International Journal of Engineering Research and General Science Volume 4, Issue 2, March-April, 2016
ISSN 2091-2730

Strength and Workability Properties of GGBS and Rice husk Ash

Divya BhavanaTadepalli, Madhavi Etaveni, Syed Eashan Adil
Assistant professors, Department of Civil engineering
Aurora engineering college , Hyderabad, India

Abstract— Sustainable development is mandatory to protect our environment .In agriculture and other industries waste materials are released which are organic and inorganic materials and can be an alternate material for cement . Rice husk ash which reduces the emission of carbon and produces green effect in environment .GGBS a slag material which also be an alternate to the cement. In this research the experimental investigations carried out in three phase M30 mix grade concrete is used with RHA in proportions of 0%,5%,10%and 15% .In second phase GGBS in various proportions of 10%,20%and 30% were tested . In third phase combination of GGBS and rice husk ash were tested .From this research the results are much better as compare to conventional concrete.

Keyword: Rice husk ash (RHA),Ground granular blast furnace slag (GGBS),compressive strength,split tensile strength,conventional concrete,workability.

INTRODUCTION

Concrete has been the major in construction for providing stable and reliable infrastructure since the days of Greek and roman civilization. Concrete is the most world widely used in construction material. The increase in demand of concrete more the new method and materials are being developed for production of concrete. Concrete is a mixture of cement, water, and aggregates with or without chemical admixtures. The most important part of concrete is the cement. Use of cement alone as a binder material produces large heat of hydration. Since the production of this raw material produces lot of CO2 emission. The carbon dioxide emission from the cement raw material is very harmful to the environmental changes. Nowadays many researchers have been carried out to reduce the co_2.The effective way of reducing co_2 is using rice husk ash which is an agricultural residue accounts for 20%of 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling plants when used as a fuel also contributes to pollution and efforts are being made to overcome this environmental issue by utilizing this material as a supplementary cementing material.

MATERIALS USED

Cement

The ordinary Portland cement of 53 grade conforming to IS 12269: 2013 was used. The specific gravity of cement was 3.11.

Rice husk ash

Rice husk ash is a pozzolanic material .A residual obtained from open field burning .In this investigation specific gravity for RHA is 2.3

GGBS

GGBS has been used in construction industry for years as replacement of ordinary Portland cement when molten iron slag is quenched in steam or water, a glassy product is obtained. It is then dried and made into powder. In this investigation specific gravity for GGBS is 3.09

Fine aggregates

Natural river sand was used as a fine aggregate conforming to grading zone I of IS: 383 1970 was used. Its specific gravity was 2.6.

Coarse aggregate

Coarse aggregate obtained from local quarry units has been used for this study. Maximum size of aggregate used is 20mm with specific gravity of 2.67.

Water

In this experimental investigation portable water which is free from organic substances is used for mixing and curing.

EXPERIMENTAL INVESTIGATION

In present study M30 grade concrete were designed as per IS: 10262-2009

A. Workability

Freshly mixed concrete were tested for workability by slump test. In this investigation, M30 mix concrete the test by-weight basis by replacing cement by 0%,10%,20%,30% with RHA and 10%,20%,30% with GGBS and 30% combine effect of RHA and GGBS are carried out.

B. Compressive strength

In this investigation, M30 mix concrete is considered to perform the test by-weight basis with 0%,10%,20% and 30% of cement replaced by RHA and 10%,20%,30% of cement by GGBS and combination of both RHA and GGBS. A 150x150 mm concrete cube was used as test specimens to determine the compressive strength of concrete cubes. The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The cubes were properly compacted. All the concrete cubes were de-moulded within 24 hours after casting. The de-moulded test specimens were properly cured in water available in the laboratory at an age of 28 days. Compression test was conducted on a 2000KN capacity universal testing machine. The load was applied uniformly until the failure of the specimen occurs. The specimen was placed horizontally between the loading surfaces of the compression testing machine and the load was applied without shock until the failure of the specimen occurred.

C. Split tensile strength

In this investigation, M30 mix concrete is considered to perform the test by-weight basis by replacing 0%,10%,20% and 30% of cement replaced by RHA and 10%,20%,30% of cement by GGBS and combination of both RHA and GGBS and combination of both quarry dust and GGBS. Cylinders of 150 mm diameter and 300 mm length were used as test specimens to determine the split tensile strength of concrete .The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The cylinders were properly compacted. All the cylinders were de-moulded within 24 hours after casting. The de-moulded test specimens were properly cured in water available in the laboratory for an age of 28 days. The split tensile strength was conducted as per IS 5816-1976.The specimen was placed horizontally between the loading surfaces of the compression testing machine and the load was applied without shock until the failure of the specimen occurred.

