



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 4, April 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



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Utilization of Rice Husk Ash in Concrete

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ABSTRACT: Rice Husk Ash provides many 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 RHA as supplementary material in cement and concrete production in India. 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 ash 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 partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength. Rice husk ash (RHA) is an agricultural based pozzolanic material, generated by rice mills in huge quantities. This paper summarizes the experimental work of concrete in which ordinary Portland cement (OPC) cement were replaced by Rice husk ash (RHA). Partial replacement of Ordinary Portland Cement was carried out at 0% to 20%. In this work different tests were performed as slump test, compaction factor, compression test and split tensile test to find the suitable percentage replacement of cement by RHA. Compression and split tests were performed for 7 days, 14 days and 28 days of curing and result shows some variation in both tests in every proportion

KEYWORDS: Rice husk ash, Lime, sand, cement, coarse aggregate

I. INTRODUCTION

The objective of this research paper is providing the information on the uses of Ash of Rice Husk of substituting cementing material for increase the high-performance concrete. This paper is based on presents data based on chemical and physical properties of Rice Husk Ash and discusses the properties of concrete incorporating the ash as a substituting cementing material.

Rice husk is an agricultural waste, constitutes about one-fifth of the 410 million metric tons of rice produced in the world wide at annually. Due to increasing environmental concerns and the requirement to conserving energy as well as resources, the efforts have been made to burn the husk at a controlled atmosphere and temperature, and to utilize the ash so produced as the replacement of cementing material. Using it provides several benefited such as improved durability as well as strength properties, and also environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions.

II. METHODOLOGY

Properties of materials:

1) RICE HUSK ASH:

It is a carbon neutral green product. There are many ways to disposed it by making commercial use of this Rice Husk Ash. It is better pozzolanic material and can be make special mixer of concrete. Now a days very rapidly demand of fine amorphous silica in the production of high performance of cement and concrete mixing, high strength, low permeability concrete, for using in bridges, marine environments, nuclear power plants etc. see the fig.no 1.

Rice Husk Ash can be used in a different variety of applications like:

- In manufacturing green concrete
- Ceramic glaze
- Roofing shingles
- concrete which is high performance

SALIENT FEATURES

- It is economical than normal cement.
- It helps to increase the concrete workability
- It helps to become the concrete more plastic and cohesive.
- It helps to decrease the corrosion of cement
- It helps to increase the durability of concrete.

Physical properties of Rice Husk Ash

SLNO.	PARTICULAR	PROPERTIES
1	Specific Gravity	2.1-2.5
2	Color	Grey
3	Shape texture	Irregular
4	Odor	Odorless
5	Particle size	<43

Chemical properties of Rice Husk Ash

SLNO.	PARTICULARS	PROPERTIES
1.	Silicon Dioxide	85.4-87.92%
2.	Ignition loss	3.13-4.41%
3.	Potassium Oxide	2.13-2.28%
4.	Sodium oxide	0.2-0.7%
5.	Calcium oxide	0.3-2.3%
6.	Aluminum oxide	0.3%
7.	Iron oxide	0.2%



Figure 1: rice husk ash

2)Lime sludge/mud

Calcium oxide (CaO), commonly known as quicklime or burnt lime, is a widely used chemical compound. It is a white, caustic, alkaline, crystalline solid at room temperature. The broadly used term "lime" connotes calcium-containing inorganic materials, in which carbonates, oxides and hydroxides of calcium, silicon, magnesium, aluminium, and iron predominate. By contrast, quicklime specifically applies to the single chemical compound calcium oxide. Calcium oxide that survives processing without reacting in building products such as cement is called free lime. Show in fig.2

*Figure 2: lime***3)Cement**

it is the important binding material in concrete. In this paperwork we are using Ordinary Portland Cement (OPC) of grade 53. All the tests were done by carried as per recommendations of IS: 4031-1988. The properties of the cement were determined from various tests conforming to Indian Standard (IS) are listed. Shown in fig.3.

S.NO.	PROPERTIES	OBSERVATION
1.	Fineness	8% residue on IS90-micro sieve
2.	Specific gravity	3.04%
3.	Compressive strength (28 days)	53
4.	Standard consistency	26%
5.	Initial setting time	30min
6.	Final setting time	220min

*Figure 3: ordinary Portland cement*

4) Fine Aggregate

Fine aggregate is basically sand from the land or the marine environment. Fine aggregate generally consists of natural sand or crushed stone with most particles passing through a 9.5mm sieve. Fine aggregate are intergranular materials such as sand, gravel or crushed stone that are an end production the own right. They are also the raw materials that are an essential ingredient in concrete. For a good concrete mix, aggregate need to be clean, hard, strong particles free of absorbed chemical or coating of clay and another fine material that could cause the deterioration of concrete. Shown in fig.4.

