IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

Study On The Behavior Of M25 Grade Concrete By Partial Replacement Of Cement By Rice Husk Ash

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Abstract : Concrete is the most widely used building material globally, and it is typically produced by mixing cement, sand, coarse aggregate and water. This mixture is used to create a solid and durable material that is used in a wide range of construction applications, from buildings and bridges to roads and infrastructure. Our country is presently making great efforts to expand and develop its infrastructure by establishing industrial, commercial, and national highway projects, which is causing serious economic issues. The advancement of concrete technology has to potential use of natural resources. India produce vast amount of Rice Husk which has agricultural waste after burning and grinding they produce rice husk ash(RHA). In recent years, numerous studies have shown the use of supplemental cementitious materials (SCMs), such as rice hush ash. The study investigated the use of rice husk ash as an additional cementitious ingredient in concrete compositions, replacing cement with rice husk ash in the following proportions: 0% (without rice husk ash), 6%, 12%, 18%, and 24%. These percentages represent the substitution levels of rice husk ash for cement in the M25 concrete mixture. The compressive, flexure, and split strengths of various concrete mixtures were tested and compared to those of standard concrete. These tests were conducted in order to evaluate the mechanical properties for the test results for compressive strength, split strength, and flexure strength up to 28 days.

Index Terms **– Rice Husk Ash, Mix Design, Compressive Strength, Split Tensile Strength, Flexural strength, Cost**

I. INTRODUCTION

It seems like you are highlighting the importance of high-strength and cost-effective concrete in today's global markets, and how research and innovation have expanded the possibilities for improving concrete performance. Various types of concrete, such as Self-Compacting Concrete (SCC) and High-Strength Concrete (HSC), have been introduced to enhance durability and strength, but their high cost can be a limiting factor. To address this challenge, researchers have explored alternative materials and methods for modifying concrete to achieve the desired characteristics while reducing costs. One such approach is the partial replacement of Ordinary Portland Cement (OPC) with rice husk ash, which has proven to be effective in meeting these requirements. Rice husk ash is a waste product from rice milling and can be used as a supplementary cementitious material. When it is incorporated into concrete, it can improve the strength and durability of the material while also contributing to cost reduction. This approach is an example of sustainable construction, as it makes use of a locally available waste product and reduces the environmental impact associated with

cement production. In summary, the development of cost-effective, high-strength concrete is a critical need in the construction industry. Researchers have explored various methods and materials, such as rice husk ash, to achieve this goal while also addressing sustainability concerns and reducing the reliance on traditional cement.

Rice husk Ash is an agricultural product on which rice husk is burnt into ashes. RHA is found to be good material which fulfils the physical characteristics and chemical composition of mineral admixtures. A small amount addition of RHA to a given water cement ratio, is sufficient and helpful to improve the stability, durability tends to increase the compressive strength and durability of the concrete. Usage of the fine rice husk ash reduces the temperature as compared to the normal opc temperature. As per the researcher observation is was found that proper proportionate ratio RHA can increase the initial setting time and also it obtains its maximum strength with a few days. RHA depends mainly on silica content, silica crystallization phase, and size and surface area of ash particles. Rice husk usage benefits are briefed in many literatures, very few of them deals in their real life.

2.MATERIALS AND METHODOLOGY

In the present study, we prepare a Mix Design of M-25 with partial replacement of cement with rice husk ash, cement, fine aggregate , coarse aggregate were used. For the experimental purposes, the materials were collected from different sources. The point of collection of these materials are shown in Table 1.

Table 1: Source of collection of different materials

Name of materials	Source of materials
Cement	Obtained from ACC CEMENT Factory, Sindri
Rice Husk Ash	Obtained from Rice Mill Govindpur ,Dhanbad
Fine and Coarse Aggregate	Obtained from B.I.T Sindri Laboratory

2.1 RICE HUSK ASH

Rice Husk Ash is the ash that is obtained by burning the rice husk until it gets reduced by 20%. The Rice Husk for the research was obtained locally. These Husk then were deliberated until fine ash is being produced. These ashes were sieved by the 45 micron where further impurities are being minimized.

