Comparative study on Partial Replacement of use Agro-Waste as Fine Aggregate for Sustainable Build Environment

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Abstract— High demand of natural resources due to rapid urbanization and the disposal problem of agricultural wastes in developed countries have created opportunities for use of agro-waste in the construction industry. This paper reviews some of the agro-waste materials, which are used as a partial replacement of fine aggregate in concrete.it has been seen that the agro-waste concrete containing groundnut shell and rice husk showed better workability than their counterparts did. Agro-waste concrete containing achieved their required strength by 20% of replacement as fine aggregate, which were maximum among all agro-waste type concrete. Three various concrete mixes with the groundnut shell as has replacement of 10%, 15%, and 20% to the fine aggregate were prepared grade of concrete. The basic test namely compressive strength is carried out on the cube in order to find out the compressive strength of the cube and result were reported in a graphical manner. Additional of rice husk ash and groundnut shell as fine aggregate in mortar increased the resistance of chloride penetration whereas inclusion of cork in mortar showed better thermal resistance and improved cyclic performance.

Keywords: Agro-waste, Compressive strength, Concrete, Fine aggregate, Groundnut shell, and Rice husk ash.

I. INTRODUCTION

Concrete is a mixture of Cement, Fine aggregate, and Coarse aggregate, which is mainly derived from natural resources. Increasing population, expanding urbanization, climbing way of life due to technological innovations has demanded a huge amount of natural resources in the construction industry, which has resulted in scarcity of resources. This scarcity motivates the researches to use, solid wastes generated by industrial, mining, domestic and agricultural activities.

It is observed that in India more than 600 MT wastes have been generated from agricultural waste, which is seriously leading to a disposal problem. Reuse of such wastes as sustainable construction materials take care of the issues of contamination, as well as the issue of area filling and the expenses of building materials.

Now a days disposing of agro-waste are the major problem. One of the agro-waste is rice husk. Every year an average of 120 million tons of rice husk are produced by paddy field. Majority of rice producing countries like India, the husk produced from the rice processing is either burnt or dumped as a waste. Rice husk can be used as a fuel if its burnt at high temperature and it turn into a ash. Ash obtained is porous as fine aggregate and its grinding into a fine power. RHA is a pozzolanic material contains 85% of silica content. Using rice husk ash as a substitute material in concrete reduces the environmental problem.

The global consumption of natural sand is too high due to its extensive use in concrete. The demand for natural sand is quit high in developing countries for infrastructure. But natural sand is expensive and not available easily so overcome this problem we replace the fine aggregate in small percentage by crushed groundnut shell without losing its strength. In this project we are going to combine the properties of GNS and RHA both and try to reduce the cost environmental issues and replace the fine aggregate by crushed GNS and RHA in various percentages, to get optimum strength.

II. OBJECTIVES

- In this project our main objectives is to study the influence of partial replacement of fine aggregate with rice husk and groundnut shell.
- To compare the compressive strength of Ordinary M20 grade concrete with replacement of 10%, 15% and 20% of cement by RHS nd GS.
- To increase the strength of concrete, to reduce the cost of the concrete and decrease the quality of fine aggregate.

III. LITERATURE REVIEW

[1] ABDULLAI, et.al has been investigated in this paper about the groundnut shell ash to increase the load carrying a capacity of concrete member and reduce the brittleness of concrete and improves its engineering properties such as tensile, flexural, impact resistance, fatigue and load carrying capacity after cracking and toughness by using the groundnut shell ash volume fraction (5.10, 15). At a curing period for 28 days test result.

[2] B.A.ALABADAN et.al (2006) estimate the potential of groundnut shell as concrete admixtures. Pozzolanic materials have long demonstrated their effectiveness in producing high-performance concrete. Artificial pozzolana such as rice husk ash have gained acceptance as supplementary cementing material in many parts of the world. This work evaluate the potentials of GS partial replacement of FA in concrete. Chemical analysis of the ash carried out to ascertain whether it possesses pozzolana or cementing properties and the partial replacement of FA by GS was varied from 0% to 50% in the concrete.

[3] MAHMOUD.H (NOV 2012) the paper studied the production of cubes using GS as FA replacement was investigated. The 3 numbers were cast for each replacement levels (10% to 30%) with GS. The cubes were cured and crushed at 7days, 14days, 21days and 28days. The results show that the compressive strength ranges from 4.50N/mm2 to 0.26N/mm2. The optimum replacement level was achieved at 50% with a corresponding strength of 3.58N/mm2.

