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EXPERIMENTAL INVESTIGATION ON HIGH STRENGTH BLENDED WITH A COMMON MINERAL ADDITIVE

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ABSTRACT
High pozzolanic activities make rice husk ash (RHA) an excellent partial substitute for cement in cement concrete. This research gives a comparative analysis of the usage of RHA in concrete specimens as a partial substitute for cement. In the M55 grade concrete mix, we will partly substitute rice husk ash for regular Portland cement. By performing several experiments, parameters of concrete such as compressive strength, initial and final cement setting times, flexural strength, and workability of concrete are estimated by substituting RHA by weight at 5%, 10%, 15%, and 20% for regular Portland cement of 53 grade. The remainder of the tests, such as the Compressive Strength Test and the Flexural Strength Test, will be conducted on hardened concrete cubes and concrete beams, respectively, after 7, 14, and 28 days of curing in water. Workability tests are conducted on fresh concrete. As a result, we will see changes in the qualities of the concrete we produce using the current conventional concrete.

Keywords: Rice huskash, Ordinary Portland Cement(OPC) , partial replacement of cement, **Workability, Compressive strength, Flexural strength.**

1. INTRODUCTION
GENERAL
Millions of tons of rice husk ash (RHA), an agricultural waste, are generated annually. RHA is produced by burning rice husk, and research has shown that it is very pozzolanic. Therefore, using industrial wastes as supplemental cementing materials has become a necessary component of concrete building due to rising environmental concerns and the need to preserve energy and resources. owing to its non-crystalline silica content and unique surface, RHA is highly reactive with lime owing to its high silicon dioxide concentration. It contains 85%–90% silica. The engineering characteristics of RHA as a material for making concrete are examined in this research.

1.2 PROBLEMDESCRIPTION
The most crucial components of a concrete mixture, including workability, compressive strength, drying shrinkage, and durability, are significantly influenced by cement. Cement particles react with water during the hydration process, binding the aggregate and creating the strength matrix. An effective strategy to lessen the impact that building operations have on the environment is to utilize replacement materials. As part of this research, we're going to perform several tests by making concrete mix for M55 grade concrete and comparing it to the currently used conventional concrete before drawing conclusions from the findings.

1.3 OBJECTIVES
The primary goal of this experiment is to determine if rice husk ash may replace cement as a pozzolanic

ingredient in concrete. However, it is anticipated that adding rice husk ash to concrete would increase its strength. Additionally, it is an effort to create concrete that satisfies the different structural features of concrete, such as compressive strength, by employing rice husk ash as a source material to replace some of the cement. In this experiment, rice husk ash is used to replace 5%, 10%, 15%, and 20% of the cement in concrete of grade M55 in order to test its strength qualities.

2. LITERATUREREVIEW

ALKHALAFandA.YOUSIF(1984) have looked at how rice husk affects the pozzolanic behavior of rice husk ash. They investigated the exact temperature range needed to burn rice husk and produce the requisite pozzolanic substance. They looked at whether, if the rice husk is burned at the right temperature, replacing cement with RHA may be done with no appreciable decrease in compressive strength when compared to the controlled mix.

ISMAILandWALIUDDIN(1996) has experience with the impact of rice husk ash on concrete with high strength. They investigated the impact of replacing cement with rice husk ash (RHA), which can pass through sieves of 200 and 325 microns, on the strength of HSC. Test results showed that when cement was largely substituted by RHA for retaining the same degree of workability, the strength of HSC dropped. They saw that RHA replaced cement at its best.

ABDULLAHIEtal.(2006) In Minna, Nigeria, research was done on the compressive strength of certain commercial sand Crete blocks. Firewood was burned to create rice husk ash (RHA). To ensure their appropriateness for block manufacturing, preliminary examination of the OPC's rice husk ash (RHA) hollow sand Crete block component materials was carried out. He tested the newly prepared combination physically.Crete blocks measuring 150mm x 450mm were cast, cured, and crushed for 1, 2, 7, 14, 21, and 28 days at 0, 10, 20, 30, 40, and 50% replacement levels. He discovered an increase in compressive strength.

