

Mechanical Properties of Rice Husk Ash Blended Cement Concretes made with OPC 53 Cement

Srinivas K.¹, Kishore Kumar M²

M.Tech Scholar, Department of Civil Engineering, Pydah College of Engineering, Visakhapatnam, India

Associate Professor, Department of Civil Engineering, GVP College of Engineering, Visakhapatnam, India

ABSTRACT: In this paper, research work has been carried out pertaining to the mechanical properties of Rice Husk Ash blended cement concretes made with OPC 53 cement. The influence of Rice Husk Ash on compressive strength of concrete, split tensile strength, flexural strength of the specimens has been carried out. It was found that there was an increase of compressive strength up to 20% replacement of cement with Rice Husk Ash. The compressive strength of concrete, split tensile strength, flexural strength of the specimens partially replaced with rice husk ash is presented.

KEYWORDS: Rice Husk Ash, Properties, Workability, Compressive Strength

I. INTRODUCTION

Rice Husk Ash has been procured from in a fine power form after grinding the raw husk ash. The Rice Husk Ash samples collected were tested for their physical and chemical properties to identify its suitability as pozzolan. The compressive strength of concretes made with fly ash is compared with the control concrete. The results pertaining to the compressive strength split tensile strength, flexural strength of the specimens have been shown in table no. 4, 6 & 7.

II. MATERIALS USED

A. Cement

Ordinary Portland cement of 53 grade with specific gravity of 3.15 has been used. The initial setting time and final setting time were found to be 33min and 315min respectively.

B. Fine Aggregate

Locally available natural river sand passing through 4.75 mm I.S. Sieve with a fineness modulus of 2.97, and water absorption of 1.5% in saturated surface dry (SSD) condition was used. The specific gravity of the sand is found to be 2.57 and was confining to ZONE-III.

C. Natural coarse aggregate

Crushed granite metal from local sources, passing through 20 mm and retained on 4.75 mm sieve was used as natural coarse aggregate. The fineness modulus of Natural Coarse Aggregate (NCA) is 6.48 and its water absorption is 0.94% in SSD condition. The specific gravity of coarse aggregate is found to be 2.65.

D. Water

Potable fresh water available from local sources free from deleterious materials was used for mixing and curing of all the mixes tried in this investigation. W/C ratio is taken as 0.47 for M40.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

E. Rice Husk Ash

The Rice Husk Ash samples were tested for their physical and chemical properties

Table: 1 Test results of Physical Properties of collected samples of Rice Husk Ash

Particulars	Properties
Colour	Gray
Shape Texture	Irregular
Mineralogy	Non Crystalline
Particle Size	< 45 micron
Odour	Odourless
Appearance	Very fine
Specific gravity	2.3

Table: 2 Test results of Chemical Properties of collected samples of Rice Husk Ash

Particulars	Proportion, %
Silica - SiO ₂	90.63
Al ₂ O ₃	1.78
Fe ₂ O ₃	0.79
Carbon	0.70
CaO	0.13
MgO	0.87
K ₂ O	2.45
Others	2.65
Moisture	0.63

Table 3: Concrete Mix Proportions of M40 grade

Mix Designation	Cement kg/m ³	RHA kg/m ³	FA kg/m ³	CA kg/m ³	W/C ratio
R0	410	0	584	1174	0.45
R10	369	41	584	1174	0.45
R20	328	82	584	1174	0.45
R30	287	123	584	1174	0.45
R40	246	164	584	1174	0.45

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

R0, R10, R20, R30, R40 – Concrete mix with 0%, 10%, 20%, 30%, 40% replacement of Rice Husk Ash with OPC 53 Cement

III. EXPERIMENTAL DETAILS

The concrete specimens were made with Rice Husk Ash of different replacements of cement. The compressive strength grade M40 were casted. The specimens of 150x150x150 mm cubes were used for the Compression test. Three specimens were tested for the required age and mean value were taken and reported. The compressive strength of concrete mixes at different ages were shown in tables 4 .

