iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** IV **Month of publication:** April 2024

DOI: https://doi.org/10.22214/ijraset.2024.60457

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Investigation on Partial Replacement of Cement with Rice Husk Ash

Dr. A. Krishna Rao[1], B. Prasad[2], M. Saicharan Goud[3], M. Manish[4], S. Umesh Kumar[5], N. Sushanth Varma[6]
[1]*Department of Civil Engineering, CMR College of Engineering & Technology(A), Kandlakoya(V) Medchal District, Hyderabad – 501401, Telangana State, India*
[2, 3, 4, 5, 6]*UG Student, Department of Civil Engineering, CMR College of Engineering & Technology(A), Kandlakoya(V), Medchal District, Hyderabad-501401, Telangana State, India*

Abstract: ***To reduce the amount of carbon-dioxide which is released by cement, we came up with the project "Investigation on Partial Replacement of Cement with Rice Husk Ash". Due to wide use of cement the environmental pollution is increasing day by day, therefore the Rice Hush Ash contains different types of physical and chemical properties. Because Rice Husk Ash is an By-product and a waste material. The rice husk is converted into rice husk ash by burning in the temperature between 500-650 degree Celsius. Materials are used in the project are Cement, Rice Husk Ash, Coarse Aggregate, Fine Aggregate, Superplasticizer, Sodium Silicate (Na2Sio3) And Sodium Hydroxide (NAOH). Tests are performed in the project to determine strength of concrete are compression test, split tensile strength test, flexural strength test.***
Keywords: Rice Husk Ash, Sodium Silicate & Sodium hydroxide, Superplasticizer.

I. INTRODUCTION

The construction industries relays heavily on conventional materials such as cement, sand and coarse aggregate for production of concrete. The quality of concrete is determined by concrete paste/mix. It is the world's most consumed manmade material. It is an great versality and relative economy in filling wide range of needs has made it a competitive building material.10,20 percentages of partial replacement will be performed in this project. By using all this materials we will mix a paste and we will pour concrete in cubes, cylinders, beams. While pouring we have to compact thoroughly at-least 3 times. The chemicals will be taken in water cement ratio. The cubes, cylinders, beams before pouring, oil should be applied thoroughly. After pouring concrete in cubes, beams, cylinders place it aside to dry at-least 24 hours. Then after drying remove the equipment carefully and place the cubes, cylinders, beams in water for getting strength. After 7 days and 14 days, test results to determine the strength the concrete. Finally, the values of compression strength test, split tensile strength test, Flexural strength test will be determined.

II. MATERIALS USED

1) *Rice Husk ASH:* Is a byproduct generated during the combustion of rice husks, which are out layers of rice grains. When rice husks are burned under controlled conditions, they produce ash as a residue. RHA contains typically high levels of silica, making it valuable for various industrial applications. RHA contains pozzolanic properties, due to this it improves strength and durability of concrete.
2) *Cement:* Is a powdery binding material used in construction to adhere other materials together. When it mixed with the water, it forms a paste that hardens and binds aggregate like sand and gravel to create concrete. Cement plays a critical role in various construction applications, including building foundations, roads and structures.
3) *Coarse Aggregate:* Is also known as gravel or crushed stone, is a granular material with particle sizes ranging from approximately 5 mm to 20 mm in diameter. It is a key component of concrete along with sand, cement and water. Coarse aggregate provides bulk and stability to concrete mixes, enhancing its strength and durability.
4) *Fine Aggregate:* Commonly referred to as sand, is a granular material with particle sizes ranging from 0.075 mm to 4.75 mm. It plays a crucial role in concrete by filling voids between coarse aggregate particles and binding them together as cement paste. Fine aggregate enhances concrete's workability, strength and durability, serving as an essential component in construction projects.
5) *Sodium Silicate:* also known as water glass or liquid glass, is a compound composed of sodium oxide(Na2o) and silicon dioxide(Sio2). It is a colourless, viscous liquid or solid, depending on its concentration. Sodium silicate is soluble in water and forms a gel when mixed with acids, such as sulphuric acid.