Fig 1. Rice Husk Ash Sample

Pysical properties of RHA

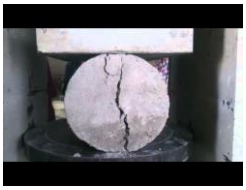
SI.No.	Properties of Rice Husk Ash	
1	colour	Gray
2	Minralogy	Non crystalline
3	Particle size	<45 micron
4	Spacific Gravity	2.14
5	Bulk Density	0.781gm/cc
6	Odor	Odorless

2.2 COMPRESSIVE STRENHTH

The compressive strength of a material is that value of the uniaxial compressive stress
at which the material fails completely. Strength test results of cubes can be used for
quality control purposes. The compressive strength was calculated from the failure
load divided by the cross-sectional area resisting the load and reported in Mega Pascal's (MPa).
Compressive strength was determined on 150 mm cube specimens
according to ASTM C 39 [67] using a compression testing machine from after 7 and 28 days of water curing. Three specimens were tested at each age and the average values are reported.
The Compressive strength Testing Machine represented in fig 2.

Fig 2

2.3 SPLIT TENSILE STRENGTH



The tensile strength of concrete is one of the basic and important properties. It is a method to determine the tensile strength of concrete.
The concrete is very weak in tension due to its brittle nature and it is not expected to resist the direct tension as a result cracks developed in concrete when subjected to tensile forces.
Thus, it is necessary to determine the tensile strength of concrete to
determine the load at which the member may crack
The Split Tensile Strength Sample represented in fig 3.
Fig 3

2.4 FLEXURAL STRENGTH

Concrete's flexure strength is tested when a road slab with insufficient subgrade support is put under wheel loads and has its volume fluctuate as a result of temperature variations.
The tensile strength of concrete is also measured. After 7 and 28 days of curing, a 500 KN-capable flexural testing equipment was used to perform a flexural strength test on cuboidal-shaped concrete with dimensions of 100X100X500 mm in accordance with IS 516-1959 guidelines. After leaving 50mm from either end, two rollers with a 400mm center-to-center spacing were used to hold the specimen.
The specimen was then loaded at a rate of 0.7N/mm2 per minute using a two-similar rule installed at the third point of the span until failure was reached. Using the provided formula, the flexural strength was determined and represented as the rupture modulus.

4.0 METHODOLOGY

- Lab testing of characteristics of rice husk ash specific gravity, physical state, particle size, odor, color, appearance etc.
- Preparation of design mix of M25 grade, as per IS 10262 code
- Preparation of different concrete mix using rice husk ash as partial replacement of cement by 0%,6%,12%,18%,24%.
- Comparative study of compressive, flexural, split tensile strength of concrete mix thus prepared.

5.0 INVESTIGATION AND RESULT

5.1 COMPRESSIVE STRENGTH TEST RESULT

The Compressive Strength results are listed below in Table 2 and corresponding graph are represented in Fig4.

Table 2: Compressive Test Results of M25 Grade conctere at different % of RHA

SI.no.	% of Rice Husk Ash (RHA)	Compressive Strength at 7 days in (Mpa)	Compressive strength at 28 days in (Mpa)
1	0	22.85	33.82
2	6	21.50	34.36
3	12	20.90	35.45
4	18	15.20	30.50
5	24	13.86	25.11

