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STUDY ON SISAL FIBER REINFORCED CONCRETE WITH GROUND NUT SHELL ASH AND RICE HUSK ASH

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Abstract - *This paper highlights about the behavior of concrete when ground nut shell ash (GSA), rice husk ash (RHA) and sisal fiber(SF) are added in concrete on the various strength properties of concrete by using the mix design of M30 grade. In the present work, GSA and RHA replacement for cement is 2.5%, 5%, 7.5% and 10%; sisal fiber is added for each percentage of GSA and RHA by 2%. The compressive and tensile strength are determined by casting cubes and cylinder. The tests are carried out after 7 and 28 days. The results were compared to the conventional concrete specimen. GSA and RHA improved strength and durability properties and environmental benefits related to the disposal of waste material and to reduce carbon dioxide emission. The main objective of this work is to study the suitability of the RHA and GSA as a pozzolanic material for cement replacement in concrete.*

Key Words: Groundnut Shell Ash , Rice Husk Ash, Sisal Fibre, etc…

1. INTRODUCTION

Concrete is always valuable product in construction industry. It is most widely used construction material for various types of structure due to its structural stability and strength. Concrete is basically made up of cementations material which have a property to bind them together, as well as with other material to form a solid mass. Now a day there is scarcity of concrete materials, so we are in need to find out the alternative materials to concrete. In this situation we should utilize the larger amount of waste products which is available. For example rice husk ash, groundnut shell ash etc. Thus the possible use of these wastes will considerably reduce the cost of construction and as well as reduce or eliminate the environmental hazards caused by such wastes. Ground nut shell ash and rice husk ash with sisal fiber are used as a partial replacement material to the cement concrete mix.

In this present study, ground nut shell ash and rice husk ash is used as a cementations material and it is partially replaced in varying percentages to the cement. The objective of this investigation is to evaluate the optimal level of groundnut shell ash and rice hush ash with sisal fiber replacement and strength properties of concrete.

1.1 AIM AND OBJECTIVE

The Aim of this paper is "To study on sisal fiber reinforced concrete with ground nut shell ash and rice husk ash".

The objectives of this investigation are:

- To evaluate groundnut shell ash and rice hush ash as supplementary cementations material.
- To make a comparative study of strength properties with partially replaced groundnut shell ash and rice hush ash with sisal fiber to cement by with varying proportions of 2.5%, 5%, 7.5% and 10%.
- To study and identify the optimal level of groundnut shell ash and rice hush ash replacement to the cement.
- To study the strength property of concrete blocks at the age of 7 and 28 days.

2. MATERILS And METHDOLOGY

2.1MATERILS

2.1.1GROUND NUT SHELL ASH

Ground nut shell used for this work was obtained from ground nut mill. The shells ash was collected in bags and transported to site, where the burning and grinding were carried out. The fiery remains were gotten by consuming the groundnut shell on an iron sheet in the outdoors under typical temperature. Groundnut shell ash is the residue powder that is left after the combustion of groundnut shell. Groundnut shell ash used in this work was powdery, amorphous solid. Its properties are same as cementations material. The ashes are sieved through 75 micron sieve to obtain the size of cement particles. It reduces the environmental problems.

Table -1: CHEMICAL COMPOSTION OF GSA

composition	Silica	Calcium oxide	Potassium oxide	Sulphite
Percentage (%)	16.25	8.69	15.73	6.21

Fig -1: Ground nut shell ash

2.1.2 RICE HUSK ASH

Rice husk ash used in the present experimental study was obtained from Maranayakanpalya village. After collection, the rice husk was burnt under guided or enclosed place to limit the amount of ash that will be blown off. The ash was ground to the required level of fineness and sieved through 600mm sieve in order to remove any impurity and larger size particles. Rice husk ash is used as partial replacement for ordinary Portland cement in concrete. It involved the determination of workability and compressive strength of the concrete at different level of replacement. Rice husk ash which is an agricultural by product has been reported to be a good pazzolonic material. It reduces the heat of hydration. This itself help in drying shrinkage & facilitate durability of concrete . There is a higher increase in the chloride and sulphite attack resistance. Rice husk ash has a finer particle size than OPC, which improve the concrete properties.

Table -2: CHEMICAL COMPOSTION OF RHA

Composition	Amorphous silica	Carbon	Potassium oxide
Percentage (%)	90.0	5.0	2.0

Fig -2: RICE HUSK ASH

2.1.3 SISAL FIBRE

Sisal fiber is one of the most widely used natural fibers and is very easily cultivated. It is obtain from sisal plant. The plant, known formally as Agave sisalana. These plants are produced rosettes of sword-shaped leaves which start out toothed, and gradually lose there their teeth with maturity. Each leaf contains no of long, straight fibers which can removed in a process known as decortications. During decortications, the leaves are beaten to remove the pulp and plant material leaving through the fibers behind. The fibers can be spun into thread for twine and textile production. Sisal fibers are exceptionally durable and low maintenance with minimal wear and tear. A sisal fiber are anti static, does not attract or trap dust particles and does not absorb moisture or water easily and it also exhibits good sound and impact absorbing properties.

