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# STUDY THE PERFORMANCE OF RICE HUSK ASH AND CALCIUM OXIDE AS CEMENTITIOUS MATERIAL IN CONCRETE

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## ABSTRACT

*Finding a replacement for cement to assure sustainability is crucial as the raw materials (limestone, sand, shale, clay, iron ore) used in making cements which are naturally occurring are depleting.. Rice husk ash (R.H.A) which has the pozzolanic properties is a way forward. An intensive study on R.H.A was conducted to determine its suitability.*

*The optimized R.H.A, by controlled burn or grinding, has been used as a pozzolanic material in concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced Carbon dioxide emissions. Up to now, little research has been done to investigate the use of R.H.A as supplementary material in concrete production. The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk as in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for replacement of cement, which not satisfies the structural properties of concrete like compressive strength.*

*In case of cementitious materials, compressive strength of proportion 50:50 (R.H.A:CaO) and 60:40 (R.H.A:CaO) is 2.4 MPa at the age of 28 days of curing period. In case of concrete, overall compressive strength of 60:40 (R.H.A:CaO) proportion is reduced by 93.6% when compared to Conventional Concrete.*

**KEYWORDS:** *R.H.A-Rice Husk Ash, CaO- Calcium Oxide, Compressive strength, Split tensile strength*

## I. INTRODUCTION

Construction industry is the one of the fastest growing sector in India. Rapid construction activity and growing demand of houses has lead to the short fall of traditional building materia. Construction materials of special requirements for the houses in different geographical region to overcome the risk of n natural hazard and for protection from sever climatic conditions has also emphasized the need for development of lightweight, insulating, cost effective, durable and environmental friendly building materials. Rice Husks can be put to use as building material, fertilizer, insulation material or fuel, rice husk uses includes aggregates and fillers for concrete and board production, economical substitute for micro silica, absorbent for oils and chemicals, as a source of silicon, as insulation powder in steel mills as to name a few

Rice husk ash is an agricultural residue which accounts for 20% of the 649.7 million tones of rice produced of annually worldwide This R.H.A is a great environment threat causing damage to the land and the surrounding area in which it is damped. Disposal of the husks is a big problem and open heap burning is not acceptable on environmental grounds, and so the majority of husk is currently going into landfill. The disposal of rice husks create environmental problem that leads to the idea of substituting R.H.A for silica in cement manufactured. The content of silica in the ash is about 92-97%. Lots of ways are being thought of for disposing them by making commercial use this R.H.A.

## I. AIM OF THE PRESENT STUDY

The main objective of this work is to study the suitability of rice husk ash as a pozzolanic material for cement replacement in concrete .However it is expected that the use of rice husk ash in concrete improve the strength property of concrete . Also is an attempt made to develop the concrete using rice husk ash as source material for full replacement of cement, which satisfies the various structural properties of concrete like compressive strength and split tensile strength.

## II. EXPERIMENTAL INVESTIGATION

### *A. Rice husk ash*

The husk was collected from Venkateshwara rice mill in Ajithnagar, Ujire, it was then burned in the laboratory by using a Muffle furnace, Chamber size: 250mm x 250mm x 300mm. Heated by resistance wire and Maximum Temp 800℃. The specific gravity and fineness of RHA was found out experimentally and the values are 2.1 and 5.2% respectively.

### *B. Calcium Oxide (CaO)*

The Calcium Oxide shells were collected from D'Souzas shell industry Melanthabettu and it is then grinded to get finely powder. The powder is the passed under 90micron sieve and used. The percentage of Calcium Oxide the determined using titration method, the three samples were taken for test and the sample containing higher Calcium Oxide content and economical one chosen for the project to decrease the cost of production and increase the strength. The specific gravity and fineness of CaO was found out experimentally and the values are 3.34 and 3.4% respectively.

### *C. Coarse aggregates*

The size of the course aggregate was 20 mm passing and of cubical shaped aggregates confirming to IS 882:1992.The tests on course aggregates such as aggregate crushing value, impact test, specific gravity aggregates were conducted for confirming its suitability use in concrete.

The specific gravity and aggregate impact value are 2.67 and 25.78% respectively.

### *D. Fine aggregate*

The size of the fine aggregate taken for the concrete was 2.36 mm passing. It should be clean and free from minerals and any alkalis. The tests conducted for the fine aggregates are specific gravity and fineness test.