M.UDABAI(2009) According to the chemical examination of the rice husk ash, silica content was high (68.12%), which is a very excellent indicator of workability. When cement and water react, calcium hydroxide (Ca(OH)2) is released, and the setting time of paste containing rice husk ash demonstrated low levels of hydration for rice husk ash concrete.

RAMEZANIANPOUREtal.(2010) Conclusion: Rice husk ashes with strong pozzolanic activity are produced when rice husks are burned at temperatures below 700°C.

OBILADEEtal.(2014) RHA should be added in the range of 0–20% as a partial substitute for cement. As the proportion of RHA rose, the concrete's compacting factor values decreased. As the proportion of RHA replacement rose, the bulk densities of concrete decreased. Concrete's compressive strength decreased as the proportion of RHA replacement rose.

SUMITBANSAL(2015) In M30 grade concrete, replacing cement with rice husk ash increased compressive strength by up to 10% across all ages. Both concrete mixtures demonstrated a 3–10% improvement in compressive strength at a 10% rice husk ash level. Compressive strength decreased in all age groups when rice husk ash levels were between 15 and 20 percent.

YOGENDERANTIL(2015)The Compressive Strength of the Concrete with a 10% Rice Husk Ash Content for Different Grades, namely M30 and M60 and at Different Ages, namely 7 days and 28 days, showed a Significant Improvement. For various grades and ages, the increase in compressive strength ranged from 4.23% to 10.93%.

ALEFIYAKACHWALA(2015) The ideal percentage of RHA to apply in order to partially replace cement and improve performance is in the range of 0 to 20%. As the proportion of RHA rose, the concrete's compacting factor values decreased. As the proportion of RHA replacement rose, the bulk densities of concrete decreased. Concrete's compressive strength decreased as the proportion of RHA replacement rose.

HIGHPERFORMANCECONCRETE

The performance strength of a high-performance concrete mix is more than 40 MPa. The major goals of employing high-performance concrete are to decrease the structure's weight, creep or permeability problems, and to increase its longevity. This mixture must be plastic or semi-fluid when it is initially prepared in order to be molded, much as the standard performance concrete mix. High-performance concrete is often sticky and challenging to handle and lay because of its high cement concentration. However, unlike with typical performance concrete, this does not result in cement bleeding.

3. METHODOLOGY

Three grades of RHA will replace 5%, 10%, 15%, and 20% of the cement in this trial. After studying the workability and qualities of new concrete, an investigation into the compressive strength at 7, 14, and 28 days will follow. Specimens were placed in the casting room for 24 hours, after which they were transferred to the water for curing until testing. To assess the workability of concrete, the slump test will be performed. Hardened concrete cubes and cylinders will undergo tests for compressive strength and tensile strength, respectively.

3.1 MATERIALS

3.1.1 CEMENT

It will be utilized ordinary Portland cement (OPC) of grade 43, whose composition and characteristics are in accordance with the Indian standard organization.When compared to 53 Grade cement, 43 Grade cement takes longer to firm up initially. In other words, since the hydration process and heat release are modest, microcracks are far less common and are readily managed by correct curing of the concrete or masonry construction.The usage of 43 Grade OPC is often advised in conventional civil construction work such as residential, commercial, and industrial projects, unless a project demands particularly high strength cement. It is employed in RCC projects, ideally when the concrete grade is up to M-30. Additionally, it is widely utilized in the production of pre-cast objects like blocks, pipes, tiles, etc., as well as asbestos-containing products like sheets and pipes. OPC 43 is currently mostly employed in plastering, flooring, and other non-structural applications where OPC 33 was formerly used since OPC 33 has largely been phased out in the nation.

Table 1 Properties of Cement

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Properties	Values
SpecificGravity	3.12
NormalConsistency	29%
InitialSettingtime	65min
FinalSettingtime	275min
Fineness	330kg/m2
Soundness	2.5mm
BulkDensity	830-1650kg/m3

3.1.2 WATER

Water is crucial to the creation of concrete because it initiates the interaction between the cement, pozzolan, and aggregates. It aids in hydrating the mixture. The primary component is water, which when combined with cement creates a paste that holds the aggregate together. Concrete hardens as a result of hydration, which is a process caused by the water. The primary chemical constituents of cement undergo a chemical process known as hydration, which results in the formation of hydrates, also known as hydration products.