Table -3: CHEMICAL COMPOSTION OF SISAL FIBRE

composition	Cellulose	Hemicelluloses	Lignin	Waxes
Percentage(%)	65.0	12.0	9.9	2.0

Fig -3: SISAL FIBRE

2.2 METHDOLOGY

- Conventional concrete specimens is prepared from a mixture of cement, fine aggregate, coarse aggregate and water.
- Cement is replaced by groundnut shell ash for 2.5%, 5%, 7.5% and 10% ; sisal fiber is added for each set of GSA Cubes/cylinders as 2% by its weight.
- Cement is replaced by rice husk ash for 2.5%, 5%, 7.5% and 10%; sisal fiber is added for each set of RHA Cubes/cylinders 2% by its weight.
- The compressive strength and split tensile strength tests are carried out.
- These specimens are compared with the conventional specimens.

3.0 MIX DESGIN

Concrete mix design of M_{30} grade in this experiment was designed as per the guidelines specified in IS 10262-2009.

Design stipulations

1. Characteristic compressive strength = 30 N/mm^2 (Required in the field at 28 days)
2. Maximum size of aggregate = 20 mm
3. workability = 50 -75mm (slump)
4. Degree of quality control = Good
5. Type of exposure = Normal

Test Data For Materials

1. Specific gravity of cement = 3.15
2. Specific gravity of coarse aggregate = 2.7
3. Specific gravity of fine aggregate = 2.62
4. Water absorption : coarse aggregate = 0.5%
5. Water absorption : fine aggregate = 1%
6. Sieve analysis of fine aggregate = (Conforming to grading Zone-1 of Table-4 IS 383-1970).
7. Sieve analysis of Coarse aggregate = (Conforming to Table-2 IS 383-1970).

Table -4: Mix proportioning

Water	Cement	Fine aggregate	Coarse aggregate
191.52ml	456kg	685.4kg	1086.4kg
0.42	1	1.5	2.38

4. CASTING , CURING AND TESTING OF SPECIMENS

4.1 Casting of the specimens

Cement, Ground nut shell ash, Rice husk ash ,Sisal fiber, coarse aggregate and Fine aggregate were taken into mix for a proportion 1:1.5:2.38 which correspond to M_{30} grade of concrete . Cement was replaced with ground nut shell ash and rice husk ash as 2.5%, 5%, 7.5%, 10% , sisal fiber is added for each set percentage of GSA and RHA as 2% by its weight. Water is added in the ratio 0.42. Wet mix concrete are mixed homogeneously. The wet concrete is poured into cubes and cylinders was compacted through hand compaction in 3 layers and kept into vibrator machine. After the compaction top surface will be smooth finished. The specimens were de- moulded after 24 hrs.

4.2 Curing of the specimens

The de mould specimen placed in to curing tank since the water is an important ingredient of concrete as it actively participates in the chemical reaction with cement, particularly in hydration process. Some of the specifications also accept for making concrete if the PH value of water lies between 6 and 8 and is free from organic matter. In the present investigation potable water is used and allowed specimens for 7 days and 28 days of curing.

4.3 Testing of the specimens

The test specimens for compressive strength test were made of cube having size 150X150X150mm cast iron mould. For each mix proportion 3cubes were casted and tested for 7 days and 28 days. The test specimens for split tensile strength test were made of cylinders having size 150mm diameter and 300 mm height, which are of cast iron. For each mix proportion 3cubes were casted and tested for 7 days and 28 days.

4.3.1 Compressive strength Test

The size of cube mould is 150X150X150mm as per IS 516-1959. The specimens of conventional cement concrete block and ground nut shell ash and rice husk ash with sisal fiber block with varying proportions of 0%,2.5%,5%,7.5%,10% as partial replacement were casted and tested in compression testing machine. The compressive strength of concrete is calculated by using equation.