6) *Sodium Hydroxide:* NAOH is a powerful alkali compound, commonly known as caustic soda. It is highly corrosive, capable of causing severe burns and extensively used in industrial processes, cleaning products, and the food industry as a pH regulator.
7) *Super Plasticizer:* is a chemical additive used in concrete mixes to increase its fluidity and workability without sacrificing strength. By dispersing cement particles more efficiently, it allows for easier placement and compaction concrete, reducing the water to cement ratio. This results in improving concrete performance, enhanced durability, and potentially reduces construction time and costs.
8) *Molarity:* Water cement ratio will be quantity of cement multiplied by 0.5 where in place of water, NAOH and NA2SIO3 will be used for concrete mix.

III. EXPERIMENTAL INVESTIGATION

In this section we will describe about the production of concrete and testing the specimen and test procedure will be explained.

A. Mix Design

In this study mix design of concrete will be M20 grade of concrete. For each mix 6 cubes, 6 beams, 6 cylinders were produced as samples for testing. The calculation of mix proportioning is given below. For M20 grade of concrete as per IS 10262: 2019.
Concrete ratio = 1:1.5:3(cement: fine aggregate: coarse aggregate), for 1 meter-cube of concrete we required quantity of cement, fine aggregate, coarse aggregate = 46kg, 81kg, 147kg. Water cement ratio will be cement quantity multiplied by 0.45 and superplasticizer will be 1.5% of mass binder is used. Based on this proportions test samples are prepared.

B. Preparation of alkaline activator

Is prepared 24 hours before casting preparation of NAOH solution of sodium hydroxide and sodium silicate is dissolved in water and mixed together. Preparation of samples and curing for compressive strength test total cubes are prepared for the test in the age of 7 days,28 days. For split tensile test 6 cylinders are prepared for the test on the age of 7 days and 28 days. Specimen size of cube is 150mm * 150mm * 150mm, size of cylinders is 150mm * 300 mm and size of beam is 750mm * 150mm *150mm. All these samples will be curing in the water, after removing the samples.

C. Tests on Hardened Concrete

Mechanical properties are compressive strength test, split tensile test and flexural strength test are done.

D. Compressive Strength Test

This test is tested on hydraulic compressive testing machine as per the code book IS 516:1969. The compressive strength of the ability of the concrete to withstand specific compressive forces depends on water to binder ratio, binder strength quality of concrete material and quality control during production of concrete. Concrete is prepared according to the mix proportion oil is applied to the inner surface of the mould. For each layer 25 blows are done by using tamping rod level the surface of the mould after one day specimen is removed from mould and cured under the ambient curing at room temperature after 7 days the specimen is placed the compression testing machine instruction is adjusted such that plate surface touches the top surface of the specimen the load is applied up to the specimen fails. Note down the readings at which load specimen fails. Test is done for 7 days and 28 days.

E. Split Tensile Test

Is obtained by applying a compressive force along the length of the cylinder specimen. This test is tested on hydraulic compressive testing machine as per the code book IS 516:1969. Fresh concrete is prepared according to the mix proportion. Cylinder specimen is used for this test, oil is applied to the inner surface of the cylinder then concrete is poured into the cylinder mould into 3 layers each is tamped 25 times by tamping rod. Level the surface of the specimen, remove the specimen after 24 hours the cylinder specimen is tested under hydraulic compressive machine at the age 7 days, 28 days.

F. Flexural Strength Test

Is the indirect calculation of tensile strength of concrete. This test is tested on flexural strength test machine as per the code book IS 516:1969. The standard size of the beam is 750mm * 150mm* 150mm. The inner surface of the beam mould is applied by oil. The concrete is poured into the beam mould into 3 layers each layer is tamped by 25 times by using tamping rod. Level the surface of the mould, remove from the mould after 24 hours the beam is test for 7 days, 28 days. The beam is placed at the surface of flexural testing machine and load is applied up to the failure of specimen.