[4] NEHAI et.al (2003) studied the authors burned of RHA using fluidized beds which based on a different technique. The buried reactor can operates with gas velocities of 3-12m/s. the RHA production technology are able to produce smaller RHA particles more economic and easy to maintain temperature.

[5] OLUREMI have studied in this paper about the concrete is good in compressive but weak in tension that is, concrete is brittle material. So, in order to improve the tensile short groundnut shell are used. The main objectives of these studied are effects of GS on flexural performance of reinforced concrete by using a steel fiber volume fraction 5, 10, 155.

IV. METHODOLOGY

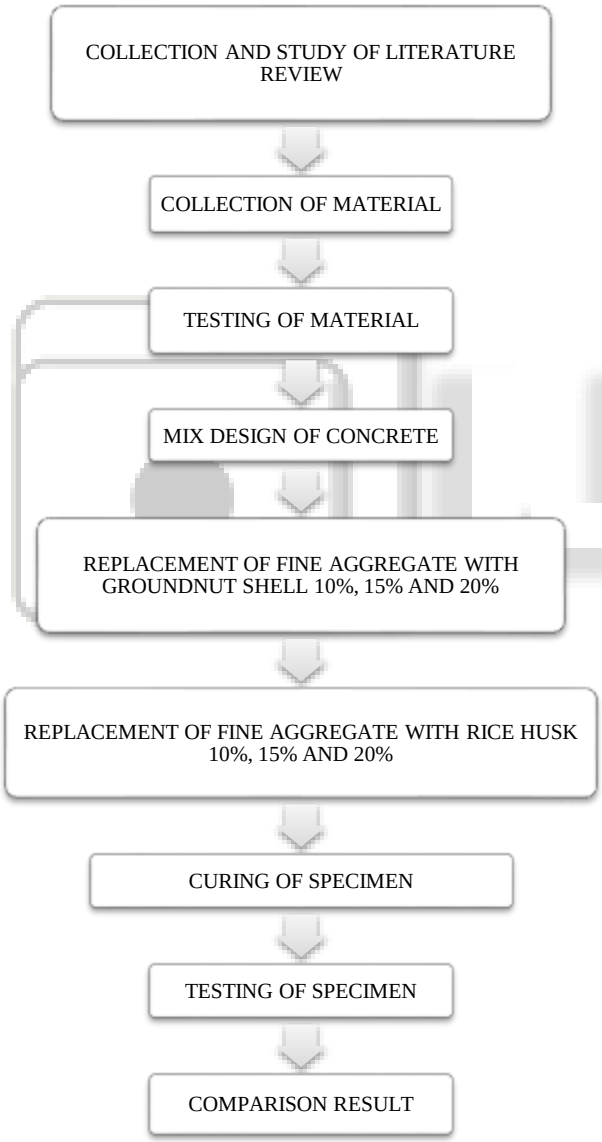

Fig. 1: Methodology

V. MATERIAL PROPERTIES

A. Cement

Cement is a building material. This history of cementing material is as old as the history of engineering construction. Ordinary Portland Cement is far the most important type of cement. The OPC classified into three grades, namely 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested as per IS4031 – 1988.

If 28 days strength is not less than 33N/mm2 it is called 33 grade cement, if the strength is not less than 43N/mm2 it is called 43 grade cement, if the strength is not less than 53N/mm2 it is called 53 grade cement. But the actual strength obtained by these cements at the factory is much higher than the BIS specification. The raw material used for the manufactured of cement consist mainly of lime, silica, alumina and iron oxide.

Chemical Properties	**Value**
Calcium oxide	60-67 %
Silicon dioxide	17-25 %
Aluminum oxide	3-8%
Iron oxide	0.5-0.6 %
Magnesium oxide	0.1-4 %
Alkalies	0.4-1.3 %
Sulfur trioxide	1.3-3 %
Physical Properties	**Value**
Initial setting time	32 minutes
Final setting time	10 hrs
Specific gravity	2.88

Table. 1: Properties of cement

B. M-Sand

Manufactured sand (M sand) is a substitute of river sand for concrete construction. Manufactured sand is produced from hard granite stone by crushing. The crushing sand is of cubical shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand is less than 4.75mm.