3.1.3 FINEAGGREGATE

One of the main components of concrete, fine aggregate, has a significant impact on the design of the concrete mix. The proportions of the concrete mix are influenced by a number of variables, including the fine aggregate fineness modulus, moisture content, specific gravity, and silt content. The fineness modulus defines the quantity of fine aggregate needed in a certain mix design.The mix percentage is significantly influenced by the fine aggregate moisture content. It details how much water may be added or taken away from the combination. Without the fine aggregate's specific gravity, mix design for concrete cannot be completed, and concrete with a greater specific gravity was stronger.

3.1.4 COARSEAGGREGATE

Concrete is made from coarse aggregates, which are granular and uneven materials like sand, gravel, or crushed stone. Coarse is often found in nature and may be produced by blasting quarries or crushing them manually or using crushers. Before utilizing them to make concrete, they must be thoroughly cleaned. Their strength and angularity have a variety of effects on the concrete. It goes without saying that choosing these aggregates is a crucial step.

3.1.5 RiceHuskAsh(RHA)

It took around 72 hours for rice husk ash to burn in the open air in an uncontrolled manner. 400 to 600 °C was the temperature range. The recovered ash was gray in color after being sieved through a standard-sized sieve. You may mix the rice husk ash with regular Portland cement. OPC may be substituted with a certain proportion of rice husk ash.

Industrial Engineering Journal
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Fig.1 Rice Husk Ash

Table2PhysicalPropertiesOfRiceHuskAsh

S.No.	Particulars	Properties
1	Colour	Gray
2	ShapeTexture	Irregular
3	Mineralogy	Non-Crystalline
4	ParticleSize	<45Micron
5	Odour	Odourless
6	SpecificGravity	2.3
7	Appearance	VeryFine

Table3ChemicalPropertiesofRiceHuskAsh

S.No.	Particulars	Properties
1	SiliconDioxide	86.94%
2	Aluminumoxide	0.2%
3	IronOxide	0.1%
4	CalciumOxide	0.3-2.2%
5	MagnesiumOxide	0.2-0.6%
6	SodiumOxide	0.1-0.8%
7	PotassiumOxide	2.15-2.30%

3.1.6 SUPERPLASTICIZER:

High range water reducers, commonly referred to as superplasticizers (SPs), are additives used in the production of high strength concrete. Chemical substances known as plasticizers make it possible to produce concrete with around 15% less water. Superplasticizers provide a 30% or more decrease in water content. These additives are used at a few weight percent level. Concrete's cure is delayed by plasticizers and superplasticizers. Superplasticizers may generally be divided into four categories: sulfonated synthetic polymers, carboxylate synthetic polymers, and synthetic polymers with mixed functionality. cementitious substances.

Fig2Superplasticizer

Here is a general overview of the Project.

• Purchasing rice husk ash from rice vendors.
• Laboratory examination of the specific gravity, physical condition, particle size, odor, color, and other properties of rice husk ash.
• Creation of the M55 grade mix design utilizing the 2019 IS code 10262.
• The creation of various concrete mixtures with 5%, 10%, 15%, and 20% substitution of cement by rice husk ash.
• A comparison of the compressive and tensile strengths of the resulting concrete mix with currently used conventional concrete.

3.2 VARIATION IN CONCRETE PROPERTIES WHEN RICE HUSK ASH IS USED:

Concrete may be made into an environmentally friendly additional cementitious material by adding rice husk ash to it. With the inclusion of rice husk, the following characteristics of the concrete are changed:

Hydration loses some of its heat. This alone aids in drying shrinkage and enhances the concrete mix's durability.The decrease in the concrete structure's permeability. This will aid in the penetration of chloride ions and prevent the structure's concrete from disintegrating.The resistance to sulphate and chloride attacks has increased.The calcium hydroxide and rice husk ashes in the concrete react to produce additional hydration products. Calcium hydroxide usage will reduce the reactivity of chemicals from the environment.