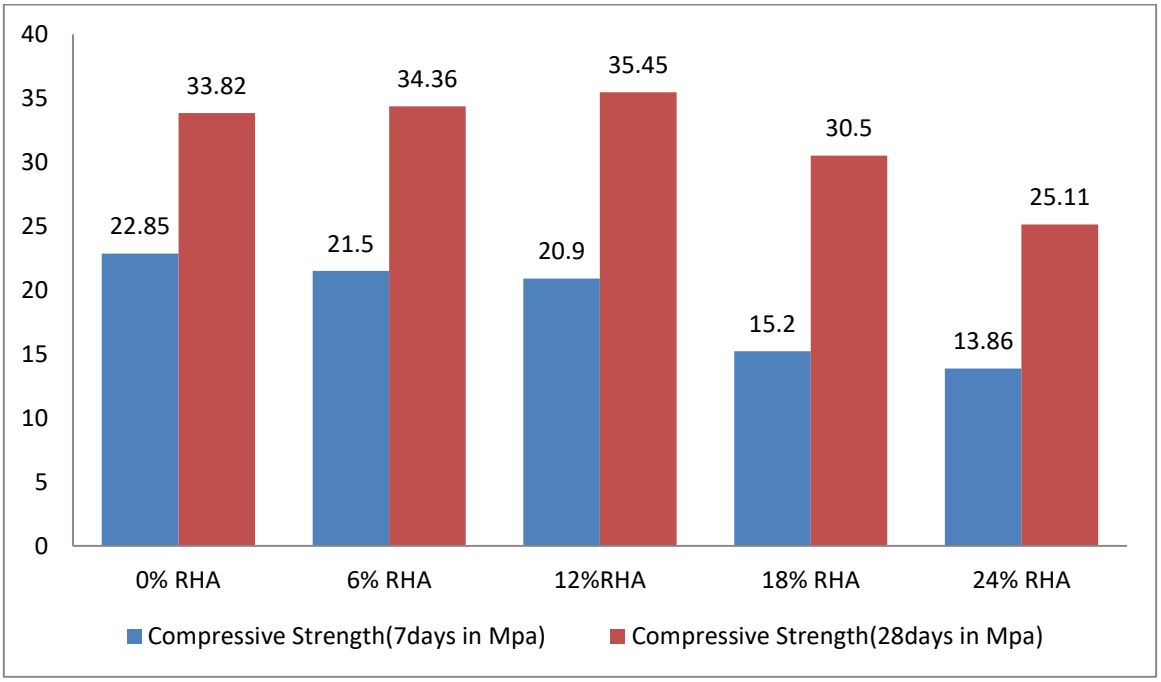


Fig 4.Compressive Strength of M25 at different % of Rice Husk Ash

5.2 FLEXURE STRENGTH TEST RESULT

The Flexural Strength values are tabulated in Table 3 and the corresponding graph are represented in fig.5.

Table 3: Flexural Strength test result of M25 Grade concrete at different % of RHA

SI.no.	% of Rice Husk Ash	Flexure Strength at 7 days in (Mpa)	Flexure strength at 28 days in (Mpa)
1	0	2.28	4.25
2	6	2.46	4.43
3	12	2.08	4.32
4	18	1.53	3.27
5	24	1.31	2.12

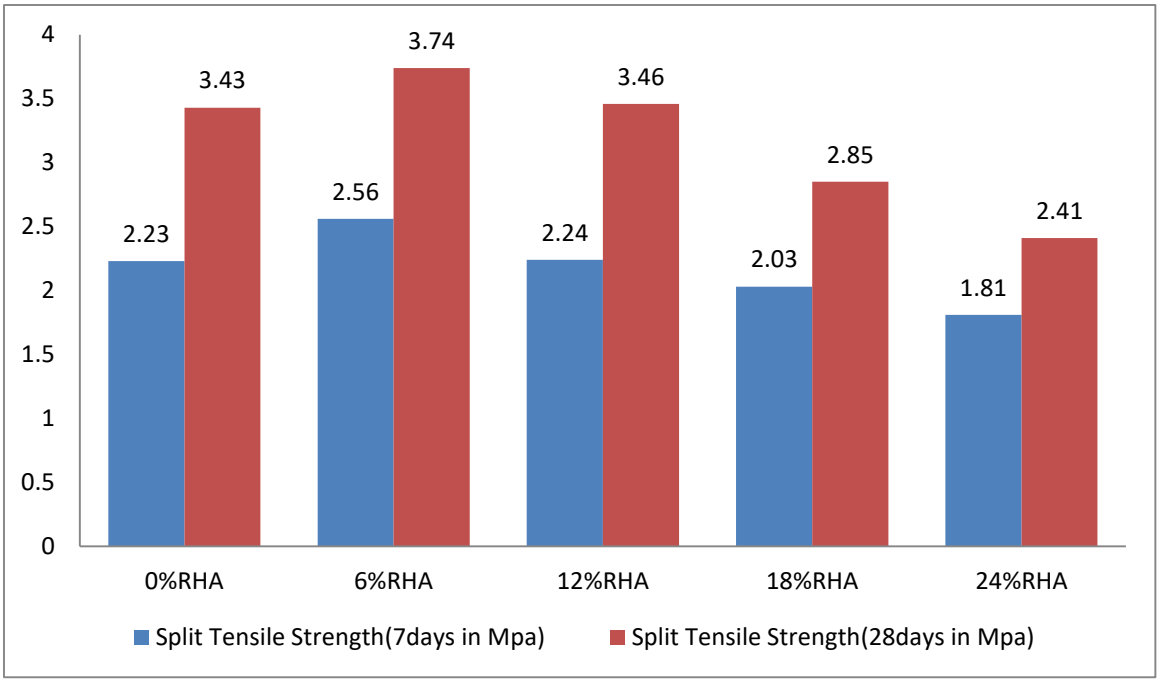


Fig 5. Flexure Strength of M25 at diff. % of Rice Husk Ash

5.3 SPLIT TENSILE STRENGTH TEST RESULT

The Split Tensile Strength values are tabulated in Table 4 and the corresponding graph are represented in fig.6.