Properties	**Value**
Textural composition (% by weight)	
Coarse (4.75-2.00mm)	28.1
Medium (2.00- 0.425 mm)	44.8
Fine (0.425-0.075mm)	27.1
Specific gravity	2.2
Bulk density	15.1
pH	10.11

Table. 2: Properties of M-sand

C. Coarse Aggregate

Machine crushed angular granite metal 10mm size from the local sources was used as coarse aggregate. It is free from impurities such as dust, clay and organic matter etc.

property	**Aggregate (10mm)**
Type	Angular
Density	1487 Kg/m^3
Specific gravity	2.63
Fineness modulus	5.66
Water absorption	0.48

Table. 3: Properties of coarse aggregate

D. Groundnut Shell

Groundnut shell can be found in large quantities as agricultural farm waste. Utilization of groundnut shell in the construction industry is expected to solve the pollution problem and increase the economic base of farmers, which encourage them to increase the production.

Groundnut shell is already used for developing roof sheet materials, sandcrete blocks as cement replacement. Crushed groundnut shell which can be used as fine aggregate in concrete.

Physical properties	Test results
Specific gravity	2.723
Water absorption	1.23%
Unit weight	1.57

Table. 4: Properties of groundnut shell

Physical properties	Values
SiO_2	77.34
Al_2O_3	9.55
Fe_2O_3	3.61
Na_2O	0.12

Table. 5: Chemical properties of CSA

E. Rice Husk Ash

Obtained from burning protecting outer cover of rice husk. It consists of non-crystalline silicon dioxide (SiO2) with high specific surface area and high pozzolanic reactivity. Chemical properties so fare closer to micro silica, silica fume.

Properties	RHA
Colour	Gray
Shape texture	Irregular
Particle size	< 45 micron
Specific gravity	2.3
Appearance	Very fine

Table. 6: Properties of rice husk ash

VI. MIX DESIGN

Mix design is the process of selecting suitable ingredient if concrete and determines their relative proportions with the object of certain minimum strength and durability as economically as possible.

The objectives of concrete mix design as follow:

1) To achieve the stipulated minimum strength.
2) To make the concrete in this most economical manner.

Concrete mix design for M20 grade in this experiment was designed as per the guidelines specified in I.S. 10262 – 1982. The table 4 shows mix proportion of concrete.

Design stipulation

1.	Characteristic compressive strength	=	20N/mm^2 (Required in the field at 28 days)
2.	Maximum size of aggregate	=	20mm (angular)
3.	Degree of workability	=	0.90
4.	Degree of quality control	=	Good
5.	Type of exposure	=	Mild

Test Data For Materials

1.	Specific gravity of cement	=	3.12
2.	Specific gravity of coarse aggregate	=	2.97
3.	Specific gravity of fine aggregate	=	2.62
4.	Water absorption: fine aggregate	=	0.9%
5.	Sieve analysis of fine aggregate	=	Conforming to grading Zone III (with reference of IS 383-1970)

Mix proportioning		
Water	191.6 ml	0.5
Cement	383 Kg	1
Fine Aggregate	549 Kg	1.43
Coarse Aggregate	1184 Kg	3.09

VII. EXPERIMENTAL RESULTS

A. Compressive Strength

It is well know that concrete is weak in tension and string in compression strength of concrete is often considered the most important property of concrete and is the most common measure used to evaluate the quantity of hardened concrete. Compressive strength can used to evaluate the quality of hardened concrete. Compressive strength can be defined as " the measured maximum resistance of a concrete specimen to axial loading" and is determined by computing the maximum stress that the specimen carries after being subjected to uni-axial compressive force.

In the compressive strength test, the size of cube specimens used for testing is 150mm x 150mm x 150mm. the 150mm cubes were casted for compressive strength test at various dosage of concrete specimen such as 5%, 10%. 15% and the test was carried out on 7. 14. And 28 days of curing were done, the cubes are removed from water and made it dry.

Clean the bearing surface of the compressive testing machine and place the specimen in the machine in such a manner that the load shall be applied touches the top portion of the cubes and notes down the failure load.

The failure load divided by cross section area of the specimen gives the compressive strength of the cube.