## III. MIX PROPORTION FOR R.H.A AND CAO

Finding out the mix proportions by trial and error method:

Specific gravity of CaO = 3.35

Specific gravity of RHA = 2.10

| PROPORTIONS | [ RHA ] : [ CAO ] |
|---|---|
| 1) 90 : 10 | 90% (2.1) : 10% (3.35)1.89: 0.335 g/cc |
| 2) 80 : 20 | 80% (2.1) : 20% (3.35) 1.68 : 0.67 g/cc |
| 3) 70 : 30 | 70%(2.1) : 30% (3.35) 1.47: 1.005 g/cc |
| 4) 60 : 40 | 60% (2.1) : 40% (3.35) 1.26 : 1.34 g/cc |
| 5) 50 : 50 | 50% (2.1) : 50%(3.35) 1.05 1.675 g/cc |

## IV. CASTING AND CURING OF CEMENTITIOUS MATERIAL

Cemetititous cubes are prepared by hand mixing cement (R.H.A+CaO) in specified proportions with required quantity of water

The specifications of the moulds used for casting were 5x5x5 $cm^3$. The moulds were filled in three layers giving each layer 25 stockes using tamping rods.

The test specimens are stored in moist air for 24 hours and after this period the specimen are marked and removed from the moulds and kept submerged in clear fresh water until taken out prior to test.

Precautions:

The water for curing should be tested every 7 days and temperature of water must be at 27+2 ℃. We should make sure that water should be free from any deleterious material.

## V. RESULTS OF COMPRESSIVE STRENGTH OF CEMENTITIOUS MATERIALS

| Sl no. | Proportions | Load (KN) | | Compressive Strength (N/mm²) | | Days |
|---|---|---|---|---|---|---|
| 1 | 50:50 | 6 | 5 | 2.40 | 2.00 | 7 |
| | | 6 | 6 | 2.40 | 2.40 | 14 |
| | | 6 | 6 | 2.40 | 2.40 | 28 |
| 2 | 60:40 | 5 | 5 | 2.00 | 2.00 | 7 |
| | | 6 | 6 | 2.40 | 2.40 | 14 |
| | | 6 | 6 | 2.40 | 2.40 | 28 |
| 3 | 70:30 | 5 | 5 | 2.00 | 2.00 | 7 |
| | | 4 | 4 | 1.60 | 1.60 | 14 |
| | | 4 | 4 | 1.60 | 1.60 | 28 |
| 4 | 80:20 | 5 | 5 | 2.00 | 2.00 | 7 |
| | | 5 | 5 | 2.00 | 2.00 | 14 |
| | | 4 | 5 | 1.60 | 2.00 | 28 |
| 5 | 90:10 | 4 | 4 | 1.60 | 1.60 | 7 |
| | | 3 | 3 | 1.20 | 1.20 | 14 |
| | | 3 | 3 | 1.20 | 1.20 | 28 |

By observing Compressive strength of all five proportions, Compressive Strength of proportion 60:40 (R.H.A:CaO) found satisfactorily these proportion taken for further concreting work.

## V. CASTING AND CURING OF CEMENT CONCRETE

Cement concrete is prepared by machine mixing graded stone of nominal size as specifies with fine aggregate and cement (R.H.A+CaO) in specified proportions with required quantity of water. Concrete is mixed by any two methods, based on requirement as per quality and quality of concrete required.

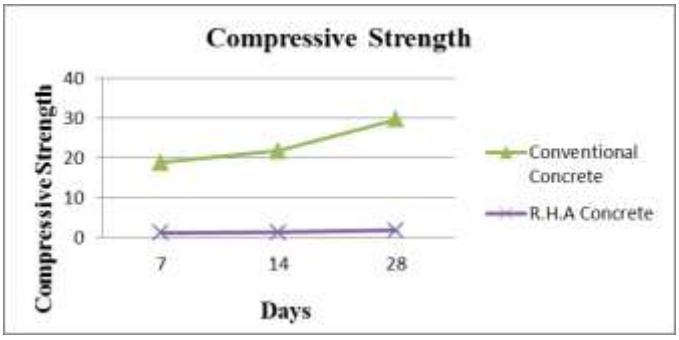
The specifications of the moulds used for casting were150x150x150 $cm^3$. The moulds were filled in three layers giving each layer 25 stockes using tamping rods.

The test specimens are stored in moist air for 24 hours and after this period the specimen are marked and removed from the moulds and kept submerged in clear fresh water until taken out prior to test.

