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Effect of Partial Replacement of Cement with Wood Ash on Concrete Block

Mr. Sri Ruban. D[1], Ashok. S[2], Logeshwaran. V[3], Nandhini Sri. R[4], Naveen Kumar. M[5]
Assistant Professor, Department of Civil Engineering[1]
UG Students, Department of Civil Engineering[2,3,4,5]
Sri Shakthi Institute of Engineering and Technology, Coimbatore, India

Abstract: *Concrete is a mixer of various materials. These materials include water, cement, and aggregates. These materials include water, cement, and aggregates develop substitute materials for cement. It reduces both greenhouse emissions and the cost of concrete. In this work, an endeavor has been made to utilize wood-ash as a substitute material to cement. The effect of wood-ash as a alternative to cement on the performance of concrete has been studied. Wood is a sustainable source for energy and eco-amiable material. The cement has been replaced with wood ash by 10%, 15%, 20%, and 25%,and studied for the performance of concrete. Results confirm that the wood-ash addition as a partial alternative to cement improves the overall performance of concrete.*

Keywords: Wood-Ash, Strength, Water absorption

I. INTRODUCTION

The construction sector is a major user of cement, playing a crucial role in global carbon emissions because of the energy-demanding process involved in cement manufacturing. To reduce the environmental effects of cement manufacturing, alternative substances that can partially substitute cement have attracted growing interest. One example of this material is wood ash, which is a byproduct of burning wood in different industrial processes like biomass power generation, as well as agricultural practices such as rice milling.

Wood ash comprises multiple oxides such as calcium oxide (CaO), silica (SiO2), alumina (Al2O3), and iron oxide (Fe2O3), all of which are essential constituents in cement. These substances allow wood ash to function as a pozzolanic material, indicating it can react with calcium hydroxide (originating from cement) when water is present, creating extra cementitious compounds that enhance the strength of the concrete.

The substitution of cement with wood ash not only aids in lowering the carbon emissions from cement production but also offers a sustainable approach to using waste materials that would typically be thrown away. Additionally, wood ash is an affordable material, and incorporating it into construction can reduce the cost concrete.

II. OBJECTIVE

- To Enhance sustainability by decreasing the carbon emissions from cement manufacturing.
- To Improve concrete characteristics like strength, longevity, and ease of use.
- To Use byproducts (wood ash) to reduce ecological footprint.
- To Reduce production expenses by substituting some cement with an inexpensive material.
- To Identify the ideal quantity of wood ash for optimal concrete performance.

III. METHODOLOGY

The approach for the project involving partial substitution of cement with wood ash will comprise multiple stages, such as choosing materials, creating concrete blends,

conducting tests, and evaluating outcomes. The procedure aims to guarantee the systematic assessment of concrete performance with different amounts of wood ash substituting cement.

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1. Material Selection and Preparation

Cement: The primary material for the concrete mixes will be Ordinary Portland Cement (OPC)

Wood Ash: Wood ash will be obtained from a nearby biomass power facility, agricultural processing units, or regulated combustion of wood. The ash will be screened to eliminate larger particles and achieve a smooth, consistent texture, essential for its pozzolanic activity.

Fine Aggregate: Sand that complies with standard specifications (e.g., IS: 383) will be utilized for mixing concrete..

Coarse Aggregate: For the concrete blend, crushed stone of consistent size (e.g., 20 mm) will be utilized

Water: Purified, drinking water devoid of contaminants will be utilized for mixing.

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2. Mix Design

The design mix will adhere to the Design Mix Method per standard standards (e.g., IS: 10262) to guarantee the concrete achieves the required workability and strength.

The initial mix (0% wood ash) will be created first, followed by substituting varying percentages of cement with wood ash, increasing in increments of 10%, 15%, 20% and 25% by weight.

The water-cement ratio will remain unchanged across all mixes, and modifications to the mix will be implemented to preserve workability Mix Proportions:

Control Mix (0% wood ash): 1 part cement: 2 parts fine aggregate: 3 parts coarse aggregate.

Proportions for Mixing:

Control Mix (0% wood ash): 1 part cement, 2 parts fine aggregates, and 3 parts coarse aggregates.

Wood Ash Substituted Mixtures:

- 10% wood ash: 90% cement, with 10% wood ash.
- 15% wood ash: 85% cement, with 15%from wood ash
- 20% wood ash: 80% cement, 20% wood residue
- 25% wood ash: 75% cement, 25% wood ash

:

3. Preparation of concrete mixtures

Measure the materials (cement, wood ash, aggregates, and water) as per the specified ratios.

Thoroughly blend the dry components (cement, wood ash, and aggregates) in a mechanical mixer.

Slowly incorporate the necessary water while stirring continuously until a uniform mixture is achieved.

The slumps test will be utilized to verify the workability of each mixture, confirming that it stays workable for casting purpose.