Compressive strength = P/A

Type of concrete	Compressive Strength (N/mm^2)		
	7 days	14 days	28 days
Conventional concrete	13.46	19.92	29.02

B. Compressive Strength of Rice Husk Ash (N/mm^2)

S.no	% CSA	7 days	14 days	28 days
1.	10%	20.55	24.18	27.99
2.	15%	18.70	23.98	26.95
3.	20%	16.93	22.25	25.33

Table. 8: Compressive strength of RICE HUSK ASH Concrete

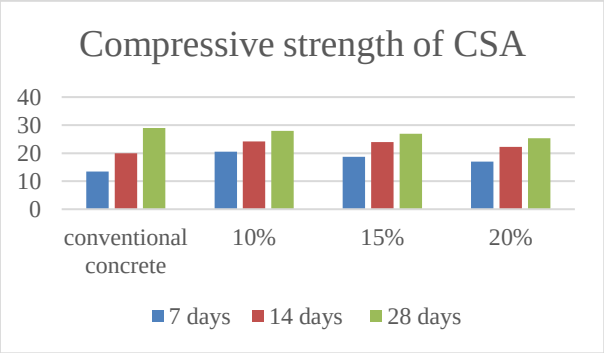

Fig. 2: Comparison of Compressive Strength.

C. Compressive Strength of Groundnut Shell (N/mm^2)

S.no	% GSA	7 days	14 days	28 days
1.	10%	15.95	20.15	29.92
2.	15%	12.25	13.78	25.18
3.	20%	8.32	10.66	19.36

Table. 9: Compressive strength of groundnut shell Concrete

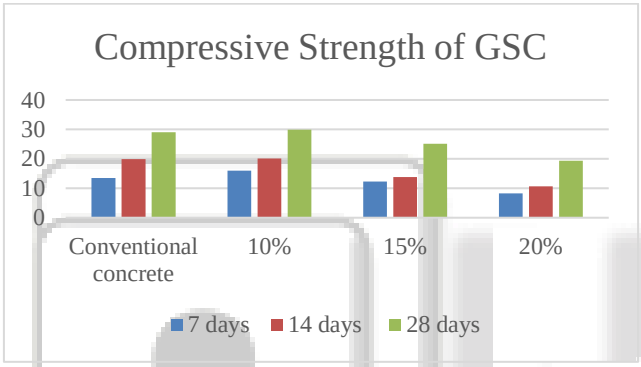

Fig. 3: Comparison of Compressive Strength.

VIII. Conclusion

- RHA and GNS is a suitable material for replacement of fine aggregate in concrete.
- Basic test for cement, fine aggregate, coarse aggregate and RHA and GNS were conducted and results were tabulated.
- The concrete was prepared for the M20 grade concrete with partial replacement of fine aggregate by RHA and GNS with various percentages of 10%, 15% and 20%.
- The specimen was casted for 7 days, 14 days and 28 days then tested. The tested are presented above.
- Replacement of RHA and GNS by 10% shows an increase in strength than conventional concrete.
- Replacement of RHS and GNS in fine aggregate reduces the cost of making concrete.
- Generally it is concluded that RHA and GNS can be used as partial replacement of fine aggregate to produce concrete with good strength.

References

[1] Arel, H. S; Aydin, Use of industrial and agricultural waste in construction concrete. ACI mater. J.2018.
[2] ASTM C128-07 standard test method for density, Relative Density and Absorption of fine aggregate. American society for testing and material, west Conshohocken, PA, 2007.
[3] Compressive strength of concrete with RHA as partial replacement of ordinary Portland cement. Scholarly Journal of Engineering Research Vol 1(2) pp 32-36.
[4] E. B. Oyetola and M. Abudullahi, The use of rice husk ash in low-cost sandcrete block production, Federal University of Miami, June 2006.
[5] Moulick, K. K. propective use of rice husk ash to produce conc rete in India. Int. J. civ environ. Struct. Constr. Archit. Eng. 2015,9, 324-329.
[6] M. R. Giddle and A. P. Jivani waste to wealth – potential of rice husk in Indian Literature Review, Bharathi Vidyapeeth Deemed University College of Engineering, Pune, 2007.
[7] Mtallib M. O. A and Ibrahim S. the effect of delayed placing on the compressive on the compressive strength of concrete. Nigerian journal of engineering, Vol 16 no 1:9, 2009.
[8] Muhmoud, H, Belel, Z.A., Nwakaire, 2012. Groundnut shell ash as a partial replacement of cement in sandcrete blocks production. Int. J. Dev. sustain 1(3), 1026-1032.
[9] Neville A.M. properties of concrete. Longman scientific and technical, Harlow Essex, England, 1981.
[10] Oluremi A. (1990), "Input of local materials in buildings as a means of reducing cost of construction", Journal of Nigerian Institute of Quality Surveyors,pp.12.

