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Behaviour of Green Concrete (Blended Concrete) using Agro-Industrial Waste AS Partial Replacement of Cement

Vishakha Namdharani[1], Aditi Mutatkar[2], Hrutuja Tamore[3], Priyanka Purohit[4], Prof. Ashwini Shanbhag[5]
DEPT: Civil Engineering, Thakur College of Engineering and Technology, Mumbai, Maharashtra

Abstract: Rapid urbanisation has increased demand for natural resources, and industrialised nations' agricultural waste disposal problems have made it possible for agricultural waste to be utilised in building. Research is being done on how to use agricultural or industrial wastes as a source of building materials to support the construction industry all over the world. In addition to being feasible, using these wastes would also produce an environment free from contamination. For financial, environmental, and specialist reasons, waste reduction research has focused on the use of agricultural and mechanical waste provided by current processes. There is an urgent need for waste management solutions since agricultural and industrial wastes like sawdust and rice husk ash are seriously impacting the environment. The initial step of the project will include creating blended cement from agro-industrial waste and evaluating its properties using various mix proportions. Then, using mixed cement, green concrete will be produced.
Keywords: Agro-Industrial Waste, Blended Cement, Concrete, Sawdust and Rice Husk Ash.

I. INTRODUCTION

Green concrete, commonly referred to as sustainable concrete, is a variety of concrete made with eco-friendly components. Green concrete can be made with agro-industrial waste, such as rice husk ash, sawdust ash, sugarcane bagasse ash in place of some quantity of cement. The act of dumping or possibly insufficient garbage management from many assembling segments has had a considerable impact on the environment in recent decades, despite the waste management systems that have been widely and universally embraced. These strategies also entail a monetary expense. In any case, correctly managed trash can be made into a resource that contributes to raw material investments, safeguards the environment, and fosters economic growth. By reducing the amount of concrete needed and so reducing CO2 emissions, the development of novel solid additive chemicals could produce a more grounded, more functional material. Because it makes a great building material for both straightforward street development and more alluring projects, cement is employed in such enormous quantities. The initial investigation work will be done to make mixed concrete utilising agro-mechanical waste and discover the qualities of the best mixed bond from different blend extents. After that, utilising Agro Waste and a few modifications, then green solid will be created for testing. This study analyses the effects of rice husk ash on cement by partially substituting concrete at a few weight proportions. In order to identify the ideal mixes, the exploratory study examines the split stiffness, compressive quality, and flexural quality of mixed cement. Waterway sand, coarse total, and mixed concrete make up the majority of the fixes.

II. MATERIALS AND IT'S PROPERTIES

A. Rice Husk Ash

Rice husk ash (RHA) is a by-product of burning rice husks, the outer layer of rice grains as shown in Fig.2.1. RHA has a high mineral and silica concentration, making it useful for a range of applications. The following are some characteristics of rice husk ash:

1) *Chemical Make-up:* Silica (SiO2) makes up the majority of RHA, with trace amounts of other minerals like potassium, salt, magnesium, and calcium.
2) *High Silica Content:* RHA has a high silica content of over 90%, making it a useful source of amorphous silica for a variety of applications.
3) *Pozzolanic Properties:* RHA has pozzolanic properties that allow it to interact with calcium hydroxide in the presence of water to form calcium silicate hydrate (C-S-H), which increases the tensile strength and long-term viability of concrete.

The source of the rice husks and the conditions under which they were burned are just two examples of the variables that might affect the specific gravity of rice husk ash (RHA). RHA's specific gravity, on the other hand, normally falls between 2.0 and 2.5 as shown in Table.2.1.

Despite encouraging its use, IS 456-2000 [8] does not specify how much rice husk ash should be added to concrete. The method and temperature of burning have an effect on the chemical makeup of rice husk ash. As the burning temperature rises, there is a rise in the amount of silica in the ash.

SR NO.	TEST CONDUCTED	TEST OUTCOMES
1.	Specific Gravity	2.14 g/cc
2.	Consistency	40%
3.	Initial Setting Time	11760 secs
4.	Final Setting Time	15600 secs

Table 2.1: Rice Husk Ash's Physical Qualities

Fig.2.1 Rice Husk Ash

III. EXPERIMENTAL WORK

This chapter presents the ideas behind experimental work. The procedures for testing the workability of fresh concrete, hardened concrete, and normal Portland cement, as well as sawdust and rice husk ash, are all described, as are the testing objectives. There were various sawdust and rice husk ash ratios, as well as mixtures, employed, ranging from 0% to 20%. Each mix had the same amount of waste.

IV. TEST OUTCOMES

A. Compressive Strengths

1) *Rice Husk Ash:* When rice husk ash was completely removed, the compressive strength was rather low. As the replacement level was increased, the compressive strength value fell. They made the connection between greater porosity and a decrease in compressive strength, which was corroborated by rice husk ash's higher water need. On the other hand, rice husk ash performed better at filling up the minuscule spaces between the cement granules.

V. METHODOLOGY

A comparison between the RHA/SDA concrete made by replacing cement with raw RHA/SDA in varying percentages and a control concrete of a certain grade. This study's main objective is to look at the characteristics of RHA and SDA.