Table: 4 Compressive strength of specimens at different ages of curing days made with Rice Husk Ash of M40 grade

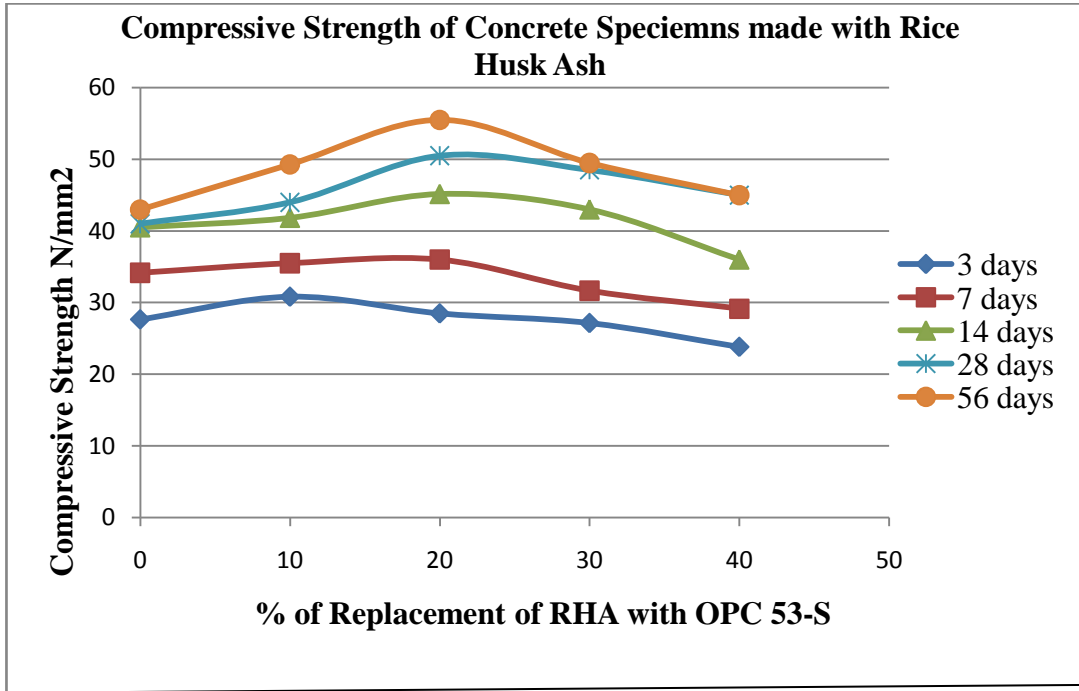
Mix Designation	Compressive-Strength, N/mm ²				
	3-days	7-days	14-days	28-days	56-days
R0	27.66	34.16	40.50	41.00	43.00
R10	30.83	35.50	41.83	44.00	49.30
R20	28.50	36.00	45.16	50.50	57.60
R30	27.16	31.66	43.00	48.50	49.50
R40	23.83	29.16	36.00	44.00	45.00

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

Fig 1: Compressive strength of specimens made with Rice Husk Ash of M40 grade at 3, 7, 14, 28 and 56 days age of curing



Comparing results with the literature review of Suresh Kulakarni with research results of OPC 53 Cement:

Table 5 Comparison of Compressive Strength at 28-days Results

Literature Review		Research Results	
Mix Proportion	Compressive-Strength N/mm ²	Mix Proportion	Compressive-Strength N/mm ²
M0	37.0	R0	41.0
M10	42.8	R10	44.0
M20	39.8	R20	50.5
M30	37.0	R30	48.5
-	-	R40	44.0

Table 6: Flexural Strength of specimens made with Rice Husk Ash of M40 grade at 28 days age of curing

Mix Designation	Flexural-Strength N/mm ²
R0	5.6
R10	6.0
R20	7.0

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

R30	6.5
R40	6.25

Table 7: Split Tensile Strength of specimens made with Rice Husk Ash of M40 grade at 28 days age of curing

Mix Designation	Split Tensile-Strength N/mm ²
R0	5.6
R10	6.0
R20	7.0
R30	6.5
R40	6.25

IV. CONCLUSIONS

1. Early strength is slightly less in RHA Blended Cement Concrete than the conventional concrete.
2. An increase of around **23.1 %**, **33.9%** compressive strength for RHA blended cement concrete was observed when replaced with 20% of **OPC 53** cement at 28 and 56 days age of normal curing.
3. The split tensile, flexure strength results of RHA blended cement concretes when replaced up to **20 %** is more than the conventional aggregate concrete at age of 28 days of normal curing
4. An increase of about **25 %**, **8.74%** of Flexural and Split tensile strength for RHA blended cement concrete when replaced with 20% of **OPC 53** cement at 28 days age of normal curing.
5. Comparative study on Rice Husk Ash concrete with various replacement percentages of RHA showed that, a replacement level of 20% RHA in concrete performs and shows better strength than other replacements.