IV. RESULTS

Table -1: Results of Compressive Strength of the concrete for 7 days, 28 days.

Replacement of RHA	7 days Compressive strength MPa	28 days Compressive strength MPa
10	17.26	31.72
20	19.89	33.5

Graph-1 : Compressive Strength Test

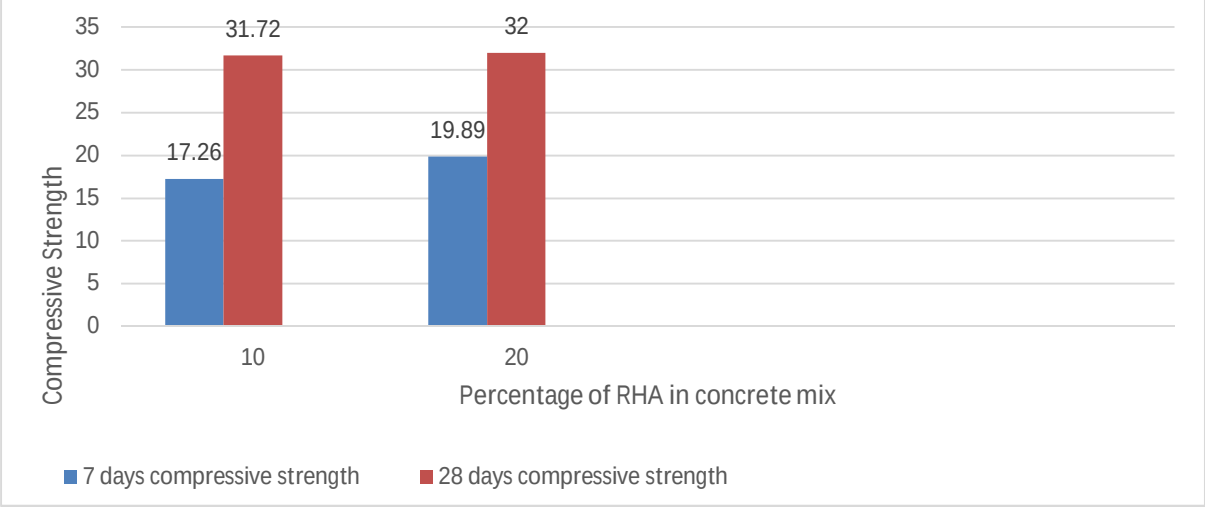


Table-2: Results of Split Tensile Strength of concrete for 7days, 28 days.

Replacement of RHA	7 days of Split Tensile Strength in MPa	28 days of Split Tensile Strength in MPa
10	1.289	1.677
20	0.950	0.961

