Comparative Study on Partial Replacement of Using Agro-Waste as Cement for Sustainable Build Environment

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Abstract— Now a days, green building is an essential part of ensuring sustainability, and concrete composition with coconut shell ash and groundnut shell ash, which results in sustainable and green concrete. In order to minimize the environment threads caused by coconut shell and groundnut shell waste disposal waste disposal has been reduced cement composition. It is necessary to effectively promote green concrete containing ash. In this experimental study, coconut shell ash and groundnut shell ash is generated by burning and grinding, coconut shell and groundnut shell respectively. The ash is mixed with cement in different proportion as per design ratio and the samples of cubes were prepared. And the basic test namely compressive strength is carried out on the cube, in order to find out the compressive strength of the cube and the results were reported in a graphical manner.

Keywords: Cement, Coconut Shell Ash, Compressive strength and Groundnut shell ash

I. INTRODUCTION

Concrete is the most widely used building material. The tensile strength of concrete, durability and capacity to resist cracks is very small. Concrete is a mixture of cement, fine aggregate, and coarse aggregate, which derived natural resources. 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 expenses of building materials. The major quantity of solid wastes generated in India is reported in expressed that research on the utilization of agricultural waste, as an aggregate substitution is generally new and more research is needed for long-term durability properties of concrete.

They also studied the relationship between the concrete made using this type of materials; environmentally friendly concrete and green building rating systems.

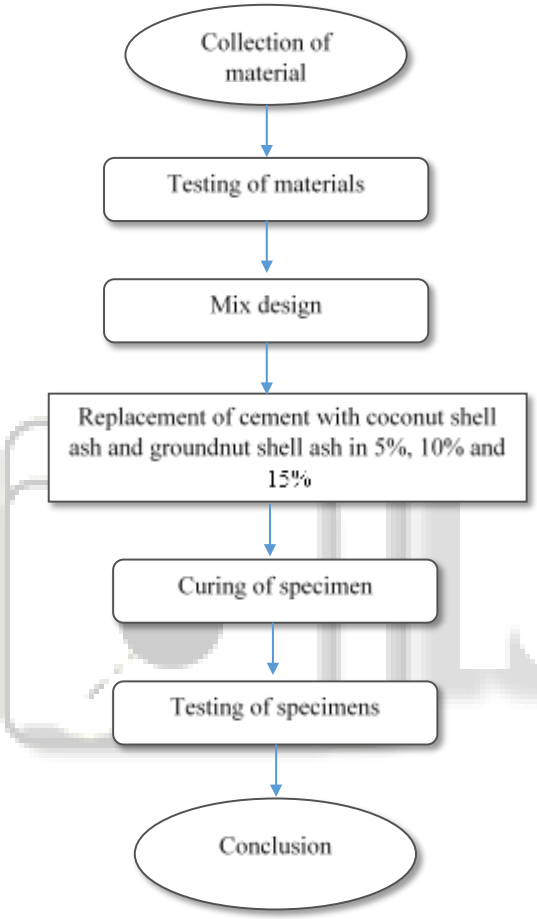
The current Green Building Rating (GRB) systems evaluate the sustainability of building according to various categories of which the construction material is one such category in most of the system. Issues lime emission of carbon di oxide, use of energy, fillers and demolition waste in concrete look less compatible with environmental requirement of a modern sustainability points in the energy and atmosphere category of LEED rating system.

