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Comparative Study on Conventional Concrete and RHA Mixed Concrete

Baljeet Yadav[1] ,Puneet Kumar[2] , Danish Khan[3]

[1]HOD Civil Engineering Department, Rajkiya Engineering College Mainpuri (Dr. A. P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow), Mainpuri- 205001, U.P. India

[2][3]B.Tech Civil Engineering Department, Rajkiya Engineering College Mainpuri (Dr. A. P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow), Mainpuri- 205001, U.P. India

[1]baljeetiitm9@gmail.com [2]puneet.kumar.recm@gmail.com [3] engdanishkhan786143@gmail.com

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Abstract - Concrete is one of the most used materials in the field of construction. These days due to population growth, the need for infrastructure is growing day by day. This increases cement production. In the current situation total cement production is 4.1 billion tons worldwide. This large amount of production encourages natural use resources and is not very safe in the environment. Large quantities of waste products delivered to the manufacturing industry, for example, mineral slag, fly ash, silica fumes, rice husk ash and more. rice husk ash is an available agricultural product from rice mills, the husk found in the mill is useless which means it is not even used to eat animals. That's why it is used as fuel in various industries the burning temperature is very high which is why they are found in that RHA is very simple. The work here is about the gradual conversion of RHA cement to concrete by various percentages such as 0%, 5%, 7.5%, 15% weight of cement. Various investigations were conducted to determine the workability, compressive strength, flexural strength at 7-day and 28-day cured concrete samples. Results obtained from experiments with satisfactory modification cement with ash husk ash is featured in this research paper.

Key Words**:** Rice Husk Ash (RHA), Compressive Strength, Flexural Strength, Workability.

1.INTRODUCTION

Rice covers about 1% of the world's population and is a vital source of food for millions of people. All over the world, about 600 million tons of rice paddy are produced each year. On average 20% of rice paddy is husk, which provides an annual production of 120 million tons. In many rice-producing countries, most of the millet produced by rice mills is burned or disposed of as waste. Rice husks are one of the most widely available but rarely used sources, which are essential oils for power generation. The calorific value varies with the variety of rice, moisture and bran content but the average amount of grains with a moisture content of 8-10% and basically zero bran is 15 MJ/ kg. The treatment of rice husks as a 'resource' for energy production is to move away from the idea that husks cause dumping problems. The idea of producing energy from rice husks is very strong, especially in those countries that rely heavily on imported oil to meet their energy needs. In these countries, the use of locally available biomass, including rice husks, is especially important. The rice husk is unusually high in ash compared to other biomass oils - close to 20%. Ash is 92 to 95% silica (SiO_2), porous and lightweight, with a high surface area. Its absorbing and anti-inflammatory properties are useful in many industrial systems, and ash has been the subject of many researcher's studies. If a long-term sustainable market and the price of rice husk ash (RHA) can be established, then the energy efficiency of rice husk or co-producing crops is much better. A 3 MW power plant would require 31,000 tons of rice per year, if it operates at a 90% capacity. This could result in 5580 tons of ash per year. The revenue from selling the ashes for profitable use will reduce the time required to repay the money needed to build the project. Many plants of 2 - 5 MW can be commercially operated worldwide and this biomass resource can be used on a much larger scale than at present. Rice husk ash has many applications due to its numerous properties. It is an excellent insulator, so there are applications in industrial processes such as metal foundations and in the construction of house protection materials and resistant bricks. Pozzolana is functional and has a few applications in the cement and concrete industry. It is also very absorbent, and is used to absorb oil on hard surfaces and is able to filter arsenic in water. Recently, refining studies have been done on refining and using it instead of silica in a series of industrial projects, including the construction of silicon chip. RHA is a common term meaning all kinds of ashes produced from the burning of rice husks. In fact, the type of ashes varies according to the process of burning. The two forms dominate the heating and gas installation. Silica in ashes undergoes structural changes depending on the temperature that occurs during combustion. At 550° C - 800° C Comparative study on conventional concrete and RHA concrete amorphous silica is formed and at high temperatures, crystalline silica is formed. These types of silica have different properties and it is important to produce ashes for a proper description for the use of a particular finish.

2. Objectives

a) Studying the different strength properties of Rice husk ash concrete and age compared to Concrete Control.

b) To compare the Compression and flexural strength development with age of Rice husk ash concrete with Control concrete of same grade.

c) To study the effect on workability of Concrete due to replacement of Cement with RHA.

3. Material Used

A. Cement

Ordinary Portland Cement of 43 grade conforming to IS 18112-1989 is used. Properties of cement used is shown in Table 1.