Table 4: Split Tensile Strength test result of M25 grade concrete at diff. % of Rice Husk Ash.

SI.no.	% of Rice Husk Ash	Split Tensile Strength at 7 Days in (Mpa)	Split Tensile Strength at 28 Days in (Mpa)
1	0	2.23	3.43
2	6	2.56	3.74
3	12	2.24	3.46
4	18	2.03	2.85
5	24	1.81	2.41

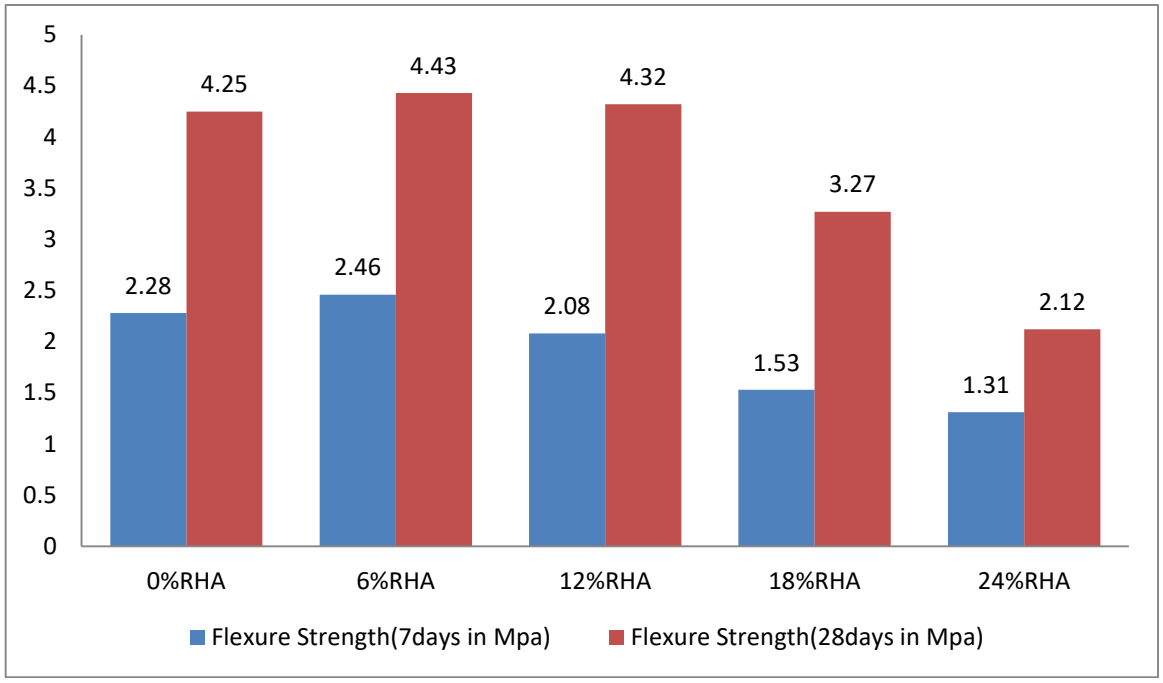


Fig 6. Split Tensile Strength of M25 at diff. % of Rice Husk Ash

5.4 COST ANALYSIS

Based on current market rates, rates for 100% cement concrete (M-25) mixes and mixes with a 12% rice husk ash partial substitution of cement will be compared. Ash made from rice husks is quite cheap in India. Since the industry that uses rice husk as fuel produces the rice husk ash for free, we just include in the cost of transporting the rice husk ash. When compared to ordinary concrete, it is discovered that the concrete using 12% rice husk ash as a partial replacement for cement costs 4.97% less.

6.0 CONCLUSION

The following conclusions can be drawn from the Experimental Investigation:

- The compressive strength of the concrete at 28 days after partial replacement with rice husk ash increases with an increase of up to 12% of rice husk ash; above 12%, it starts decreasing.
- The flexure strength of rice husk ash concrete has been increased by up to 6% by RHA. After that, there is a continuous decrease in the flexural strength at 7 days and 28 days.
- Up to 12% rice husk ash replacement in concrete is possible for split tensile strength; however, only up to 12% rice husk ash replacement in compression and flexural strengths provides satisfactory results.
- Rice husk ash is a waste product from rice production. It is a valuable supplementary material for cement replacement in concrete that can enhance sustainability and reduce the environmental impact of construction projects.
- For a 12% replacement of cement with RHA, the compressive strength has increased to 4.82% at 28 days, and the cost has reduced to 4.97%.

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