II. LITERATURE REVIEW

1) [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) [2] ADEALE A.J and et.al (2020) has been investigated the need to find alternative binding materials other than cement has become pressing issue in research and technology world. Agriculture waste material such as coconut shell were collected and pulverized in the furnace from 800 c to 1000 c for four hours to produce coconut shell ash (CSA), after XRF analysis was carried out to determine its pozzolanic property, which was used as partial replacement of cement in concrete production. Concrete cubes were produced using graded levels of 0, 10, 15 and 20 percent replacement of CSA for ordinary portland cement. The concrete mix ratio of 1:2:4 with water cement ratio of 0.5 were used and total of 60 cubes were produced and cured in water for 7, 4, 21 and 28 days. Properties such as workability, density, compressive strength and water absorption were determined. Thus the replacement of OPC with CSA from 5% upto 15% is recommended for normal weight concrete production
3) [3] BURAI T.A and et.al (2013) has been investigated to describe the characteristics strength of groundnut shell ash (GSA) and Ordinary Portland Cement (OPC) blended concrete in Nigeria as the pozzolanic activity of GSA increase with increase in time. GSA is a good pozzolanic material which reacts with calcium hydroxide forming calcium silicate hydrate. The specific gravity of the GSA gotten was less than of the OPC it replaced, this means that a considerable greater volume of cementitious materials will results from mass replacement. The compressive strength value of the GSA/OPC blended concrete at 10% replacement level performed better and would be acceptable and considered as a good development for construction of masonry walls and mass foundations in low cost housing in Nigeria. And he found the specific gravity of GSA is being 1.54.
4) [4] OLUREMI, etc. have studied in this paper about the concrete is good in compression but weak in tension that is, concrete is brittle material. So, in order to improve the tensile short groundnut shell ashes are used. The main objectives of these studies are effects of groundnut shell ash on flexural performance of reinforced concrete by using a steel fiber volume fraction 5, 10, 15%.
5) [5] OYEDEPO, O.J., et.al (2015) has been investigated the high cost of cement used as binder in the production of concrete has led to a search for alternative. Using a mix design of 1:2:4 and water binder ratio of 0.653, concrete cubes were casted using varying ordinary Portland cement (OPC): palm kernel shell ash (PKSA)

and ordinary Portland cement (OPC): coconut shell ash (CSA) ratios of 100:0, 90:10, 80:20, 70:30, 60:40, 50:50 respectively. This research reveal that partial replacement of cement with 20% PKSA and CSA in concrete gives an average optimum compressive strength of 15.4 N/mm^2 and 17.26 N/mm^2 respectively at 28 days. While, the optimum value of compressive strength obtained at 28 days is 20.58 N/mm^2 at 10% replacement with CSA.

III. METHODOLOGY



IV. MATERIAL PROPERTIES

A. *Cement:*

Portland cement are calcareous material as a, such as limestone or chalk, and argillaceous material such as shale or clay. The chemical composition of cement as properly added. It possess the high compressive strength.

It is a corrosion resistance material and atmospheric agent has no appreciable effect on it. It hardens with age the process of hardening continues for a long time after the concrete has attained sufficient strength. It is this property of cement concrete which gives it a distinct place among building materials.

Chemical Properties	Value
Calcium oxide	60-67 %
Silicon dioxide	17-25 %
Aluminium 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
Retain on 90micron sieve %	6.25
Unit weight kg/m^3	1440
Specific gravity	3.15

Table 1: Properties of cement

B. *M-SAND*

M-Sand is a by-product of the crushing process which is a concentrated material to use as aggregates for concreting purpose, especially as fine aggregates. In quarrying activities, the rock as the Crushed into varies sizes during the process the dust generated is waste.

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

Table 2: Properties of M-sand

C. *Coarse Aggregate*

Coarse aggregate are irregular broken stone or naturally occurring rounded gravel used for making concrete. Materials which are large to be retained on 4.7mm sieve size are called coarse aggregate, and its maximum size can be up to 63mm.

- Specific gravity of coarse aggregate is 2.76
- Water absorption is 0.4

D. *Coconut Shell Ash (CSA)*

The coconut shell in the form of ash is a material which can be as a substitute of cement. The research indicates that the materials rich in amorphous silica can be used as partial replacement of cement. Use of such material can lead to increase the compressive and flexural strength.

Coconut shell are cheap and really available in high quantity. Coconut shell contains about 65-75% volatile matter and moisture which are removed largely during the carbonization process.

Physical properties	Test results
Specific gravity	1.33
Bulk density (Kg/m^2)	800
Shell thickness	2 – 7 mm

Table 3: Properties of Coconut shell ash

Physical properties	Values
SiO_2	37.97
Al_2O_3	24.12
Fe_2O_3	15.49
CaO	4.98
MgO	1.89
MnO	0.81
Na_2O	0.95
K_2O	0.83
P_2O_3	0.32

SO_3	0.71

Table 4: Physical properties of CSA

E. Groundnut Shell Ash (GSA)

Groundnut shell ash and cement increased the optimum moisture content. There was a slight decrease in the dry density and modulus of elasticity of soil. These can be used as a viable economic alternative in construction of roads and for stabilizing soil acting as bearing medium.