Physical Properties are as follow:

- Specific gravity: 2.53
- Fineness modulus: 3.08
- Density: 1.63gm/cc
- Void ratio: 0.55



Figure 4: fine aggregate (sand)

5) Coarse aggregate

Coarse aggregate occupied 73 to 82% of the volume of the concrete. Coarse aggregate is the one of important concrete materials. The coarse aggregate retained at 4.75 mm. It can be found from rocks bed or boulders crushing. It is available in different shape (Irregular, Rounded, Flaky, Angular) and size(6mm,10mm,20mm). it should be free from mud or dirt and any organic impurities materials.

Coarse Aggregate Locally available coarse aggregates were used in this work. Aggregates passing through 12mm sieve and retained on 10mm sieve were sieved and tested as per Indian standard specification IS:383-1970. Shown in fig 5.



Figure 5: coarse aggregate

6)Super Plasticizer:

Super plasticizers are usually highly distinctive in their nature, and they make possible the production of concrete which, in its fresh or hardened state, is substantially different from concrete made using water-reducing admixtures.

Conplast SP430A2: This is the name of the super plasticizing admixture manufactured by “FOSCROC Chemicals” used in this project. The main objectives of using this super plasticizer are:

- To produce high workability concrete requiring little or no vibration during placing.

MIX RATIO

The concrete was mixed in the pan mixer, in such the way to avoid loss of water or other materials. The batch of concrete was of a size as to leave about not more than 10 percent after moulding the materials in desired number of test specimens. The Ordinary Portland Cement and fine aggregate(Sand) were mixed dry until the mixture is thoroughly blended and is uniform in a colour. The coarse aggregate (6mm,10mm and 20mm) was then be added in one by one and blended with the ordinary Portland cement and fine aggregate(Sand) until the coarse aggregate(6mm,10mm and 20mm) is uniformly distributed throughout the batch, and then the water was added in 20% of cement, and the Whole batch was mixed until the concrete looks to be homogenous and has the desired consistency.

The following parameters were used for mix design:

- Grade of concrete = M25(1:1:2)
- Type of Cement = OPC-53 Grade
- Brand of Cement = Coromandel
- Admixture Used = Conplast SP430A2(FOSCROC Chemicals)
- Fine Aggregates =Zone III
- Specific Gravity of Cement = 3.04
- Specific gravity of FA = 2.53
- Specific Gravity of C.A
- 10mm = 2.69
- 6mm =2.63
- Moisture content of FA =less than 5%

The design mix adopted for M25 grade mix is given in table

Mix Proportion for M25 grade Concrete

Cube (150x150x150)mm	Rice Husk Ash(Kg)	Lime (Kg)	Cement (kg)	Fine aggregate(kg)	Coarse aggregate(kg)			Admixture (ml)
					6 mm	10 mm	20mm	
Cube1(10%)	3	0.03	27	30	36	18	6	50
Cube2(15%)	4.5	0.045	25.5	30	36	18	6	50
Cube3(20%)	6	0.06	24	30	36	18	6	50
Cube4(25%)	7.5	0.075	22.5	30	36	18	6	50

III. RESULTS AND DISCUSSION**Compressive Strength:**

The cube of size 150mmx150mmx150mm were compressive strength results at different time duration such as 7days,14days and 28 days for different replacement of Rice Husk Ash such as 10%, 15% and 20% and 25% of cement. The Compressive Strength with different stages are in table. From the Testing results it was observed that the maximum strength is obtained for mixing with 20% RHA was observed that the maximum compressive strength at the

water-binder ratio of 0.54. The compressive strength occurs due to the pozzolanic reaction of Rice Husk Ash (RHA). The high strength comes with a short period of time due to high % of Aluminum. The action of silica fumes on the calcium hydroxide (CaOH), more gel is formed. These two factors help to the formation of a gel, which helps to better development of strength at early stages. Silica fume starts reacting with calcium hydroxide (CaOH) and produces C-S-H (Calcium silicate Hydrate) gel immediately.

