrete

B. Strength Of M20 Concrete

The 28 days strength obtained for M20 grade Control concrete is 30.64 Mpa. The strength results reported in table 3 are presented in the form of graphical variation, where in the compressive strength is plotted against the curing period. Table 3:

Table 3. Strength of M20 Concrete

M20 Grade of Concrete	Compressive Strength N/mm2	Tensile Strength N/mm2
7 day	18.63	1.54
14 day	23.75	2.54
28 day	30.64	3.96



Graph2. Compressive and tensile strength of M20 Concrete

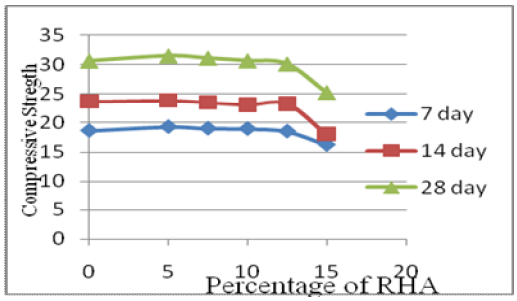
C. Compressive Strength Test of RHA Concrete

The result of the compressive strength of concrete cubes show that the compressive strength upto 12.5% replacement gives good result and reduced as percentage of RHA increase after 12.5%. However, the compressive strength increased as the no. Of days of curing increased for each percentage RHA replacement. It is seen from Table4 that for controlled cube, the compressive strength increases from 18.52 N/mm2 at 7 day to 30.14 N/mm2 at 28days. The strength was above the specified

value of 30N/mm2 for grade M30 concrete as shown in Graph3.

Table4. Compressive strength of RHA Concrete

S.No.	Ratio (%)		Amount(Kg/m3)					7 Day	14 Day	28Day
	R.H.A.	Cement	Name	Cement	RHA	Sand	Aggregate			
1	0.00	100.0	N1	384.35	0	580.4	1176.1	18.63	23.75	30.64
2	5.00	95.0	R1	365.15	19.2	580.4	1176.1	19.30	23.92	31.50
3	7.50	92.5	R2	355.55	28.8	580.4	1176.1	19.02	23.60	31.12
4	10.0	90.0	R3	345.90	38.44	580.4	1176.1	18.96	23.20	30.69
5	12.5	87.5	R4	336.31	48.04	580.4	1176.1	18.52	23.37	30.14
6	15.0	85.0	R5	326.70	57.65	580.4	1176.1	16.22	18.08	25.32



Graph3. Compressive Strength of RHA Concrete

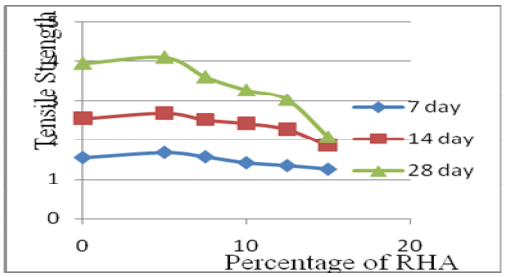
D. Tensile strength test:

The results show that the Tensile strength at 28 days increased with the replacement of 12.5percent cement with RHA. This is due to the higher specific area of the RHA which accelerated the pozzolanic reaction. Another possible reason may be the presence of higher CaO content in the RHA. The results of the present investigation indicate that the percentage of RHA contributing to the mechanical properties is more significant than that of control concrete.

Table 5. Tensile Strength of RHA Concrete:

S.No.	Ratio (%)		Amount (kg/m3)				7 Day	14Day	28Day
	R.H.A.	Cement	Cement	RHA	Sand	Aggregate			
1	0	100	384.35	0	580.4	1176.1	1.54	2.54	3.96
2	5	95	365.15	19.2	580.4	1176.1	1.67	2.68	4.11
3	7.5	92.5	355.55	28.8	580.4	1176.1	1.56	2.51	3.62
4	10	90	345.90	38.44	580.4	1176.1	1.41	2.42	3.29
5	12.5	87.5	336.31	48.04	580.4	1176.1	1.34	2.27	3.04
6	15	85	326.70	57.65	580.4	1176.1	1.25	1.85	2.08

The result of the Tensile strength of concrete cubes shows that the Tensile strength upto 12.5% replacement gives good result and reduced as percentage of RHA increase after 12.5%. However, the Tensile strength increased as the no. Of days of curing increased for each percentage RHA replacement. It is seen from Graph 3that for controlled cube, the Tensile strength increases from 1.34 N/mm2 at 7 day to 3.04 N/mm2 at 28days.



Graph4. Tensile Strength Of RHA Concrete

V. CONCLUSION

A. Improvement in Fresh Concrete Properties:-

1) Due to addition of rice Husk ash, concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete.

2) It also increases workability of concrete.

3) Increased chloride and sulphate resistance/mild acids.

B. Reduced heat of hydration – leading to minimal crack formation in higher grades of concrete.

C. The bulk density of RHA concrete is reducing with increase in RHA content.

D. Due to addition of RHA it is observed that early strength gain is slightly increasing with addition of 05%, 7.5%, 10%, 12.5% and 15% RHA in normal concrete at 7 days.

E. But in 28 days tests results it is found that with addition of 12.5% RHA in normal concrete strength is running parallel or more than of normal concrete. Thus 12.5% RHA is the optimum content for getting nearly equal strength at 28 days.