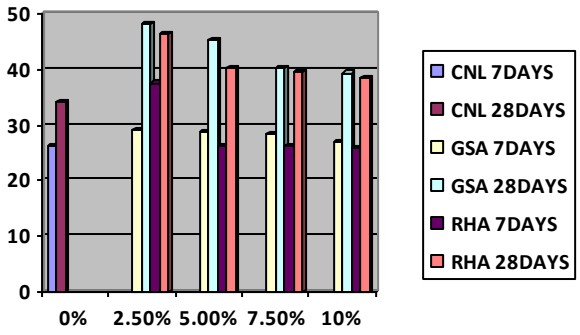
$$F=P/A$$

F= Compressive stress in N/mm^2
P= Maximum load in N
A= Cross section Area cube specimen mm^2

Fig -4: Compressive strength test set-up

Table -5: Compressive strength comparison of GSA, RHA and SF Added concrete.

Designation	%of GSA replacement	% of RHA replacement	% of sisal fiber	Average Compressive strength for 7days in N/mm^2	Average compressive strength of 28 days in N/mm^2
GSA+SF	2.5	-	2.0	29.13	48.28
GSA+SF	5	-	2.0	28.73	45.26
GSA+SF	7.5	-	2.0	28.32	40.36
GSA+SF	10	-	2.0	26.90	39.40
RHA+SF	-	2.5	2.0	37.6	46.55
RHA+SF	-	5	2.0	26.12	40.45
RHA+SF	-	7.5	2.0	26.21	39.70
RHA+SF	-	10	2.0	26.01	38.58



NOTE:-
CNL-CONVENTIONAL
GSA-GROUND NUT SHELL ASH
RHA-RICE HUSK ASH

Fig -5: Compressive strength comparison of GSA, RHA and SF Added concrete.

4.3.2 Split tensile strength Test

The tensile strength is one of the basic and an important property of the concrete .The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. The test specimens for split tensile strength test were made of cylinders having size 150 mm diameters and 300 mm height, which are of cast iron. The specimens of conventional cement concrete block and ground nut shell ash and rice husk ash with sisal fiber block with varying proportions of 0%,2.5%,5%,7.5%,10% as partial replacement were casted and tested in testing machine. The split tensile strength of concrete is calculated by using equation.

$$F=2P/(\Pi \times D \times L)$$

F= Split tensile strength in N/mm^2
P= Maximum load in N
D= Diameter of cylindrical specimen in mm
L= Length of cylindrical specimen in mm

Fig -6: split tensile strength test set-up

Table -6: split tensile strength comparison of GSA, RHA and SF Added concrete.

Designation	%of GSA replacement	% of RHA replacement	% of sisal fiber	Average Tensile strength for 7days in N/mm^2	Average Tensile strength of 28 days in N/mm^2
GSA+SF	2.5	-	2.0	2.39	3.83
GSA+SF	5	-	2.0	2.24	2.75
GSA+SF	7.5	-	2.0	2.29	2.66
GSA+SF	10	-	2.0	1.82	2.60
RHA+SF	-	2.5	2.0	2.85	3.27
RHA+SF	-	5	2.0	2.05	2.74
RHA+SF	-	7.5	2.0	2.20	2.76
RHA+SF	-	10	2.0	2.29	2.62

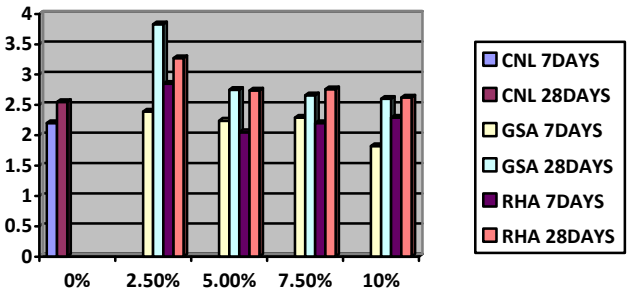


Fig -6:Split tensile strength comparison of GSA, RHA and SF Added concrete.

5. CONCLUSION

- Compressive strength of concrete cubes gave optimum result with 2.5% Replacement of cement by GSA and RHA at 7 and 28 days.
- Split tensile strength of concrete cylinder gave optimum result with 2.5% Replacement of cement by GSA and RHA at 7 and 28 days.
- Compared to conventional concrete block, Sisal incorporated blocks gave higher compressive and tensile strength.
- The achieved strength was more in GSA than compared to RHA.
- There was reduction in cost of construction when using GSA and RHA.

FUTURE SCOPE OF WORK:

- In the present study M30 grade concrete was considered, the present work can be extended for higher grades of concrete.
- In the present study rice husk ash and ground nut shell ash of 2.5% replacement gave optimum result and for future work it can be varies from 0 to 2.5%.
- The study can be continued by investigating these concrete blocks under flexure, shear and torsion.

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CODE BOOK

- IS CODE 10262:2009 for Concrete Mix Proportion, Page No 4-7

- IS 383:1970 for fine aggregate conforming zone-1, table - 4.