4. Results & Discussion

4.1 STIPULATIONSFORPROPORTIONING(M55Gradeconcrete)

Gradedesignation:M55
Typeofcement:43gradeOrdinaryPortlandCement
MaximumnominalsizeofCoarseAggregate:20mm
Maximumwatercementratio:50asperTable5ofIS456:2000
Workability:75mmslump
Exposurecondition:Moderate(ForReinforcedConcrete)
Methodofconcreteplacing:Manual
DegreeofSupervision:Good
TypeofAggregate:CrushedAngularAggregate

TESTDATAFORMATERIALS

Cementused:53gradeOrdinaryPortlandCement
Specificgravityofcement:3.15
SpecificgravityofCoarseaggregate20mm:2.72
SpecificgravityofFineaggregate:2.68
SpecificgravityofRHA:2.18
WaterAbsorption:
Coarseaggregate20mm:0.47%
Fineaggregate:0.9%
Theslumpfor53Gradecement=75mm

4.2 COMPRESSIONTESTRESULTS

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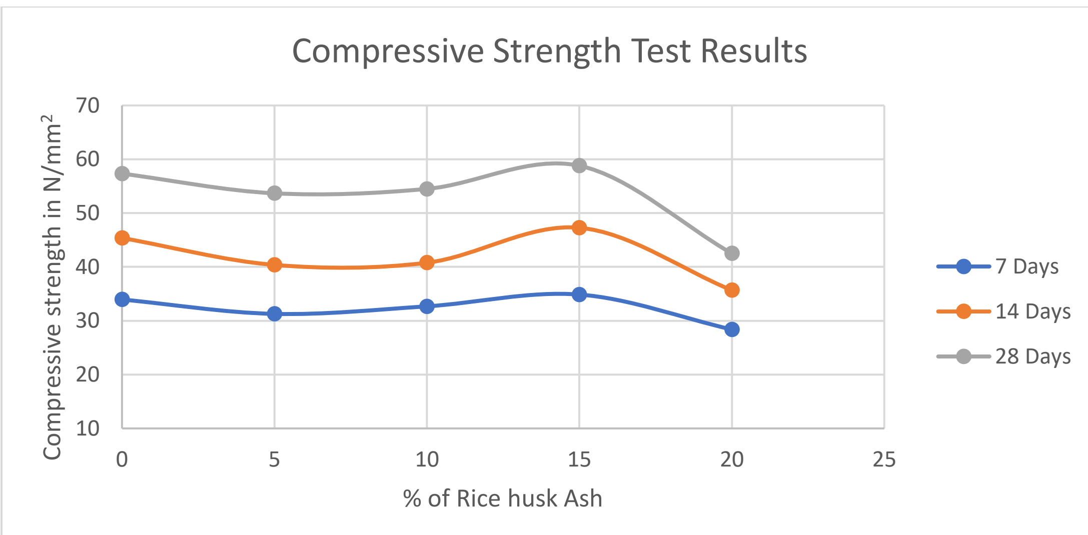
FollowingarethetestresultsobtainedfromtheCompressionTestonconcretecubesafter7,14and28days respectively.

Table4Compressive Strength Results

% Of Rice Husk Ash	Compressive Strength in N/mm2		
	7 Days	14 days	28 Days
0%	33.95	45.38	57.34
5%	31.28	40.38	53.68
10%	32.68	40.78	54.5
15%	34.87	47.28	58.8
20%	28.38	35.67	42.5



Graph.1Graphforcompressivestrengthofcubesfordifferentpercentagesof Ricehuskashfor7&14&28days

