Effect of Rice husk ash and Coconut shell ash on Cement mortar: Enhancing Sustainability and efficiency in Building

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Abstract- **Concrete is always expected to be stronger and more durable than in the past while being cost and energy efficient. Moreover the major advantages that concrete possesses over the construction material have to be conserved. So, the need for improving the performance of concrete and concern for the environment impact arising from the continually increasing demand for concrete has lead the growing use of an alternative material components. In this project, the characteristics of concrete by employing Coconut Shell Ash (CSA) and Rice Husk Ash (RHA) as a partial replacement for regular Portland cement (OPC) was experimentally investigated. Workability, Density of concrete and characteristics like compressive strength, Splitting tensile strength, flexural strength, Impact resistance and Modulus of elasticity were assessed and compared with the conventional concrete. Finally, the conventional concrete and Concrete with CSA and RHA respectively, two concrete mixtures were used. Compressive strength increases as CSA and RHA replacement increases and provides Satisfactory result up to 15% CSA and RHA replacement. This experimental study demonstrates that adding CSA and RHA at a replacement rate of 15% improves the workability and mechanical characteristics of both the conventional concrete and CSA and RHA**

Keywords: **Performance of concrete, Use of alternative material, Partial replacement, Strength Properties.**

I.INTRODUCTION

In most of the world's largest agricultural nations, Rice is produced in large quantities, which result in the disposal of a substantial amount of rice husk into the natural environment. Rice husk is the protective covering of rice grain. It is a weightless and coating that protects the seed during the growing season and is typically discarded when the grain is milled. But it is considered bulky and accounts for 20% (by volume) of a rice paddy harvest which traditionally challenges the farmers to find a way for its disposal. Meanwhile, the Tamil Nadu is one of the leading producers of coconut goods for over 92 countries worldwide. But the enormous amount of coconut production led to the increased agricultural waste. Waste from mature coconuts has been tightly controlled since there is a market for solid coconut fibres in various technical applications such as Automobile component and rice husk ash and coconut shell ash for cement replacement. The environment concerns regarding disposal of the agricultural byproduct are mitigated by the discoveries or utilizing them, such as generating rice husk ash and coconut shell ash for various applications. Rice husk are burned in an oxygenic environment to release thermal energy and produce silica rich ash.

Rice husk ash)RHA) can be utilized to make high value added goods as a sustainable source of silica that results in pozzolanic effect, which leads to the investigation on applying it as an additives to enhance the performance of concrete and waste from mature coconuts has been tightly controlled because there is a market for solid coconut Fibers in various technical applications such as coir mattresses, automobile components. Pozzolans are defined by the American Society of Testing Materials (ASTM) as siliceous or aluminous materials that have little or no cementitious capabilities. RHA and CSA have already been used to replace cement of concrete and concrete masonry units as they contain silica, Alumina and Ferric oxide with a lower amount of Calcium oxide Compared to Portland cement.

II.OBJECTIVE

To study the effect on some durability properties of coconut shell ash concrete for the optimized percentage of Rice husk ash. To study the properties

(FLEXURE STRENGH, CREEP, SHRINKAGE, ETC.) of concrete after adding coconut shell and rice husk ash. To study the strength after adding these components on concrete. Comparison of results before and after addition of above said material in concrete.

MATERIALS USED

1.COCONUT SHELL ASH:

Coconut shell Ash is an agricultural waste and it can be re used in engineering applications. Approximately, 5 Kg of coconut shell ash is obtained from 100 Kg of coconut. Cultivation of coconuts has been done in more than 90 countries worldwide on about 10 million hectares. Indonesia, Philippines and India accounts for almost 75% of world's coconut production. Coconut shell Ash contains organic and inorganic material and the organic materials in coconut shells are 33.61% Cellulose, 36.51% Lignin, 29.27% Pentose's and 0.61% ash.

Fig 1: Coconut Shell Ash

2. RICE HUSK ASH

Rice husk is a kind of agricultural waste with huge yield and wide distribution, which can get rice husk ash (RHA) containing a large amount of amorphous silica and porous structure by combusting under certain conditions. As a supplementary cementitious material (SCM), the RHA has high pozzolanic activity and internal curing characteristic. It was reported that RHA can significantly improve various performances of cement-based materials. The raw material of RHA, rice, is one of the leading food crops, and has huge production capacity. More than 75 countries in the world cultivate rice, among them China is the largest output one. Specifically, the rice production of China was estimated at 211.2 million tons in 2016, which can produce about 42.24 million tons of rice husk, about 7.6 million tons of RHA can be obtained after combustion . The rice production of China increased to 214.4 million tons in 2017 .

Fig 2: Rice Husk Ash

3. CEMENT

Ordinary Portland cement is composed of calcium silicate, calcium aluminate and alumina ferrite. It is obtained by blending predetermined proportions lime stone clay and other minerals in small quantities which is pulverized and heated at high temperature-around 1500 degree centigrade to produce clinker. The clinker is then ground with small quantities of gypsum to produce a fine powder called Ordinary Portland cement (OPC).

Table 1 Properties of Cement

Properties	Results
Specific Gravity	3.16
Fineness	2.6
Initial Setting time	40 min
Final Setting time	10 ours

4. AGGREGATE

Normally Sand is used as fine aggregate for preparing concrete. An individual particle in this range is termed as Sand grain. These sand grains are between coarse aggregate (2mm to 64mm) and silt (0.004mm to 0.0625mm). Aggregate most of which passes through 4.75mm sieve is used. The Coarse aggregate for the work should be river gravel or crushed stone. Angular Shape aggregate of size is 20mm and below. The aggregate which passes through 75mm sieve and retain on 4.75mm are known as coarse aggregate.

Table 2 Properties of Fine Aggregate

Properties	Results
Specific Gravity	2.83
Water Absorption	0.8%
Fineness	36.9%

Table 3 Properties of Coarse Aggregate

Properties	Results
Specific Gravity	2.75
Water Absorption	1%
Fineness	21.5%

EXPERIMENTAL METHODS

1. Concrete Mix Design

The mix design is done by the various proportions of materials for M30 grade concrete which is used in the present study. .

Table 6 Mix Design Proportions

Cement kg/m^3	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	Water kg/m^3
348	868	1032	195
1	2.5	3	0.40

2. Casting of Specimen

Cubes of Size 150mm x150mm x150mm, Cylinder of size 200mm x 300mm , Beam of size 700mm x 150mm x 150mm were casted. The materials which are mixed by coarse aggregate, manufactured sand, cement, egg shell powder, Copper slag and water. After the moulds were casted and compacted. Demoulding was done after 24 hours of casting and specimens were allowed to cured in a water tank.

CONCRETE TESTS AND RESULTS

1. FRESH CONCRETE TESTS

SLUMP CONE TEST in M40 Grade Concrete

Table 7 Slump Cone Test

S.NO	% Replacement	Slump (mm)
1	0% CSA + 0% RHA	0
2	5% CSA + 5% RHA	25
3	10% CSA + 10% RHA	27
4	15% CSA+ 15% RHA	30
5	20% CSA + 20% RHA	35
6	25% CSA + 25% RHA	50
7	30% CSA + 30% RHA	75

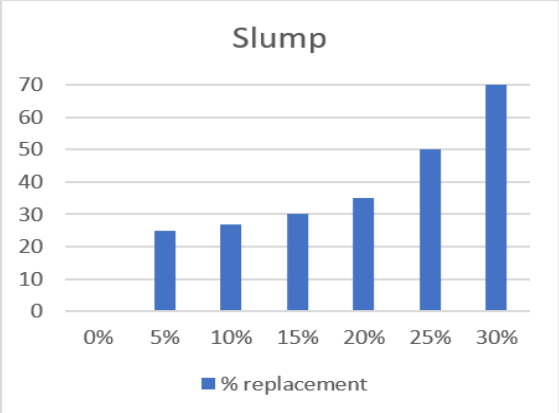

Fig 3 Slump Cone Test

COMPACTION FACTOR TEST in M40 Grade

Table 8 Compaction factor Test

S.NO	% Replacement	Compaction factor
1	0% CS + 0% ESP	0.98
2	5% CS + 5% ESP	0.94
3	10% CS + 10% ESP	0.90
4	15% CS + 15% ESP	0.88
5	20% CS + 20% ESP	0.86
6	25% CS + 25% ESP	0.82
7	30% CS + 30% ESP	0.78

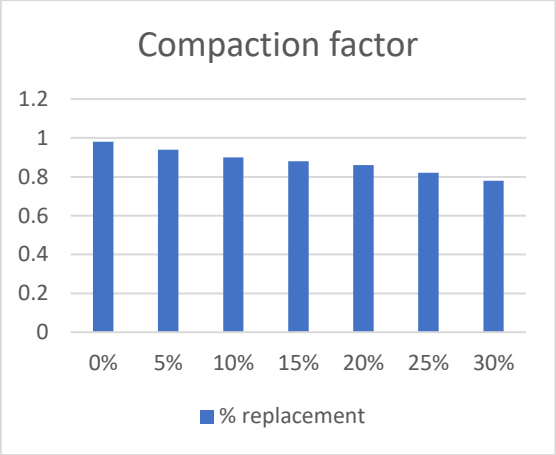

Fig 4 Compaction factor Test

2. HARDENED CONCRETE TEST

The individual variations of specimen was not more than ± 15 percent of the average. The specimen stored in water was tested immediately on the removal from the tank. The specimen were wiped off and the dimensions of the specimen and their weight were recorded before testing. The bearing surface of the testing machine were wiped clean the other materials, which may come in contact with the compression plates. While placing in the cube in the machine, care was taken such that the load was applied to opposite side of the cube as casted and not to the top and the bottom. The maximum load applied to the specimen was recorded and any usual appearance in the type of failure was noted.

COMPRESSIVE STRENGTH OF CONCRETE

Table 9 Compressive strength test

S.NO	% Replacement	Compressive Strength		
		7 days	14 days	28 days
1	0% CSA + 0% RHA	36.60	37.45	38.80
2	5% CSA+ 5% RHA	36.85	38.10	39.40

3	10% CSA + 10% RHA	38.24	39.75	41.10
4	15% CSA + 15% RHA	39.60	40.20	43.75
5	20% CSA + 20% RHA	37.45	39.15	42.10
6	25% CSA + 25% RHA	35.22	37.40	39.05
7	30% CSA + 30% RHA	32.80	33.45	35.03

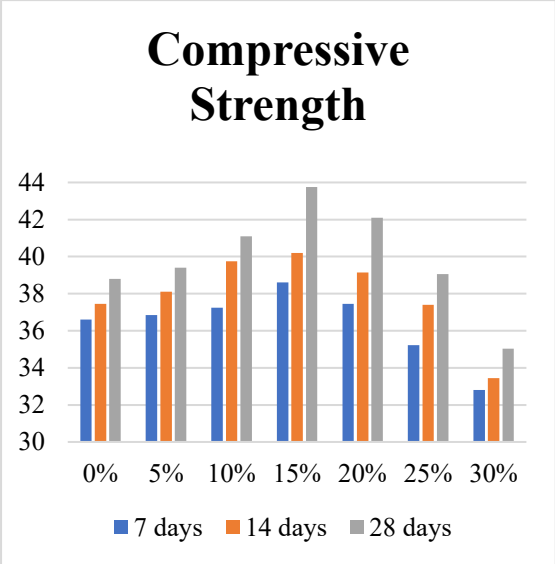

Fig 5 Compressive strength Test

SPLIT TENSILE STRENGTH TEST

Table 10 Split tensile strength Test

S.NO	% Replacement	Tensile Strength		
		7 days	14 days	28 days
1	0% CSA + 0% RHA	3.78	3.86	3.96
2	5% CSA + 5% RHA	3.83	3.95	4.02
3	10% CSA + 10% RHA	3.98	4.05	4.24
4	15% CSA + 15% ESP	4.02	4.16	4.37
5	20% CSA + 20% RHA	3.92	4.06	4.23
6	25% CSA + 25% RHA	3.84	3.92	3.98
7	30% CSA + 30% RHA	3.72	3.85	3.84

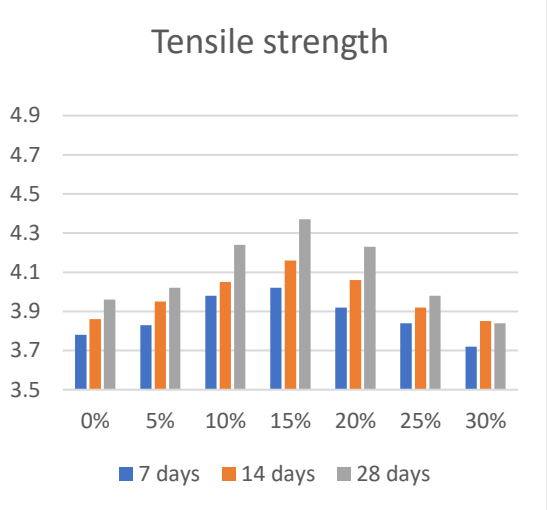

Fig 6 Split Tensile Strength Test

FLEXURAL STRENGTH TEST

Table 11 Flexural strength Test

S.NO	% Replacement	Flexural Strength		
		7 days	14 days	28 days
1	0% CSA + 0% RHA	5.02	5.35	5.80
2	5% CSA + 5% RHA	4.89	5.15	5.69
3	10% CSA + 10% RHA	4.74	5.02	5.57
4	15% CSA + 15% RHA	4.65	4.78	5.25
5	20% CSA + 20% RHA	4.85	5.05	5.36
6	25% CSA + 25% RHA	5.12	5.45	5.75
7	30% CSA + 30% RHA	5.50	5.92	6.05

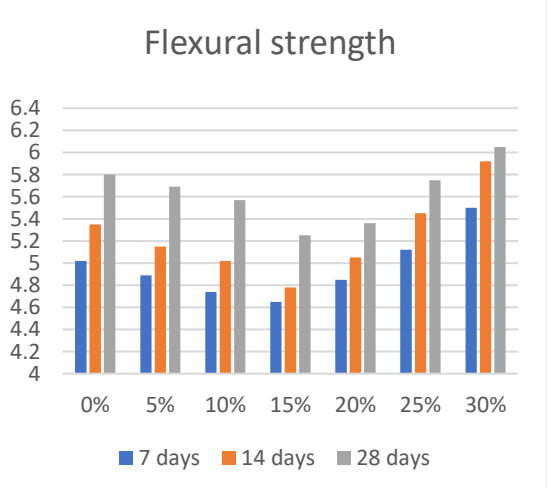

Fig 7 Flexural Strength Test

III.CONCLUSION

1. The Cement, Fine aggregates and Coarse aggregate material qualities are within the permissible limits according to IS code requirements, So we will use the materials for study.
2. Slump Cone value for the concrete increases with increasing in the percentage of coconut shell ash and Rice husk ash so the concrete was not workable.
3. The compaction factor value of concrete decreases with increases in the percentage of coconut shell ash and rice husk ash.
4. The compressive strength of concrete at 15% replacement of coconut shell ash and rice husk ash and is the optimum value for 7 days, 14 days and 28 days curing.
5. Split tensile strength for the cylindrical specimen is maximum at 15% of replacement of coconut shell ash and rice husk ash.
6. The flexural strength of the beam is also maximum at 15% replacement of coconut shell ash and rice husk ash.

So, the replacement of 15% of concrete with coconut shell ash and rice husk ash is generally useful for better strength values in M40 grade of concrete.

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