A Study On Optimising The Strength Of Concrete Using Green Materials

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ABSTRACT:

India is a major agriculture wastage producing country, and the generated husk during milling is mostly used as a fuel in the boilers for producing energy, processing paddy, through direct combustion or by gasification. About the million tonnes of Rice Husk Ash (RHA) and Sugarcane Bagasse Ash (SCBA) is produced annually. This RHA and SCBA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. Many ways are being thought of for disposing them by making commercial use of this RHA, and SCBA. It is wastage can be used as a replacement for concrete (15 to 20%).
This paper evaluates how different contents of Rice Husk Ash, Groundnut Shell Ash, and Sugarcane Bagasse Ash added to concrete may influence its physical and mechanical properties. Sample Cubes, Cylinder were tested with different percentage of RHA, SCBA and different w/c ratio, replacing in mass of cement. Properties like Compressive strength, Water Absorption, Split tensile strength, Slump Retention is done. The grades of concrete used were M20.

Keywords: *Rice Husk Ash, Sugarcane Bagasse Ash, Split tensile strength, Cylinder compressive strength, Water Absorption, Slump Retention.*

OBJECTIVE:

- To find out the optimum percentage of cement replacement by RHA and SCBA for better strength.
  - Making eco friendly and green concrete.
  - Making modern concrete for strength effective, cost effective
  - The cement industry is continuously seeking alternative approaches to reduce the high energy and environment costs of Portland cement.
  - Limiting the usage of natural raw materials for future.

1. INRODUCTION:

Concrete is a vital ingredient in infrastructure development with its versatile and extensive applications, which is globally accepted construction material in all civil engineering structures. The Indian construction industry consumes approximately 400 million tons of concrete every year and is expected to reach the billion-ton mark in less than a decade. Human activities on earth produce solid wastes in considerable quantities of more than 2,500 million tons per year, including industrial and agricultural wastes from rural and urban societies. Recent technological developments have shown that these materials can be used as valuable inorganic and organic resources to produce various useful value-added products. The concrete industries are constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem.

Production of large quantity of Agricultural wastes all over the world faces serious problems of handling and disposal. The disposal of Agricultural wastes creates a potential negative impact on the environment causing air pollution, water pollution finally affecting the local ecosystems. Hence safe disposal of Agricultural wastes becomes challenging task for engineers.

Hence this paper aims to investigate the use of some Agricultural wastes such as Sugar Cane Bagasse ash (SCBA) and Rice husk ash (RHA) to different percentage replacement of cement.
To find out the optimum percentage of cement replacement by RHA, and SCBA for better strength. To find out the influence of internal curing in concrete with the above replacement materials. Making eco friendly and green concrete also a modern concrete for strength effective, cost effective.

2. MATERAIAL AND METHODS:

2.1 Rice Husk Ash

Rice husk ash is a major Agricultural product obtained from paddy. For every 40 KN of rice 10 kN of husk is produced. The husk is disposed off

by dumping it in an open heap near the mill site or on the road side to be burnt later.
Burning the rice husk generated about 15-20% of its weighing as ash. The ash being very light is easily carried by wind and water contributing to air and water pollution. The huge quantity of ash generated requires large areas for disposal.
The high percentage of siliceous material present in rice husk ash indicated that it has pozzolanic properties. The normal method of conversion of husk to ash is by incineration.

Rice Husk ***Rice Ash***

Fig1: Rice Husk Ash

2.2 Sugarcane Bagasse Ash

The Bagasse Ash is the fibrous waste produced after the extraction of the sugar juice from cane. This material usually causes a disposal problem in sugar factories particularly in tropical countries. In many of the tropical countries there are substantial quantities of Bagasse (the fibrous residue from the crushing the sugar cane) is rich in amorphous silica indicated that it has pozzolanic properties.

Sugarcane ***Sugarcane Ash***

Fig2: Sugarcane Bagasse Ash

2.3 Cement

Ordinary Portland cement (53grade) available in local market was used in the investigation.