TABLE 1. PROPERTIES OF CEMENT

Properties	Value Obtained
Fineness	4%
Initial Setting Time	80 mins
Final Setting Time	180 mins
Standard Consistency	31%
Specific Gravity	3.15

B. Rice Husk Ash

Each 100 Kg of rice husk gives 25 Kg of RHA, the RHA is purchased from a reliable resource. Table 2 shows the property of RHA used.

TABLE 2. PROPERTIES OF Rice Husk Ash

Properties	Value Obtained
Initial Setting Time	185 mins
Final Setting Time	305 mins
Standard Consistency	41%
Specific Gravity	2.12

C. Coarse Aggregate

Crushed Granite has been used as coarse aggregate having maximum size as 20mm. It has following properties:

a) Specific Gravity = 2.64
b) Fineness Modulus = 6.816

TABLE 3. Sieve Analysis

Sieve Size	Cumulative Percent Passing	
	20mm	IS383-1970 Limits
20mm	100	85-100
16mm	56.17	N/A
12.5mm	22.32	N/A
10mm	5.29	0-20
4.75mm	0	0-5

D. Fine Aggregate

We use fine aggregate with following properties:

a) Specific Gravity = 2.7
b) Fineness Modulus = 2.71

E. Water

Water with pH value 6.0 to 8.0 is used, portable water containing no alkalinity and salinity.

3. Methodology

A. Proportioning:

The proportioning is done for M20 grade concrete is 1:1.5:3 conforming to standards of IS 456:2000. Here extent is embraced 1:1.55:3.54 which is determined by mix design method. Concrete is replaced with RHA at different percentages of 0%, 5%,7.5%. Weight of constituents is as follow:- Cement = 50 kg; Fine total = 77.5 kg; Coarse total = 177 kg .

B. Workability Test

a) Slump Test:

Slump test is performed to measure the workability of fresh concrete and test should be done before it sets. Slump test should be conforming to IS 1199-1959.

Figure 1: Slump Test

b) Compaction Factor Test:

It is essentially designed for laboratory but also can be used in field. It is more sensitive than the Slump Test so it is performed to get more deep in workability. It should performed as per IS 1199-1959. Ratio is measured as ratio of weight of partially filled compacted concrete to the fully compacted concrete.

Figure 2: Compaction Factor Test

C. Sample Casting

Total 108 cube has been casted for 3 days, 7days, 28 days, 56 days strength test and for 0 %, 5%, 7.5%, 15% replacement with RHA. And similarly sample for flexural strength test has been casted.

D. Curing

For 24 hours + ½ hours from the time of adding water to other components, test samples will be stored on site in a vibration free place, under a wet mat, sacks or other similar material. Storage temperature should be in the range of 220 to 320C. After a period of 24 hours, they will be marked for subsequent identification, removed from the mould and stored in clean water at a temperature of 24^0C 30^0C until they are taken to a testing laboratory for testing within 24 hours. They will be sent to a test lab well-packed in wet sand, damp bags or other suitable material to reach the wet condition less than 24 hours before the test time. Upon arrival at the test laboratory, samples will be stored in water at a temperature of 270 + 2 0C for the duration of the test. Both daily maximum and minimum temperature records will be kept during the time the samples remain on site and in the laboratory.

Figure 3: Test specimens being cured in curing tank

E. Compressive Strength Test

The concrete cubes of size 150mm ×150mm × 150mm are casted. These samples are tested in UTM (Universal Testing Machine) of capacity 2000 KN. at pace of 140 kg/cm2/min. The compressive strength test is performed at 3 days, 7 days, 28 days, 56 days.

Figure 4: Compressive Strength Test

E. Flexural Strength Test

The concrete beams are casted of size 150mm ×150mm ×700mm. These samples are tested in Central Point Loading machine by applying pressure of 400kg/min. The flexural strength test is performed at 3 days, 7 days, 28 days, 56 days.

Figure 5: Flexural Strength Test

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4. Results

A. Slump and Compaction Factor Test Result:

Sr. No.	RHA%	W/C Ratio	Slump(mm)	Compaction Factor
1.	0%	0.55	20	0.70
2.	5%	0.55	10	0.71
3.	7.5%	0.55	7	0.715
4.	15%	0.55	2	0.73

B. Compressive Strength Test:

- **Compressive Strength of M20 Conventional Concrete with 0% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	14.51
2	7	20.58
3	28	30.3
4	56	36.36

- **Compressive Strength of M20 Conventional Concrete with 5% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	12.96
2	7	20.58
3	28	30.30
4	56	36.36