Graph-2: Split Tensile Strength Test

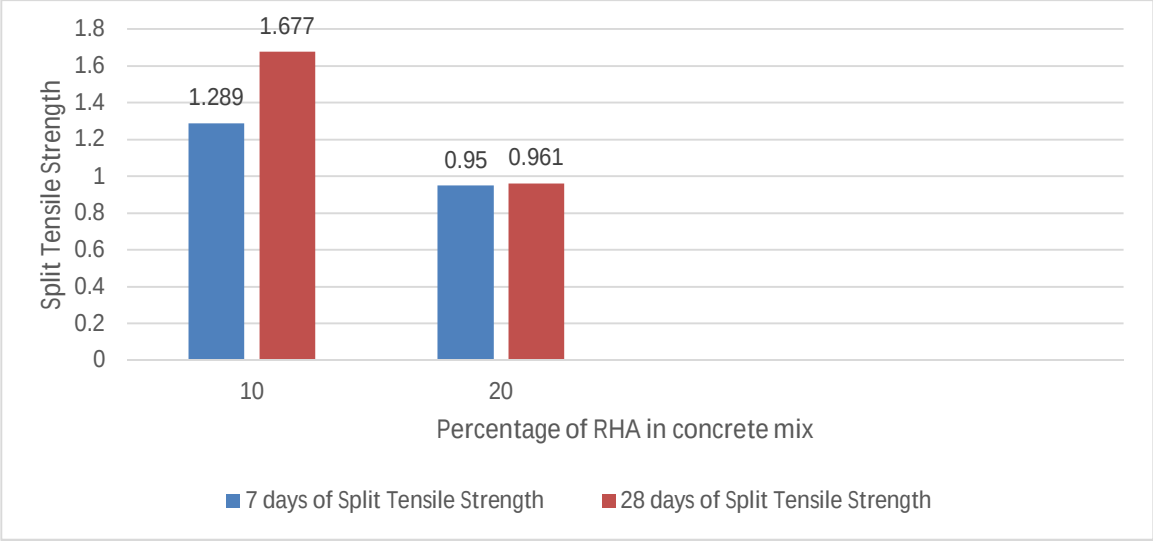
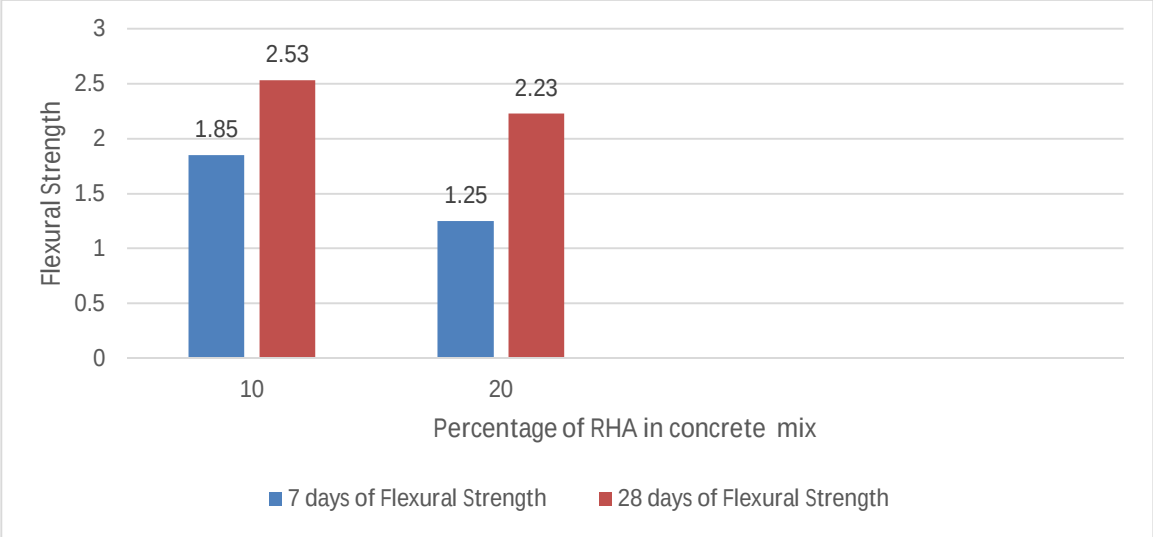


Table-3: Results of Flexural Strength of concrete for 7 days, 28days.

Replacement of RHA	7 days of Flexural Strength in MPa	28 days of Flexural Strength in MPa
10	1.85	2.53
20	1.25	2.23

Graph-3: Flexural Strength Test:



V. CONCLUSION

The conclusions are observed from above following Experimental Investigation.

1) The compressive strength of conventional concrete at 28 days of 20% is 33.5MPa and 10% rice husk ash concrete is 31.72 MPa, 20% shows better improvement compare to other percentage.

2) The split tensile strength of conventional concrete for 28 days of 10% is found to be 1.677MPa and that for 20% rice husk ash concrete is 0.961MPa. 10% shows that improvement compare to other percentage.

3) The Flexural Strength of conventional concrete at 28 days of 20% is 2.53MPa and 10% rice husk ash concrete is 2.23MPa, 10% shows better improvement compare to other percentage.