2.4 Fine Aggregate

River sand was used as fine aggregate. Its fineness modulus and specific gravity were 2.93 and 2.57 respectively.

2.5 Coarse Aggregate

Crushed angular granite metal of 20mm size from a local source was used as Coarse aggregate. Its fineness modulus and specific gravity were 6.97 and 2.73 respectively.

2.6 Admixture: Super plasticizer.

2.7 Methodology:

The next stage is to heat the treated RHA, SCBA in an electric muffle furnace at a temperature of 700oC for 4 hours in order to produce the materials.

The result is then tested to determine the particle size distribution of the ash in accordance with Indian standard institution, which would pass 90microns sieve. Fineness test was carried out for each sample by sieving the samples for 15 minutes using the percentage of the residue by mass.

The mix ratio used for different nominal replacement of OPC with RHA, SCBA and water cement ratio weight.

The replacement levels of 15% to 20% by weight of RHA, SCBA in the mass proportioning was used to prepare the fresh concrete mix which are then placed into the test cube moulds of 150mm x 150mm x 150mm. For each replacement level, twenty test cubes were cast.

In preparing for the compressive strength test, the test cubes were taken out of the moulds after 24hours and then put in a curing tank containing clean water to cure for 7, 14, 21 and 28 days and the compressive strength values obtained.

- Collection of raw materials RHA, SCBA.
- Sieving the replacement materials.
- Mix proportioning as per (IS 10262-2009) M20.
- Replacement for cement in percentage.
- Casting cube, cylinder for nominal mix & replacement factor.

3. Results and Discussion:

3.1 The Setting Time:

The initial and final setting times of the entire cubes were considered using cement and different percentages of rice husk (RHA and SCBA). The initial and final setting times increases with increase in rice husk ash content. The reaction between cement and water is exothermic. The liberation of heat and evaporation of moisture causes the stiffening of the paste and slower heat induced evaporation of water from the cement/RHA, SCBA paste due to its lower cement content and therefore an accelerated increase in the initial setting time of the mixture was observed. Thus, an increase in the setting time was noticeable from 154 minutes (at 20% RHA), and 213 minutes (at 15% SCBA). Similarly, the final setting time also increase as the percentages of RHA, SCBA increases thereby retarding the hydration process.

Table1: Initial and Final Setting Times of Cement Pastes

Cement (%)	RHA (%)	SCBA (%)	Initial Setting Time (Mins)	Final Setting Time (Mins)
80	20	-	154	255
85	-	15	213	350

3.2 Workability:

Fig3: Slump test

Table2: Slump Result

Grade	SLUMP(mm)		
	Normal	20%RHA	15%SCBA
M20	100	140	120

3.3 Cube compressive strength:

Cube compressive strength tests were carried out on Cube specimens of the age of 7, 14 and 28 days curing, using compression testing machine of 3000 KN capacity. The test set up for compression strength on Cube specimen is shown in Figure

Fig4: Cube compressive strength

Compressive strength Results:

Calculated compressive strength on the test specimen from the maximum compressive load on the specimen and the initial computed cross-sectional area as follows:

$$s = P / A$$

Where: s = compressive strength, lbs/in2 (KN/m2)
P = maximum load, lbf (KN)
A = cross sectional area, in2 (m2)