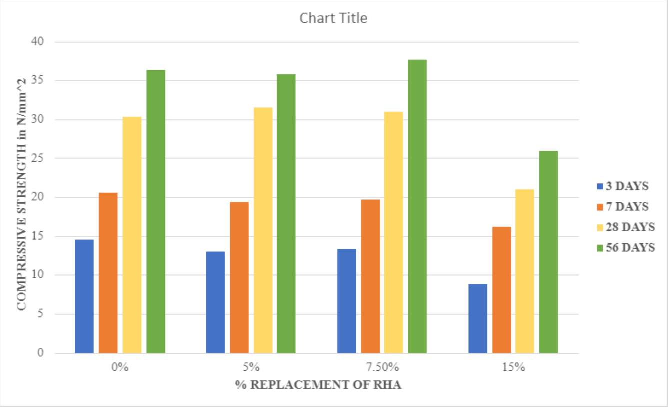
- **Compressive Strength of M20 Conventional Concrete with 7.5% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	13.32
2	7	19.70
3	28	31
4	56	37.62

- **Compressive Strength of M20 Conventional Concrete with 15% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	8.88
2	7	16.22
3	28	21
4	56	25.88

- **Variation of Compressive Strength With Age And Percentage of RHA**



B. Flexural Strength Test:

- **Flexural Strength of M20 Conventional Concrete with 0% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	1.01
2	7	1.17
3	28	4.21
4	56	4.95

- **Flexural Strength of M20 Conventional Concrete with 5% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	1.22
2	7	1.36
3	28	3.62
4	56	4.21

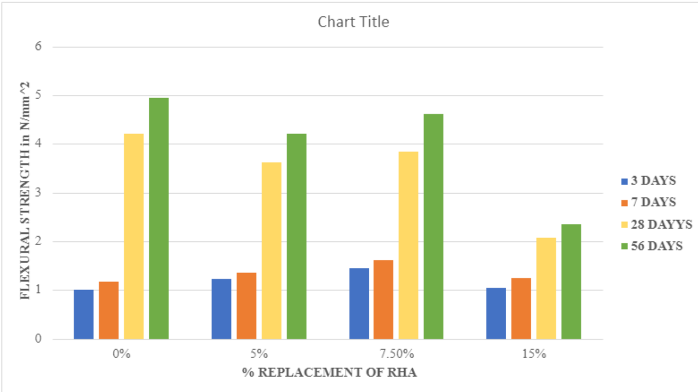
- **Flexural Strength of M20 Conventional Concrete with 7.5% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	1.44
2	7	1.62
3	28	3.84
4	56	4.62

- **Flexural Strength of M20 Conventional Concrete with 15% RHA**

S. No.	Days	Strength (N/mm^2)
1	3	1.04
2	7	1.25
3	28	2.08
4	56	2.35

- **Variation of Flexural Strength With Age And Percentage of RHA**



5. Conclusion

The following results are reached from the limited study on the strength behaviour of Rice Husk ash:

1. The compressive strength is gradually increased from 3 days to 7 days for all cement replacement level of rice husk ash. However, from 7 to 28 days, the compressive strength increases significantly, followed by a progressive increase from 28 to 56 days.
2. The flexural strength of Rice husk ash concrete is found to steadily decline with increasing percentage replacement of both Rice husk ash and cement till 7.5 percent replacement. The flexural strength of Rice Husk ash concrete, on the other hand, decreases significantly with age.
3. The flexural strength of rice ash concrete has been steadily declining by an ever-increasing percentage up to 7.5% instead of both rice ash and cement. The flexural strength of rice husk ash concrete, on the other hand, greatly decreases with age.
4. The construction and rice industries, especially those in rice-growing countries in Asia, should take advantage of the technical and economic benefits of using Rice Husk Ash in concrete.

5. Scope

- ➢ Other levels of rice husk ash substitution can be investigated.
- ➢ Water permeability, resistance to chloride ion penetration, corrosion of steel reinforcement, resistance to sulphate attack durability in marine environments, and other tests with Rice husk ash need to be investigated.
- ➢ The research might be expanded to learn more about the behaviour of concrete and whether it is suited for pumping purposes, as modern technology is used in RMC to pump concrete to great heights.
- ➢ It is required to research the behaviour of reinforced Rice husk ash concrete under flexure, shear, torsion, and compression in order to use it as a structural material.

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AUTHORS:

BALJEET YADAV
HOD, Department of Civil Engineering
Rajkiya Engineering College, Mainpuri
Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh
baljeetiitm9@gmail.com

PUNEET KUMAR
B.Tech, Department of Civil Engineering
Rajkiya Engineering College, Mainpuri
Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh
puneet.kumar.recm@gmail.com

DANISH KHAN
B.Tech, Department of Civil Engineering
Rajkiya Engineering College, Mainpuri
Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh
engdanishkhan786143@gmail.com