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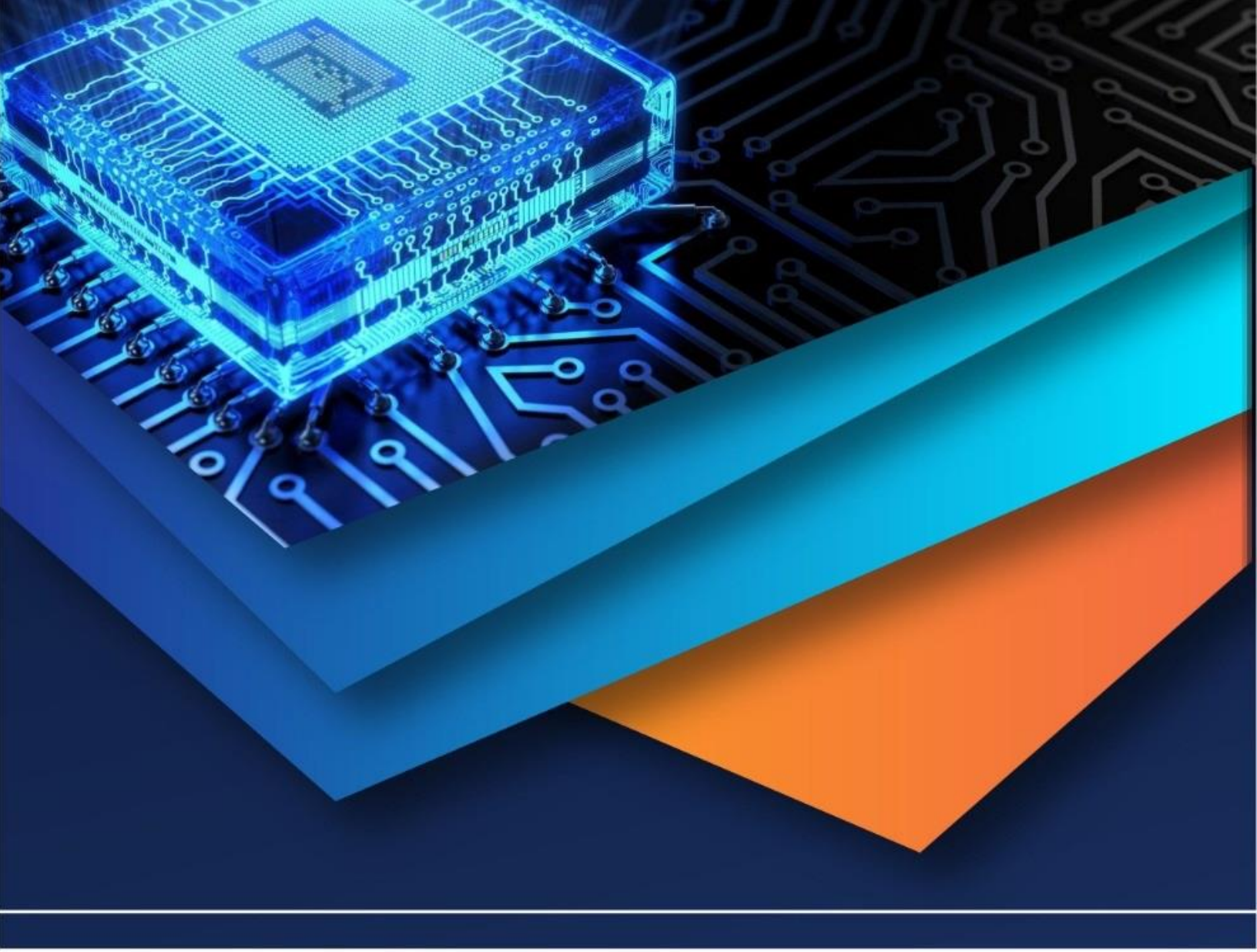

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