4. Casting of Concrete Specimens

Concrete samples will be prepared in standard molds (e.g., 150 mm cubes for compressive strength testing, 100 mm x 100 mm x 500 mm beams for flexural strength testing).

Each mixture will be prepared in triplicates to ensure consistency and reliability of results.

The molds will be filled with the freshly mixed concrete in layers and compacted properly to eliminate air voids.

The concrete specimens will be cured by immersing them in water for a period of 7, 14, and 28 days, following standard curing procedures.

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5. Testing and Evaluation

The following tests will be conducted on the concrete specimens:

Workability Test:

Slump Test: To assess the workability of the fresh concrete for each mix.

Compressive Strength Test:

Concrete cubes (150 mm x 150 mm x 150 mm) will be tested at 7, 14, and 28 days of curing using a compression testing machine to evaluate the effect of wood ash on the strength development.

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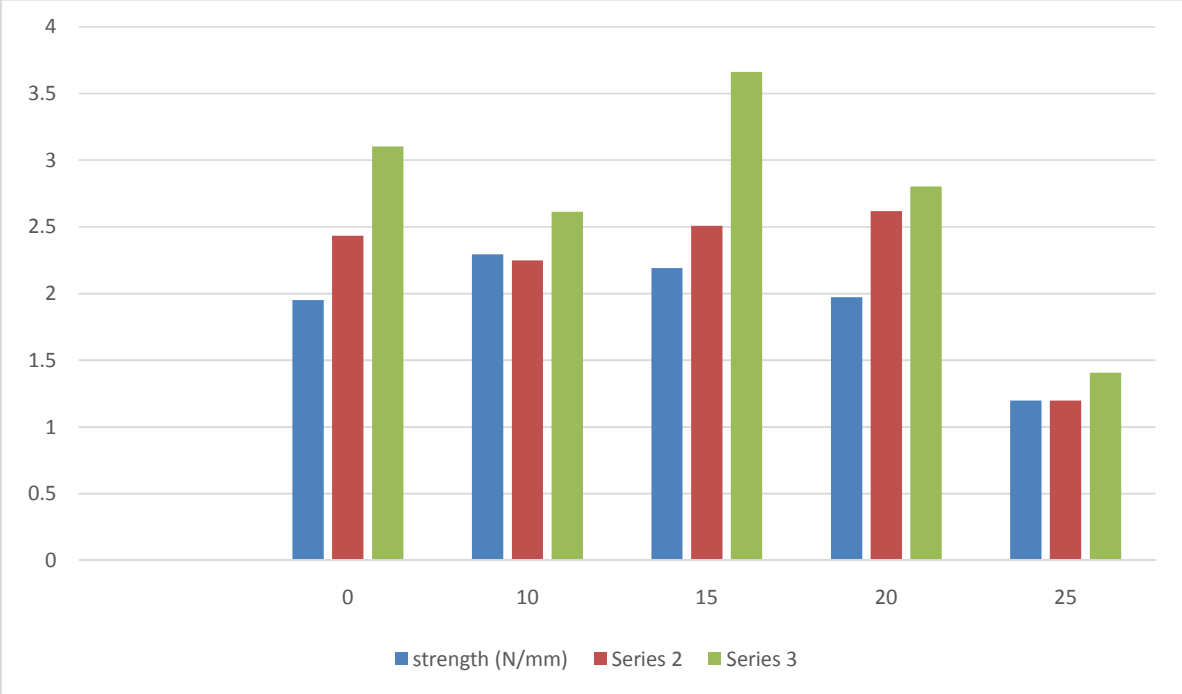
IV. RESULTS

Table 1: The average compressive strength of blocks

Wood Ash contenty\(%)	Strength /(N/mm) 7 days	14 days	21 days
0	1.9592	2.4338	3.1033
10	2.2939	2.2477	2.6142
15	2.1917	2.5074	3.6631
20	1.9736	2.6200	2.8046
25	1.1974	1.1974	1.4052

COMPRESSIVE TEST RESULT



V. CONCLUSION

The wood ash has the potential ability to replace the cement partially in cement block manufacturing industry .According to the results the optimum percentage od wood ash that can replace cement is 15%and it provides a block with a high compressive strength water absorption capacity is obtained at 15% of wood ash replacement after 21 days of curing period Wood ash is a valuable addition due to its slow rate of heat release and 15% replacement showed slower heat release The blocks can be modified with 15%of wood ash together with other cement materials.

VI. FUTURE SCOPE

Material Choice: Wood ash will be obtained from nearby biomass facilities or farming operations.
Replacement Ratio: The research will concentrate on substituting 10%, 15%, 20%, and 25% of the cement content in concrete with wood ash by weight.
Testing: Concrete samples will undergo assessments for various criteria, including workability, setting time, compressive strength, and durability (encompassing water absorption, chemical resistance, and freeze-thaw resistance).
Comparison: The results will be evaluated against traditional concrete that does not contain wood ash in order to determine the performance and viability of this alternative.

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