RESULTS AND DISCUSSIONS

A. WORKABILITY

Slump test of various mix proportions of RHA and GGBS in concrete are shown below

Table1: Slump values with various proportions of Rice husk ash and GGBS replacing cement in M30 grade concrete

S.No	RHA Content	Slump
1	0%	96
2	5%	90
3	10%	85
4	15%	79

S.No	GGBS content	slump
1	0%	96
2	10%	97
3	20%	98
4	30%	99

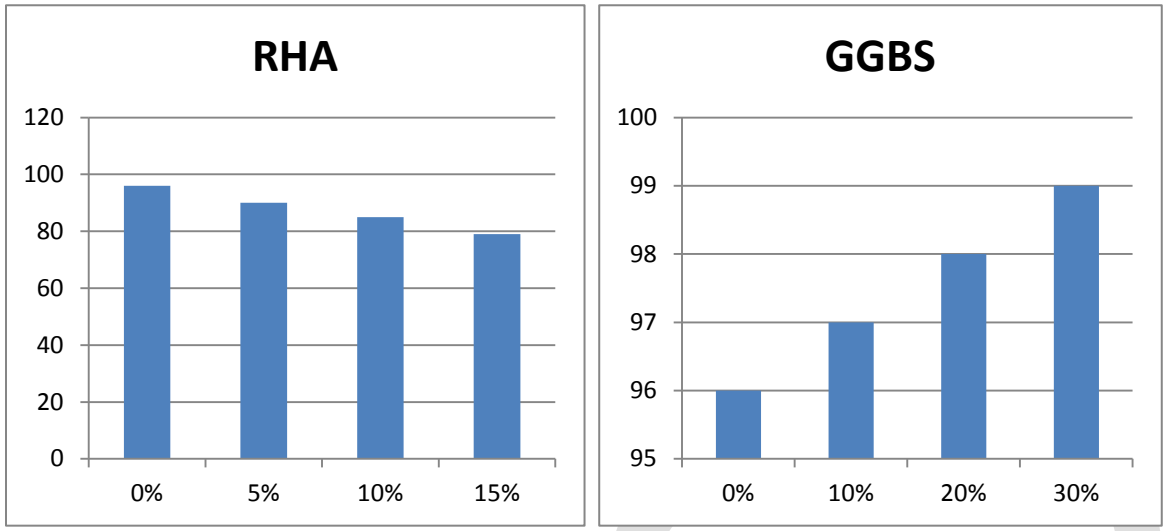


Fig 1: slump values when replacement of cement by RHA and GGBS

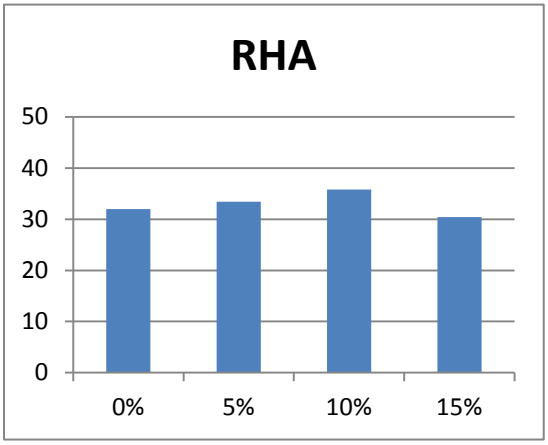
B. Compressive Strength Test

The compressive strength of concrete was achieved in 28 days of various proportions and presented below. The specimens were cast and tested as per IS: 516-1959.