1. Compressive strength = P/A
2. Where, P = load in KN and A = Area of cross section



Figure 6: Compressive Strength Testing

Testing Table compressive strength:

Mix Name	7 days strength(N/MM ²)	14 days strength(N/MM ²)	28 days strength(N/MM ²)
Cube1	20.01	23.98	28.22
Cube2	21.94	27.06	31.12
Cube3	24.02	29.67	33.47
Cube4	20.12	26.49	29.45

Split Tensile Strength

The split tensile strength results of mixing at the time period of 7 days, 14 days and 28 days for different replacement of Rice Husk Ash such as 10%, 15%, 20% and 25% of cement. The strength of Split tensile strength of the different mixing was given in table. From the testing results it was observed that the maximum split tensile strength is obtained from mixing with 20% Rice Husk Ash (RHA). The rate of loading was 2.1 KN per second.

- The Split Tensile Strength can be calculated as $\sigma_c = 2P/\pi DL$
where,
- P = load in KN
- D = diameter of cylinder
- L = Length of cylinder
- σ_t = split tensile strength of specimen in N/mm²

*Figure 7: Split tensile Strength Testing***Split Tensile strength of concrete.**

Mix Name	7days strength(N/MM2)	14days strength(N/MM2)	28days strength(N/MM2)
Cube1	2.1	2.72	2.98
Cube2	2.47	2.86	3.12
Cube3	2.51	2.91	3.89
Cube4	1.15	1.98	2.03

Flexure Strength:

It was seen that the strength of concrete in tension and compression (both tension and flexural tension) are closely related to each other, but the relationship is not the direct proportionality to each other. The ratio of the two strengths depends on general level of strength of concrete. In other words, for higher value of compressive strength concrete shows there higher tensile strength value, but the rate of increasing the tensile strength is of decreasing order. The uses of pozzolanic material it helps to increases the tensile strength of concrete. The rate of loading was 0.1KN/second. The size of beam was used 100mm x 150mm x 1000 mm. The trial specimens having a span of 1000 mm were tested under two-point loading. The effective span was 800 mm. Hence the point load were applied at one third point from the ends support.

The flexure strength of the beam can be determined by using formulae

$\sigma_c = 3PL/4bd^2$ } if crack occurs at the middle third span of the beam,

or $\sigma_c = 3Pa/4bd^2$ } if the crack occurs at the outer third span of the beam

Where, P = load in KN, L= length of the specimen b= width of specimen, d= depth of specimen, and a = distance between crack and the nearest support.

Table flexural strength

Mix Name	7days strength(N/MM2)	14days strength(N/MM2)	28days strength(N/MM2)
Cube1	4.18	4.59	5.15
Cube2	4.21	4.63	5.95
Cube3	4.37	4.78	6.80
Cube4	3.92	4.38	5.23

IV.CONCLUSION

- Rice husk ash was added to the concrete in the replacement of cement. Based on the results the following conclusions were drawn:
- The time duration of 7days, 14days and 28days the compressive strength of mixes containing Rice husk ash(RHA) was greater than that of mixes without Rice husk ash(RHA). This helps to understand the addition of Rice husk ash(RHA) as partial replacement to cement causes an increase in compressive strength.



Therefore Rice husk ash(RHA) acts as pozzolanic material, hence the compressive strength of concrete increases as the percentage of Rice husk ash increases.

- At the time of 28days the compressive strength of mix 20% Rice Husk Ash (RHA) shows the highest strength then compared to other replacement Rice Husk Ash (RHA) with Cement. This shown that the percentage of replacement of Rice husk ash(RHA) with cement is 20percent.
- By using this Rice husk ash(RHA) in concrete as replacement of the cement the emission of greenhouse gases can be decreased to a greater extent. As a result, it helps to gain more number of carbon credits.
- The economic and technical advantages of incorporating Rice Husk Ash(RHA) in concrete should be exploited by the construction and rice industries, more so for the rice growing nations of India.
- The Rice Husk Ash is waste material, it helps to reduces the cost of construction.
- It helps to decrease the environment pollution.

ACKNOWLEDGEMENTS

I Sincerely Thanks my Parents, colleagues (Anushka Nayak, Upamanyu Chatterjee) and my supportive member (Mr. Aaquib Hussain, Yash Vardhan Goyal, Sri Brojendranath Dey) for supporting me throughout the process of completing the report

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