## VI. RESULTS AND DISCUSSION

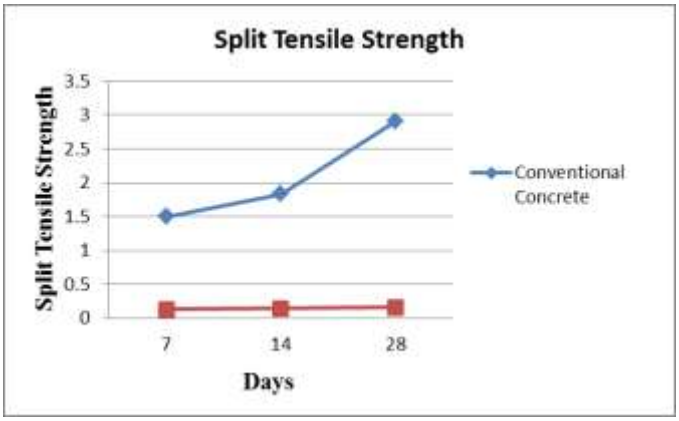
### *A. Compressive strength at different curing periods*

Compressive strength of R.H.A Concrete 93.70%, 94.80% and 92.30% reduced when compared to Conventional Concrete at the age of 7, 14 and 28 days respectively.



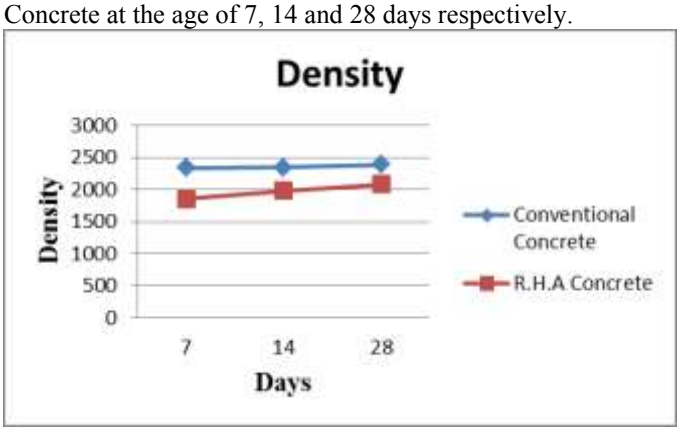

### *B. Split Tensile Strength at different curing periods.*

Split tensile strength of R.H.A Concrete 92.00%, 92.30% and 94.80% reduced when compared to Conventional Concrete at the age of 7, 14 and 28 days respectively.




### *C. Density of Conventional Concrete and R.H.A Concrete at different curing periods.*

Density of R.H.A Concrete 20.68%, 15.78% and 12.54% reduced when compared to Conventional Concrete at the age of 7, 14 and 28 days respectively.



## VII. CONCLUSION

- Compressive strength of cementitious material of proportion 50:50 (R.H.A:CaO) and 60:40 (R.H.A:CaO) is 2.4 MPa at the age of 28 days of curing period.
- Overall compressive strength of 60:40 (R.H.A:CaO) proportion is reduced by 93.6% when compared to Conventional Concrete.
- Overall Split tensile strength of 60:40 (R.H.A:CaO) proportion is reduced by 93.03% when compared to Conventional Concrete.
- Density of R.H.A Concrete is reduced by 16.33% when compared to Conventional Concrete.
- Because of improper mixing of cementitious material which is replaced by CaO and R.H.A, Compressive strength is reduced.
- Sufficient workability has found in all proportions except proportion 90:10(R.H.A:CaO).
- When the mix has been done for weigh batching volume of the material have been increased.

## VIII. SCOPE FOR FUTURE STUDY

- Good compressive strength can be achieved by using different types curing methods like air curing or sun light curing,oven dry curing,membrane curing,steam curing etc.
- Compressive strength test for R.H.A concrete can be done for longer periods (Durability study).
- The other proportions like (R.H.A:CaO) 10:90, 20:80, 30:70, 40:60 can be casted and tested for further study.
- Mix design is done for different grading with adding admixture.
- The reaction between CaO , R.H.A and water can be studied by X-ray diffraction method (X-R-D).
- Both the Calcium Oxide and Rice Husk can be collected from different sources.
- It will be appreciable if the replacing cementitious materials have the comparable proportion of constitutent materials as that in cement to achieve required target mean strength.

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