1) Its effect on workability when replacing cement with RHA/SDA in different quantities with cement in a mix design
2) Impact on concrete's compressive strength
3) Determine the RHA/SDA dosage that should be used in the concrete mix.

A single batch of standard Portland cement in 53 grades was used to accomplish the entire job, although it had to be maintained in airtight containers to prevent exposure to ambient moisture and monsoon humidity. Chemical and physical criteria were tested in compliance with IS: 4032-1977 and IS: 12269-1987, respectively as shown in Table.5.1.

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A. Properties of Cement

SR.NO	PROPERTY	VALUE
i.	Normal consistency	33 mm
ii.	Setting times	
	Initial (Minutes)	85
	Final (Minutes)	240
iii.	Fineness of cement	7 %
iv.	Compressive Strength	
	7 Days	40.35 Mpa
	28 Days	54.60 Mpa

Table.5.1: Properties of Cement

B. Preparation of Testing Specimen

1) Mixing

Fig.5.2.1 Mixing of materials

Ingredients are mixed in a pan mixer with a capacity of 40 litres as shown in Fig.5.2.1. The aggregate is added and blended following complete mixing of the cementitious components, and then water is slowly added and mixed. The mixture is acceptable for casting once the wet mixing process has produced a homogeneous colour and consistency. Before casting the specimens, a compaction factor test was used to assess the mixtures' workability.

Fig.5.2.1.1 Mixing of materials

2) Preparation of Specimens

Fig.5.2.2 Preparation of materials

Mineral oil is used to clean the cast iron moulds of dust particles before concrete is poured into them as shown in Fig.5.2.2.1. On a flat surface, the moulds are placed and used. The moulds are put on a vibration table after being filled with properly mixed concrete. Extra concrete was removed and disposed of, and the top surface was polished to a level and smooth finish in compliance with IS 516-1969. The specimens' cure After casting, the specimens are left at room temperature for about 24 hours without being touched. The samples are then taken out of the moulds and swiftly placed in various curing environment tubs, where cubes are cured in fresh water.

Fig.5.2.2.1 Preparation of moulds

3) Casting

Fig.5.2.3 Casting of cubes

Apply oil to the moulds after cleaning. Layers of concrete around 5 cm thick should be placed inside the moulds as shown in Fig.5.2.3. With the tampering rod (a steel bar having a 16 mm diameter and 60 cm long), compact each layer with at least 35 strokes each layer. (Bullet aimed towards bottom)

Fig.5.2.3.1 Setting of materials

4) Curing

The initial batch of 12 test samples is kept in the moist environment for 24 hours (Fig.5.2.4); following that, the samples are labelled, removed from the moulds, and kept immersed in clean, fresh water until they are removed for the test.

Fig.5.2.4 Curing of cubes

5) Marking of Cubes

In order to test the strength of concrete, concrete cubes must be marked.

- On the top of the cube, mark the date of casting, cube identification number, and mix designation with a marker (Fig.5.2.5)
- For a predetermined period of time, typically 7, 14, or 28 days, allow the cubes to set and solidify in a curing room or below wet burlap or plastic.
- After the allotted curing time has passed, remove the cubes from the curing conditions and wipe off any extra moisture or water that may have accumulated on their surfaces.

Fig.5.2.5 Marking of cubes

6) Testing of Specimens

A material's capacity to sustain a compressive load without being crushed or distorted is known as its compressive strength. A conventional concrete cube or cylinder specimen with defined dimensions—typically 150 x 150 x 150 mm or 100 x 200 mm—is compressed to determine the strength. Once within the testing device as shown in Fig.5.2.6, the specimen is subjected to an ever-increasing compressive force until it breaks. Compressive strength of the concrete, measured in units of pressure and typically expressed in megapascals (MPa) or pounds per square inch (psi), is the maximum load that the specimen can withstand before failing.

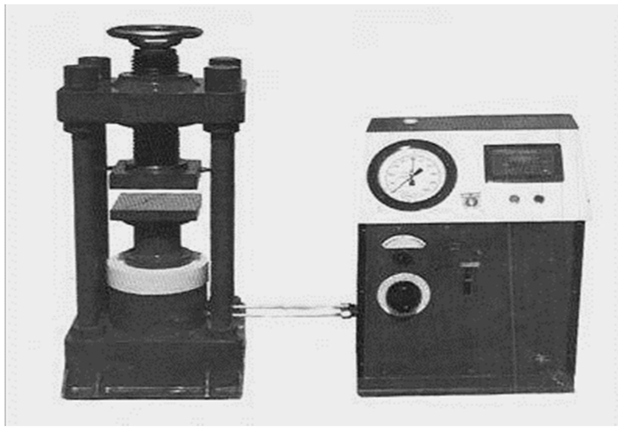

Fig.5.2.6 Compression Testing Machine

To guarantee that specimens are properly tested on the due day and time, there is a timetable for when samples are tested. According to IS 516-1959, the cast specimens must be examined right away after being taken out of the curing tubs and wiped dry of surface water. Compressive strength and workability durability of the specimens are tested. With CTM, it is possible to determine a cube's compressive strength (Compression Testing Machine)

VI. RESULTS

Compressive Strengths (N/mm2)				
Days	0%	5%	10%	15%
7	16	12	10	8
28	22	17	22	21

Table.6.1

VII. CONCLUSION

Following conclusion can be made on the limited testing and results, refer Table.6.1.