REFERENCES

1. Barbhuiya A S, Nimityongskul P and Chitasombuti; (2006), "Use of classified rice husk ash for high strength concrete", *The Indian concrete journal*, May, 11-16.
2. Dabai M U, Muhammad C, Bagudo B U and Musa A (2009) "Studies on the Effect of Rice Husk Ash as Cement Admixture", *Nigerian Journal of Basic and Applied Science* (2009), 17(2)252-256
3. Deepa G Nair, K. Sivaraman, and Job Thomas (2013) "Mechanical Properties of Rice Husk Ash (RHA) – High strength Concrete", *American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-093, Volume-3 pp-14-19.*
4. Ettu L O, Ajoku C A, Nwachukwu K.C (2013) "Strength variation of OPC-rice husk ash composites with percentage rice husk ash", *Int. Journal of Applied Sciences and Engineering Research*, Vol. 2, Issue 4, 2013.
5. Giaccio G, Sensale G R, and Zerbino R (2007), "Failure mechanism of normal and high strength concrete with rice husk ash", *Cement and concrete composites*, 29
6. Godwin A Akeke, Maurice E Ephraim, Akobo, I Z S and Joseph O Ukpata (2013) "Structural Properties of Rice Husk Ash Concrete", *International Journal of Engineering and Applied Sciences*, May 2013. Vol. 3, No. 3
7. Gyanen Takhelmayum, Ravi Prasad, Savitha A L (2014) "Experimental Study on the Properties of cement concrete using Rice Husk Ash", *International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 3, Issue 6, November 2014.*
8. Kartini K, "Rice Husk Ash – Pozzolanic Material for Sustainability" *International Journal of Applied Science and Technology, International Journal of Applied Science and Technology*
9. Makarand Suresh Kulkarni, Paresh GovindMirgal, Prajyot Prakash Bodhale, Tande S N (2014) "Effect of Rice Husk Ash on Properties of Concrete", *Journal of Civil Engineering and Environmental Technology*, Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 1, Number 1; August, 2014 pp. 26-2.
10. Nair D G, Jagadish K S, Fraaij A (2006). "Reactive pozzolanas from rice husk ash: An alternative to cement for rural housing." *Cement and Concrete Research*, (36), 1062-1071
11. Padma Rao P, Pradhan Kumar A, Bhaskar Singh B (2014) "A Study on Use of Rice Husk Ash in Concrete", *IJEAR Vol. 4, Issue Spl-2, Jan - June 2014 ISSN: 2348-0033 (Online) ISSN: 2249-4944 (Print).*

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

12. Ramadhyansyah Putra Jaya (2011) "Strength and permeability properties of concrete containing rice husk ash with different grinding time", *Central European Journal of Engineering*, March 2011, Volume 1, Issue 1, pp 103112.
13. Reddy D V., and Alvarez B S M, "Marine Durability Characteristics of Rice Husk Ash-Modified Reinforced Concrete", *Fourth LACCEI International Latin American and Caribbean Conference for Engineering and Technology (LACCET)*, June 2006.
14. Sathish Kumar R (2012) "Experimental study on the properties of concrete made with alternate construction materials", *International Journal of Modern Engineering Research (IJMER)* Vol. 2, Issue. 5, Sept.-Oct. 2012 pp-3006-3012.
15. Thiruchelvam S, "Efficiency of Rice Production and Issues relating to Cost of Production in the Districts of Anuradhapura and Polannaruwa", *Nat J, Sci.Foundation Sri Lanka* 2005 33(4), October 2005, pp. 247-256
16. Uduweriya R B Y B, Subash C, Sulfy M M A and Sudhira De Silva (2010) "Investigation of Compressive Strength of concrete containing Rice Husk Ash", *International Conference on Sustainable Built Environment (ICSBE-2010) Kandy, 13-14 December 2010*.

BIOGRAPHY



Mr. K.Srinivas is a Research Scholar pursuing his Masters degree in Structural Engineering Specialization at Pydah College of Engineering, Visakhapatnam. His areas of interest are durability studies on concrete.



Dr. M Kishore Kumar obtained his master degree in Structural Engineering from PSG College of Technology, Coimbatore and Doctorate from JNT University, Hyderabad. He has been working as Associate Professor at the department of Civil Engineering in GVP College of Engineering, Visakhapatnam. His areas of interest are durability studies on materials, corrosion of reinforcement in concrete structures including prediction of residual and service life.