Table 2: Compression test at 28 day with various Proportions of RHA and GGBS replacing cement in M30 grade concrete

S.No	RHA Content	Compressive strength N/mm^2
1	0%	32
2	5%	33.44
3	10%	35.8
4	15%	30.4

S.No	GGBS Content	Compressive strength N/mm^2
1	0%	32
2	10%	36.44
3	20%	39.55
4	30%	23.55



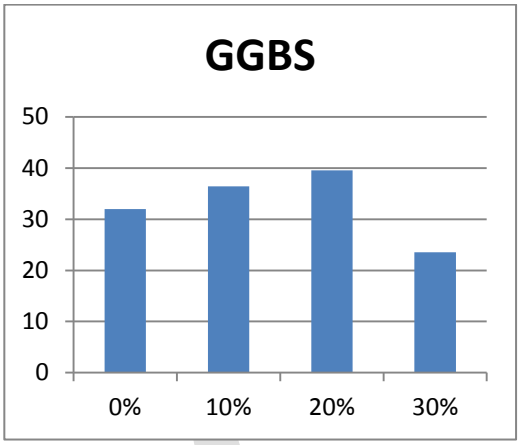
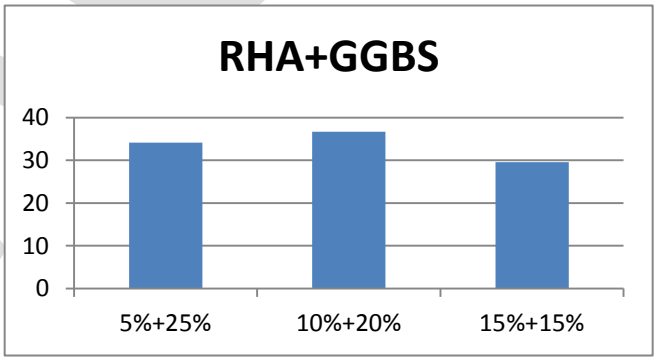


Fig 2: Compressive Strength when replacement of Cement by RHA and GGBS

From the figure 2 and table 2 it is observed that 10% Rice husk ash (RHA) and 20% GGBS achieved maximum strength in comparison to normal concrete.

Table 3 and Fig 3: Compression test at 28 day with various Proportions of GGBS and RHA replacing cement in M30 grade concrete

S.No	RHA and GGBS content	Compressive strength N/mm^2
1	5% RHA +25% GGBS	34.11
2	10% RHA+20%GGBS	36.7
3	15% RHA+ 15%GGBS	29.6



From the figure 3 and table 3 it is observed that combine 5% RHA and20% GGBS achieved maximum strength in comparison to normal concrete.

c. Split Tensile Test

The tensile strength of concrete with 28 days curing period for various proportions and presented below .The specimens were cast and tested as per IS: 516-1959.

Table 4: Split tensile test at 28 day with various Proportions of RHA and GGBS replacing cement in M30 grade concrete

S.No	RHA Content	Split tensile strength N/mm^2
1	0%	3.56
2	5%	3.57
3	10%	3.6
4	15%	3.4

S.No	GGBS Content	Split tensile strength N/mm^2
1	0%	3.56
2	10%	3.58
3	20%	3.65
4	30%	3.01

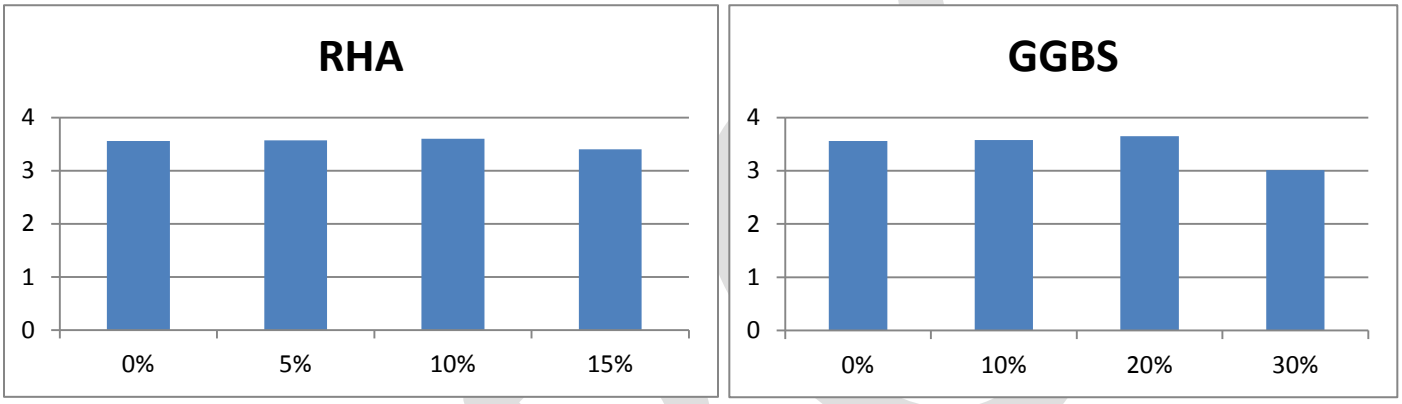
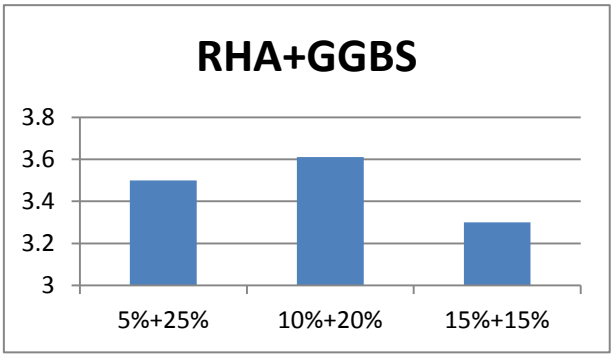