1) Comparing the compressive strength values of the 5%, 10%, RHA combinations to the normal concrete mix, there is no appreciable drop.
2) In comparison to all other concrete mixes, the compressive strength values of the 0-15% replacement combinations revealed maximum strength.
3) Concrete samples with 20% replacement had the lowest strength values.
4) As a waste product, rice husk ash lowers the cost of building.
5) The emission of greenhouse gases can be significantly reduced by substituting this rice husk ash for cement. As a result, there is a better chance of obtaining more carbon credits.

Overall, depending on the type and quantity of waste utilized, the behaviour of green concrete that uses agro-industrial waste as a partial replacement for cement can vary. Green concrete can, however, have a number of advantages if it is created and constructed appropriately, including a lower cost, increased durability, and less environmental effect. The data that support the findings of this study are available from the corresponding author, [V N], upon reasonable request.

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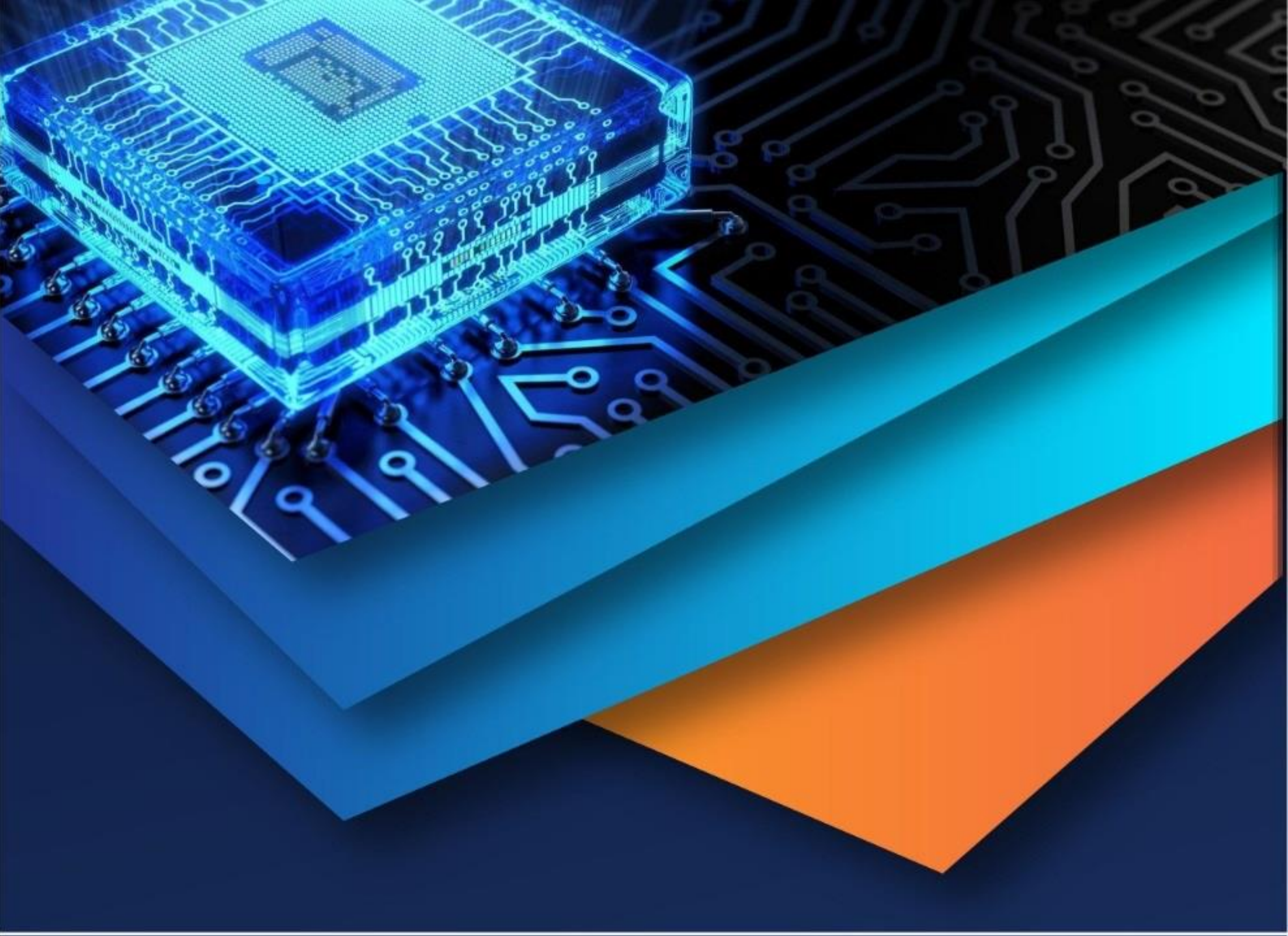

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