The durability characteristics of stabilized soil were studied based ion the improvement of un-drained shear strength for various days of curing by increasing the percentage of cement. Stabilized soil showed satisfactory improvement in strength and consistent durability characters. Groundnut shell ash and cement increased the replacement moisture content.

- Moisture content = 0.42%
- Specific gravity = 1.54

Physical properties	Values
SiO_2	41.42
Al_2O_3	11.75
Fe_2O_3	12.60
CaO	11.23
MgO	3.51
TiO_2	0.63
Na_2O	1.02
K_2O	11.89
P_2O_3	1.71
MnO	0.23
SO_3	0.44

Table 5: Physical properties of GSA

V. 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.

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

Table 6: Design stipulation

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)

Table 7: Test Data for Materials

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

Table 8: Mix proportioning

VI. EXPERIMENTAL RESULTS

A. Compressive Strength

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.

Compressive strength = P/A

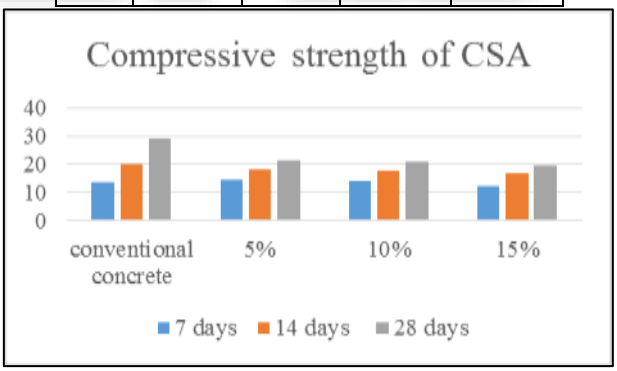
Compressive strength of conventional concrete

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

Compressive Strength OF CSA (N/mm^2)

Compressive strength of CSA Concrete

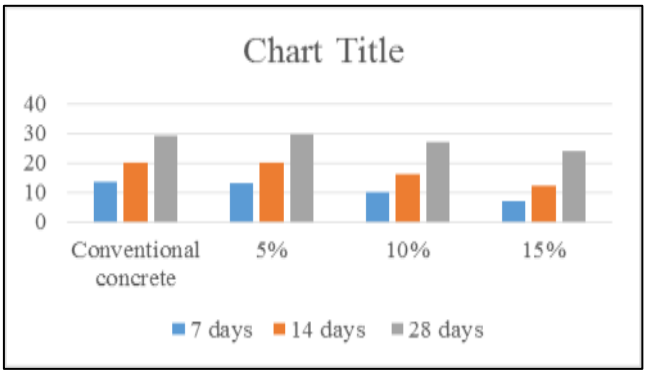
S.no	% CSA	7 days	14 days	28 days
1.	5%	14.30	18.15	21.45
2.	10%	13.83	17.78	20.75
3.	15%	12.11	16.77	19.63



Compressive Strength of GSA (N/mm^2)

Compressive strength of GSA Concrete

S.no	% GSA	7 days	14 days	28 days
1.	5%	13.02	19.07	29.50
2.	10%	10.27	16.19	27.10
3.	15%	7.18	12.46	23.80



VII. CONCLUSION

- CSA and GSA is a suitable material for replacement of cement in concrete.
- Basic test for cement, fine aggregate, coarse aggregate and groundnut shell ash (GSA) and coconut shell ash (CSA) were conducted and results were tabulated.
- The concrete was prepared for the M20 grade concrete with partial replacement of cement by GSA and CSA with various percentages of 5%, 10% and 15%.
- The specimen were casted for 7 days, 14 days and 28 days then tested.
- Replacement of GSA and CSA by 5% show an increase in strength than conventional concrete.
- Replacement of GSA and CSA in cement reduces the cost of making concrete and reduces the consumption of cement.
- Generally it is concluded that GSA and CSA can be used as partial replacement of cement to produce concrete with good strength.

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