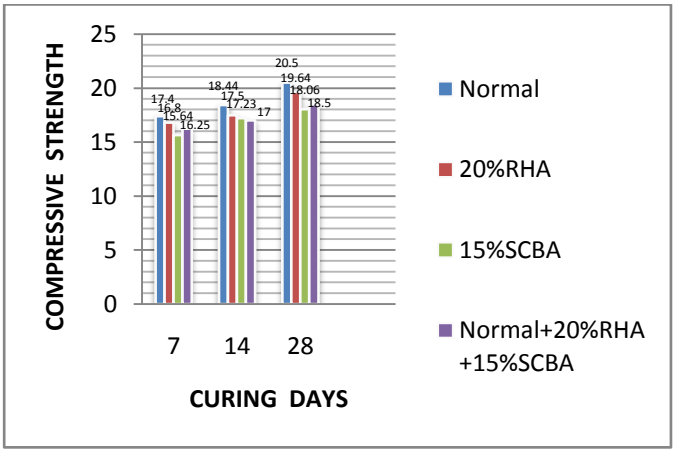

Chart1: Cube Compressive Strength

3.4 Cylinder Splitting Tensile Strength:

The tensile strength of the concrete specimens. It shows that the tensile strength of concrete specimens incorporated with 20% RHA and 15% SCBA is lower at 7 days but similar at 14 and 28 days. This result shows that higher RHA amounts will not increase the flexural and tensile strengths of Grade 20 concrete.

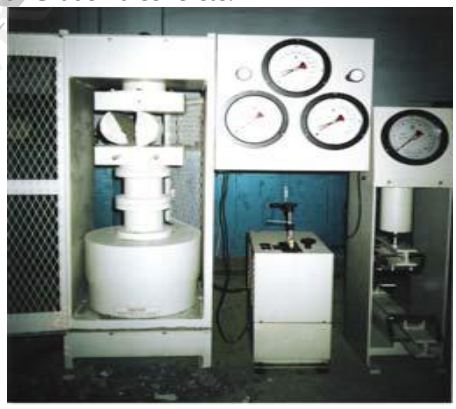

Fig5: Split Tensile Strength

Cylinder splitting tensile strength:

Calculated splitting tensile strength of the specimen as follows:

$$T = 2P/\pi ld$$

Where: P = maximum applied load indicated by the testing machine, KN

l = length, m

d = diameter, m Where:

T = splitting tensile strength, kPa.

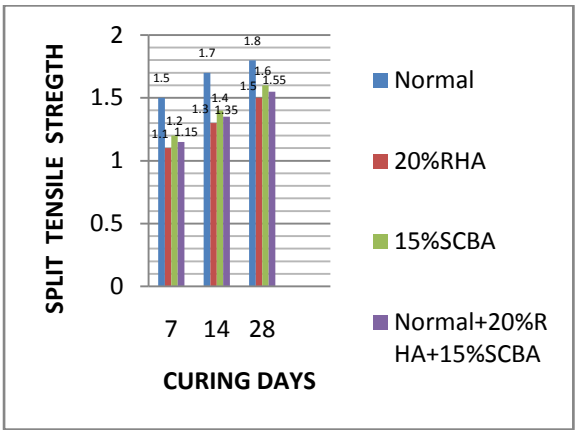

Chart2: Cylinder Splitting Tensile Strength

3.5 Saturated Water Absorption:

The variations of the saturated water absorption in percentage for all blended cement mortars mix. It is observed that the saturated water absorption for all rice husk ash, groundnut shell ash, sugarcane bagasse ash and their combination mixes are less than that of ordinary cement mortar. The maximum replacement level in cement is up to 20% for Rice Husk Ash, 10%Groundnut Shell Ash, 15%Sugarcane Bagasse Ash and 35% for their combination. It is probably due to the presence of pozzolanic materials that leads to greater precipitation of cement gel products than that occurs in ordinary Portland cement alone, which more effectively blocks the pores helping to reducing saturated water absorption.

Table3: Water Absorption

Materials	Normal	20%RHA	15%SCBA
M20	4.8	3.9	4.3

4. Conclusion:

The results show that the value of compressive strength of Rice Husk Ash is M20 grade of concrete ranged 20% replacement level of the compressive strength of the control at the 28th day. By using the OPC 53 grade, normal strength of 19.50MPa at 28-days can be obtained. The RHA can partially replace cement by20%and give ultimate strength of concrete. Its economical than the normal concrete.

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