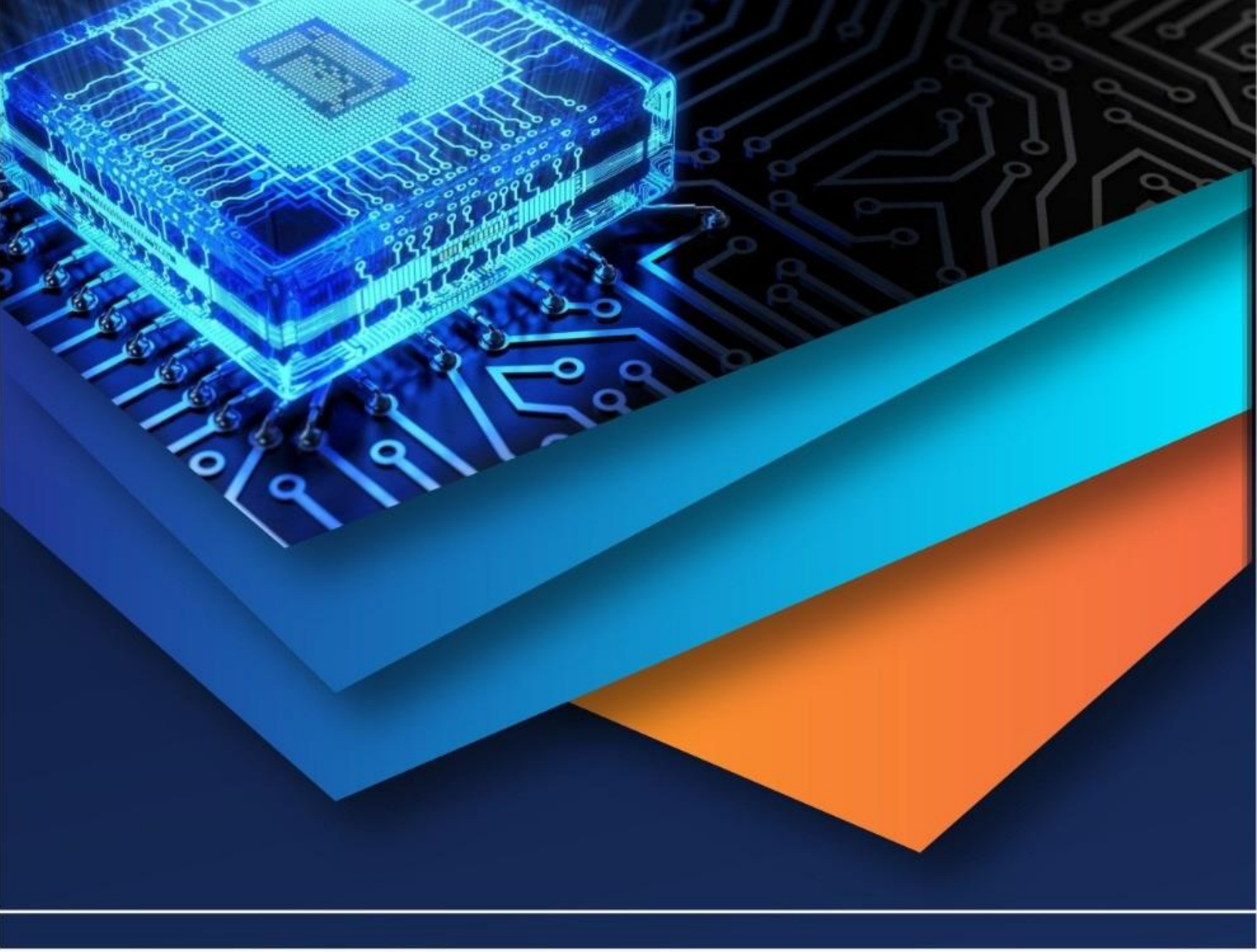
F. As the replacement of cement by RHA in concrete increases, the workability of concrete increase.

G. Replacement of cement with Rice Husk Ash leads to increase in the compressive strength improves the workability and achieved the target strength at 12.5% replacement for the grade of concrete.

The compressive and tensile strength RHA Concrete is similar to the conventional concrete. Thus RHA concrete perform good environment point of view.

REFERENCES

[1] Ephraim etal, (2012): Compressive Strength of Concrete with RHA as partial replacement of ordinary Portland Cement. Scholarly Journal of Engineering Research Vol. 1(2)pp32-36.
[2] Ogunbode etal (2012): An evaluation of compressive Strength of Concrete made with RHA obtained by open air burning. www. Academia.edu.
[3] Muga,H etal (2005): Development of appropriate and Sustainable Construction Materials. www.Ricehuskash.com
[4] Karim, MR (2012): Strength of Mortar and Concrete as influence by RHA. Idosi.org/wasj/wasj19(10)12/19.
[5] International Institute of Concrete Technology Journal, Uk, N0.55 Autumn 2004. ASTM Standard C311 Standard Test Methods for Sampling and testing Fly Ash or Natural Pozzolans for use in Portland cement concrete. West Conshohocken, Pennsylvania.
[6] Al-Khalaf, M.N. and Yousif, H.A. (1984). Use of Rice Husk Ash in Concrete. The Inter. J. Cement Composites Lightweight Concrete, 6(4): 241-248.
[7] Anwar, M., Miyagawa, T. and Gaweesh, M. (2000). Using Rice Husk Ash as Cement Replacement Meterial in Concrete, Waste Mangt Series, 1: 671-684.
[8] Rice Husk Ash – Properties and its Uses : A Review" by A. Muthadhi, R. Anita and Dr. S. Kothandaraman .
[9] " Rice Husk Ash – Properties and its Uses : A Review" by A. Muthadhi, R. Anita and Dr. S. Kothandaraman.
[10] Building Materials in India: 50 years, A Commemorative Volume, Edited by T. N. Gupta, 1998.
[11] Proceedings of International Training Course on, Materials design and production processes for Low Cost Housing, Trivandrum, India, 27- 31 March, 2001.
[12] International Conference, Waste and Byproducts as Secondary Resources for Building Materials, 13-16 April, 1999, New Delhi, India.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY