# EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY COCONUT SHELL AND ORDINARY PORTLAND CEMENT BY RICE HUSK ASH

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***Abstract:*** *The high cost of conventional construction material affects economy of structure. With increasing concern over the excessive exploitation of Natural aggregates, lightweight aggregate produced from waste is a viable new source of structural aggregate material. In this work we have partially replaced coarse aggregate with coconut shell and ordinary Portland cement with rice husk ash. The percentage of replacement are 0%, 18%, 20%, 22%, 24% with coconut shell and 0%, 5%, 8%, 10%, 12% with rice husk ash. The characteristic properties of concrete such as compressive strength, split tensile strength using the mix made by partial replacement of coarse aggregate with crushed coconut shell aggregate and ordinary Portland cement with rice husk ash were reviewed in the present work. The results show that high strength is attained at replacement of 18% with coconut shell and 8% with rice husk ash.*

***Keywords:*** *Cement, Coconut Shell, Concrete, Rice Husk Ash, Strength.*

## Ⅰ. INTRODUCTION

Infrastructure development across the world created demands for construction material. Concrete is the leading material in building construction. Concrete manufacturing involves consumption of ingredients like cement, aggregates, water & admixtures. In the group of ingredients, coarse aggregates form the majority posuition. In light of this in the contemporary civil engineering construction, using alternative materials in place of Natural aggregate in concrete makes concrete as long life and eco friendly construction material. Coconut shell being a hard and not easily degrade material if crushed to size of sand can be a potential material to substitute sand. The chemical composition of the coconut shell is similar to wood. It contains 33.61% cellulose, 36.51% lignin, 29.27% and ash at 0.61%. Rice husk ash is an agricultural waste material. Rice husk ash (RHA) is obtained by burning of rice husk in a controlled manner. When properly burnt, it has high silica content and can be used as an admixture in mortar and concrete.

## Ⅱ. REVIEW OF LITERATURE

Obilade I.O[1] Investigated OPC was replaced with RHA by weight at 0%, 5%, 10%, 15%, 20% and 25%. 0% replacement served as the control. Compacting factor test was carried out on fresh concrete while Compressive Strength test was carried out on hardened 150mm concrete cubes after 7, 14 and 28 days curing in water. The results revealed that the Compacting factor decreased as the percentage replacement of OPC with RHA increased. The compressive strength of the hardened concrete also decreased with increasing OPC replacement with RHA. It is recommended that further studies be carried out to gather more facts about the suitability of partial replacement of OPC with RHA in concrete.

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of structure. With the increasing concern over excessive exploitation of natural aggregates, synthetic lightweight aggregate produced from environmental waste is a viable new source of structural aggregate material. It is becoming more difficult to find natural resources. Therefore the coconut shell as partial replacement for coarse aggregate in concrete is studied. The density, slump and compressive strength of concrete are tested. The replacement of coarse aggregate by coconut shell by 0%, 10%, 20% and 30%. The tests were carried out and the results obtained suggested that the replacement more than 20% leads to lightweight aggregate concrete. The slump found out to be increases as the percentage replacement increased. Similarly the density is reduced as the percentage replacement increased. The compressive strength found to be decreases as the percentage replacement increases.

## Ⅲ MATERIALS AND METHODS

- **CEMENT:** Cement is the most important constituent of concrete, it forms the binding medium for the discrete made out of naturally occurring raw materials and sometimes blended or inter-ground with industrial wastes. Cement comes in various types and chemical compositions, “ordinary Portland cement” 53 mega pascal grade of cement is used for concrete. The properties of cement were determined as per the IS 4031: 1968.
- **FINE AGGREGATE:** River sand was used in preparing the concrete as it was locally available in sand quarry. The specific gravity and water absorption were found to be 2.73 and 2.5% respectively, with sieve analysis data and fineness modulus value of sand confirms to grading zone as per IS: 383-1970.
- **COARSE AGGREGATE:** The material retained on 4.75mm sieve is termed a coarse aggregate. Crushed stone and natural gravel are the common material used as coarse aggregate for concrete. Coarse aggregate are obtained by crushing various types of granites, schist, crystalline and lime stone and good quality sand stones. When high strength concrete is required very fine-grained granite perhaps the best aggregate. Concrete made with sand stone aggregate give trouble due to cracking because of high degree of shrink. Aggregates should be chemically inert strong, hard, durable and limited porosity.
- **RICE HUSK ASH:** It is an active pozzolana and has several applications in the cement and concrete industry. RHA can be used as an economical substitute for silica fume as SCM having almost the same properties as that of micro-silica. RHA should be in the size of the ordinary Portland cement. This is used as the partial replacement of cement in concrete.
- **COCONUT SHELL:** The budding of waste coconut shell are used as a alternative for coarse aggregate in concrete. After the coconut is tattered out, the shell is regularly discharged. The bulk density of coconut shell is about 500 to 600 kg/m3, producing concrete of about less than 2000 kg/m3 in density, which makes them lightweight. The coconut shell concrete straight forwardly attains the strength around 17 N/mm2.
- **MIXING OF MATERIALS:** The percentage replacement of OPC by RHA were 0%, 5%, 8%, 10%, 12% and replacement of Coarse aggregate by Coconut shell were 0%, 18%, 20%,22%,24%. The 0% replacement was to serve as control for other samples.
- **CONCRETE MIX DESIGN:** The mix ratio used in this experiment is M20 (1:1.5:3)
- **METHODS:** The materials required for this project were ordinary portland cement, sand, coarse aggregate, coconut shell, rice husk ash. The cement used here is of 53 grade and it is bought from ACC brand. River sand is used as the fine aggregates which is bought from sand suppliers near by. Granites that are crushed to 20mm size are taken as coarse aggregates. Coconut shells are taken from near by areas as it is readily available and crushed to 20mm which is used as partial replacement for coarse aggregates. These are available in abundance in southern states of India. The bulk density of coconut shell is about 500 to 600 kg/m3. Rice husk ash is obtained from burning of rice husk in maintained conditions. The ash should be in the size of cement as it is partially replaced for OPC. It is an active pozzolana and has several applications in the cement and concrete industry. RHA is mostly composed of about 88.5% silica in it. The mix ratio taken for this concrete is 1:1.5:3 by volume. Coconut shells were used to replace 18%,20%, 22%, 24% of coarse aggregate by volume. 5 different mixes were taken and 2 cubes were produced with each percentage for 7, 14, 28 days. Rice husk