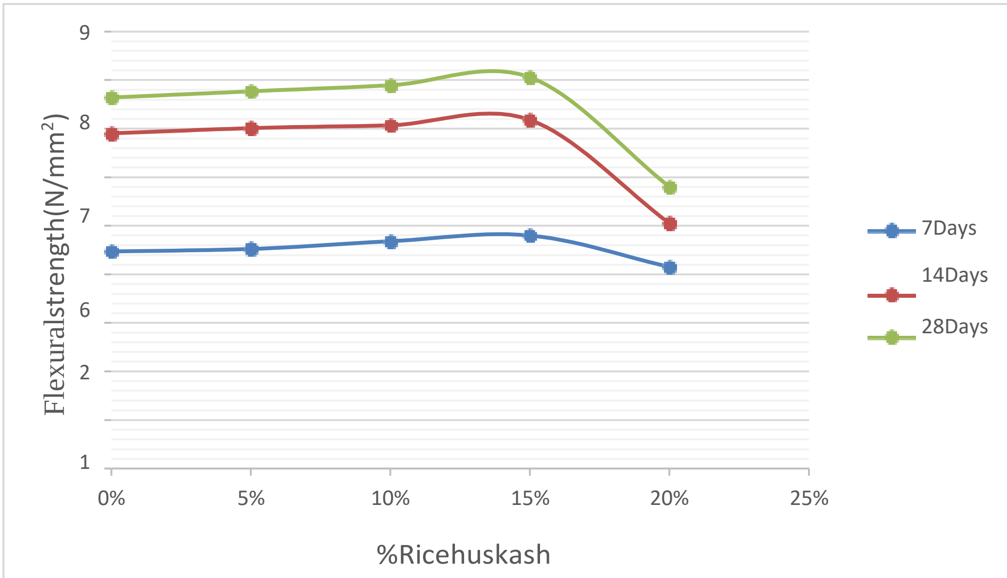
The graph above illustrates the compressive strength of samples at different ages, i.e., 7, 14, and 28 days, with various proportions of rice husk ash, i.e., 0%, 5%, 10%, 15%, and 20%. The graph reveals the maximum compressive strength of concrete on 28 days at 15% replacement of cement with rice husk ash as when it is again replaced with 20% of rice husk ash, the compressive strength of the concrete decreases because rice Since we are aware that the rice husk ash mix concrete has a quick setting period, the concrete blocks are becoming stronger as the number of days they have been curing grows. The graph increases gradually between days 7 and 14, and it reaches its maximum compressive strength on day 28 when cement is 15% replaced with rice husk ash.

5.2FLEXURALTESTRESULTS

Followingarethetestresultsobtainedfromthe FlexuralTestonconcretebeams after 7,14and28 daysrespectively.

Table5Flexural Strength Results

% Of Rice Husk Ash	Flexural Strength in N/mm2		
	7 Days	14 Days	28 Days
0%	4.47	6.9	7.64
5%	4.52	7.01	7.77
10%	4.68	7.07	7.89
15%	4.8	7.18	8.06
20%	4.15	5.05	5.8



Graph2.Graphforflexuralstrengthofbeamsfordifferentpercentagesofricehuskashfor7,14,28days

It was observed that the strength reduced once the replacement was more than 15% complete. Since the specific gravity of rice husk ash is lower than that of cement, it seems that at and above 15% replacement level on equal weight basis, surface area of mix was enhanced owing to addition of rice husk ash.It shown that the delayed hydration process caused by the addition of more rice husk ash to concrete boosted the rate of strength at young ages.The trend after 28 days, however, was not the same as the trend at 7 days. The rice husk ash cement concrete's strength at 28 days of curing exceeded that of the reference concrete by up to 15% replacement level.In the current investigation, it was also shown that the created mix was sticky up to 15% replacement level. The mix's workability and finish ability declined over a 15% replacement level. Since more water was available for lubrication, the thick sticky mixture may have resulted from rice husk ash particles' ability to fill holes between fine aggregate particles and operate as a binding agent up to 15% replacement level.53 Grade OPC is shown to have the lowest increase in setting times at each replacement level. The finer the 53 Grade OPC is compared to cement, the more quickly it hydrates because there is more surface area available for chemical reaction. This causes early hardening and strength development.

5. CONCLUSION

The study's findings allow for the following conclusion to be drawn.

• For M55 grade concrete, rice husk ash may substitute cement up to 15% of the time to boost compressive strength. At 28 days, the compressive strength decreased from 20%.

• Concrete with 15% rice husk ash by weight of cement produces the best results when compared to 0%, 5%, 10%, and 20%.

• Up to 15% of the cement in M55 grade concrete may be replaced with rice husk ash to boost flexural strength. At 28 days, the flexural strength had decreased by 20%.

• For concrete of the M55 grade, the maximum replacement amount of rice husk ash was 15%.

• By completing this project, we were able to cut the cement content of ordinary concrete by 15%.

The long-term binding strength of masonry mortar may be increased by adding rice husk ash. The masonry bond strength is greatly increased when rice husk ash is used in lieu of some of the standard Portland cement.Through this investigation, we came to the conclusion that rice husk ash would make an inventive addition to building materials.

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