Fig 4: split tensile Strength when replacement of Cement by RHA and GGBS

From the figure 4 and table 4 it is observed that 10% Rice husk ash (RHA) and 20% GGBS achieved maximum strength in comparison to normal concrete.

Table 5 and Fig 5: Split tensile test at 28 day with various Proportions of RHA and GGBS replacing cement in M30 grade concrete

S.No	RHA and GGBS content	Split tensile strength N/mm^2
1	5% RHA +25% GGBS	3.5
2	10% RHA+20%GGBS	3.61
3	15% RHA+ 15%GGBS	3.3



From the figure 5 and table 5 it is observed that 10% Rice husk ash (RHA) and 20% GGBS achieves maximum strength in comparison to normal concrete

CONCLUSION

Based on the experimental investigations the following conclusions are drawn:

- As cement is very costlier and use of cement creates a environmental problems need to find alternative material. Rice husk ash is a waste material which is obtained from rice mills a, it is a suitable substitute for cement at very low cost.
- By adopting critical mix and replacing the cement by rice husk ash fine, it is found that by increasing the percentage of rice husk ash workability decreases because of its increased water absorption and strength decreases gradually.
- Similarly replacing cement with GGBS increases the workability
- From the above compressive strength results, it is observed that rice husk ash based concretes have achieved an increase in strength for 10% replacement of cement and 20% replacement of cement by GGBS and combine 10% RHA and 20% GGBS at the age of 28 days when compared to conventional concrete.
- From the above split tensile strength results, it is observed that rice husk ash based concretes have achieved an increase in strength for 10% replacement of cement and 20% replacement of cement by ggbs and combine 10% RHA and 20% GGBS at the age of 28 days when compared to conventional concrete.
- From the above experimental investigation rice husk ash(RHA) can be used as alternate material to cement up to 10% ,20% GGB Sand 10%and 20% combine effect of RHA and GGBS .

ACKNOWLEDGMENT

The author T.Divya Bhavana wish to thank S.k Chandra sir Associate professor and aurora engineering college for their kind support, valuable guidance and providing all facilities for conducting this experiment on replacement of RHA and GGBS in concrete.

REFERENCES :

[1]. Satish H.Sathawane and Vikrant S.Varigade “Combine Effect of Rice Husk Ash and Fly Ash on Concrete by 30% Cement Replacement”.

[2]. B. N. Sangeetha “Effect of Rice Husk Ash and GGBS on Performance of Concrete”.

[3]. Prasanna Venkatesan Ramani, Pazhani Kandukalpatti Chinnaraj,"Geopolymer concrete with ground granulated blast furnace slag and black rice husk ash"

[4]. Sonali K. Gadpalliwar1, R. S. Deotale2, Abhijeet R. Narde To Study the Partial Replacement of Cement by GGBS & RHA and Natural Sand by Quarry Sand In Concrete” .

[5]. IS 2386: Part 3: “Methods of Test for Aggregates for concrete” Part 3, 1963.

[6] IS 4031: Part 4: “Methods for physical test for hydraulic cements”, Bureau of Indian standards, Ne Delhi, 1988.

[7] IS 516:1959, “Method of Test for Strength of Concrete”, Reaffirmed 2004, Bureau of Indian standards, New Delhi

[8]IS 10262 -2009 “IS Method of Mix Design”, Bureau of Indian Standards, New