| Replacement of Coconut shell | Cube no | Compression Strength in N/mm$^2$ for 28 days | Average Compression Strength of Cube in N/mm$^2$ |
|---|---|---|---|
| 18 % | 1 | 20.40 | 20.34 |
| | 2 | 20.28 | |
| 20 % | 1 | 19.68 | 19.85 |
| | 2 | 20.02 | |
| 22 % | 1 | 19.62 | 19.51 |
| | 2 | 19.4 | |
| 24 % | 1 | 18.8 | 18.8 |
| | 2 | 18.8 | |

ash were replaced with 5%, 8%, 10%, 12% of OPC by volume. 5 different mixes were produced with each percentage for 7, 14, 28 days. The compressive strength and split tensile test for each specimen is tested and the results are compared.

**Compressive Strength of Cube =**

$$\frac{Applied\ load\ (P)}{Surface\ area\ of\ cube\ (L*B)}$$

**Table 4.1 -Compression Strength of Cube (Coconut shell) Test**

## IV. TESTING RESULTS

**Compressive Strength:**

Compression strength is the capacity of material or structure to withstand against the compressive force which artificially applied by hydraulic pressure in compression testing machine. The cubes of size 150 X 150 X 150 mm which casted in 3 numbers for 28 days of curing. After curing cubes are placed in CTM one by one between bearing plates and load is applied gradually in kilo Newton.

**Table 4.2 -Compression Strength of Cube (Rice Husk Ash) Test**

| Replacement of Rice Husk Ash | Cube no | Compression Strength in N/mm$^2$ for 28 days | Average Compression Strength of Cube in N/mm$^2$ |
|---|---|---|---|
| 5 % | 1 | 25.7 | 25.5 |
| | 2 | 25.3 | |
| 8 % | 1 | 22.7 | 22.1 |
| | 2 | 21.5 | |
| 10 % | 1 | 20.9 | 21.7 |
| | 2 | 22.5 | |
| 12 % | 1 | 19.9 | 19.4 |
| | 2 | 18.9 | |



**Table 4.3 -Compression Strength of Cube (RHA+ CS) Test**

| Replacement of Rice Husk Ash + Coconut Shell | Cube no | Compression Strength in N/mm$^2$ for 7 days | Average Compression Strength of Cube in N/mm$^2$ |
|---|---|---|---|
| 5 % RHA +18 % CS | 1 | 14.58 | 14.64 |
| | 2 | 14.7 | |
| 8 % RHA +18 % CS | 1 | 13.83 | 13.79 |
| | 2 | 13.75 | |
| 10 % RHA +18 % CS | 1 | 13.08 | 13.1 |
| | 2 | 13.12 | |

**Spilt Tensile Strength of Cylinder:**

Spilt tensile strength is the capacity of material or structure to withstand against the tensile force which artificially applied by hydraulic pressure in universal testing machine. The

cylinders of size 150 mm dia. and 300 mm length which casted in 3 numbers for 28 days of curing. After curing cylinders are placed in UTM one by one between bearing plates and load is applied gradually in kilo Newton.

**Spilt Tensile Strength of Cylinder = 2 (P)/πLD**

**Table 4.4 - Spilt Tensile Strength of Cylinder (RHA+ CS) Test**

| Replacement of Rice Husk Ash + Coconut Shell | Cylinder no | Spilt Tensile Strength of Cylinder of 28 days of curing in ($N/mm^2$) | Average Spilt Tensile Strength of Cylinder in ($N/mm^2$) |
|---|---|---|---|
| 5 % RHA +18 % CS | 1 | 2.28 | 2.285 |
| | 2 | 2.29 | |
| 8 % RHA +18 % CS | 1 | 2.14 | 2.125 |
| | 2 | 2.11 | |
| 10 % RHA +18 % CS | 1 | 1.95 | 1.92 |
| | 2 | 1.91 | |



## V.CONCLUSION

**From this experimental investigation the following conclusions are drawn:**

- The rice husk ash used as partial replacement of Ordinary Portland Cement gives better results at 5-8% replacement of RHA. The maximum replacement of RHA shall not be more than 10%.
- The test results obtained from replacing coconut shell for coarse aggregate shows that it is better when 18% coconut shell is used. The maximum replacement shall not be above 20%.
- When combined usage of RHA and coconut shell as partial replacement of OPC and coarse aggregate gives satisfying strength at 5% RHA and 18% coconut shell.

## REFERENCE

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