

Use of Coconut Shell Ash as A Partial Replacement of Cement in Concrete

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Abstract - The present project explores the potential use of Coconut Shell Ash (CSA) as a partial replacement of cement in concrete. Cement production contributes significantly to carbon dioxide emissions, creating the need for sustainable and eco-friendly alternatives. Coconut shells are an agricultural waste material abundantly available in India and are often disposed of improperly, causing environmental issues. When coconut shells are burned under controlled conditions and ground into fine ash, they exhibit pozzolanic properties suitable for use in concrete.

In this study, cement is partially replaced with Coconut Shell Ash at 2%, 4%, 6%, and 8% by weight of cement. Concrete specimens are cast and tested to evaluate the compressive strength at different curing ages. The results indicate that CSA can be effectively used as a partial replacement of cement without significant loss of strength at lower replacement levels. This study promotes sustainable construction practices through waste utilization and reduction in cement consumption.

KEYWORDS: Coconut Shell Ash, Partial Replacement, Sustainable Concrete

I. INTRODUCTION

Concrete is one of the most widely used construction materials due to its excellent compressive strength, durability, and versatility. It plays a vital role in the development of infrastructure such as buildings, bridges, pavements, and dams. However, the extensive use of concrete has resulted in a significant increase in the consumption of cement, which in turn has led to depletion of natural resources and increased environmental pollution. Cement manufacturing is an energy-intensive process and contributes significantly to greenhouse gas emissions, particularly carbon dioxide.

The growing concern over environmental sustainability has encouraged researchers to explore alternative materials that can partially replace cement without compromising the performance of concrete. The use of supplementary cementitious materials derived from industrial and agricultural wastes has gained importance in recent years. Materials such as fly ash, rice husk ash, sugarcane bagasse ash, and coconut shell ash have shown promising results when used in concrete.

Coconut shells are generated in large quantities as agricultural waste, especially in coastal and tropical regions. Disposal of coconut shells poses environmental challenges, as they are non-biodegradable and occupy large landfill space. By converting coconut shells into ash and utilizing them in concrete, both waste management and reduction in cement consumption can be achieved. This study focuses on investigating the feasibility of using coconut shell ash as a partial replacement of cement in M30 grade concrete important area of research in civil engineering.

II. METHODOLOGY

- To study the feasibility of using Coconut Shell Ash (CSA) as a partial replacement of cement in concrete.
- To collect coconut shells from local sources and process them by controlled burning and grinding to obtain Coconut Shell Ash of required fineness.
- To select and test construction materials such as PPC cement, fine aggregate, coarse aggregate, water, and Coconut Shell Ash as per relevant Indian Standard codes.
- To design a concrete mix for M30 grade as per IS 10262 by partially replacing cement with Coconut Shell Ash at different percentages.
- To cast concrete cube specimens using conventional concrete and CSA based concrete mixes following standard batching, mixing, and compaction procedures.
- To cure the cast specimens in clean water for different curing periods of 3, 7, 21, and 28 days as per IS 516.
- To conduct workability and compressive strength tests on the specimens and record the results for comparison between conventional concrete and Coconut Shell Ash concrete.

- The experimental results obtained from the tests were carefully recorded, analyzed, and compared to evaluate the performance of Coconut Shell Ash concrete.

III. OBJECTIVES OF WORK

- To study the feasibility of using coconut shell ash as a partial replacement of cement in concrete.
- To evaluate the workability characteristics of fresh concrete containing CSA.
- To determine the compressive strength of concrete at different curing periods.
- To identify the optimum percentage of coconut shell ash replacement for M30 grade concrete.

IV. MATERIALS USED

Cement

Portland pozzolana Cement (PPC) was used for the experimental investigation. The cement was tested for standard consistency, specific gravity, and fineness as per IS specifications.

Fine Aggregate



Locally available river sand conforming to Zone II as per IS 383 was used as fine aggregate. The sand was clean, dry, and free from organic impurities.

Coarse Aggregate



Crushed coarse aggregate of nominal size 20 mm conforming to IS 383 was used. The aggregates were tested for specific gravity and water absorption.

Coconut Shell Ash



Coconut shells were collected, cleaned to remove impurities, dried under sunlight.

V. EXPERIMENTAL TEST RESULTS

Table 1: Compressive Strength Test Results (M35 Concrete with CSA)

Cube size: 150 mm × 150 mm × 150 mm Standard:

IS 516 : 1959

S. n	CSA Replacement	Age Of Concrete	Compressive Strength
1	0%	3	17.56
2		7	23.33
3		21	31.56
4		28	35.11
5	2%	3	20.00
6		7	25.77
7		21	33.50
8		28	37.11
9	4%	3	21.11
10		7	25.55
11		21	35.11
12		28	36.44
13	6%	3	21.77
14		7	26.88
15		21	33.11
16		28	34.44
17	8%	3	14.00

18		7	20.88
19		21	30.00
20		28	34.00

Table 1 :- compressive strength test

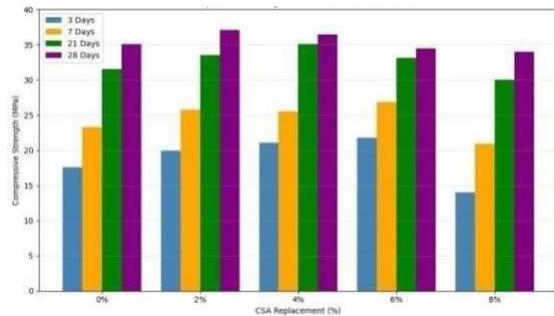


Fig 1:- Graphical representation of compressive test

Table 2: Slump Test Results for CSA Concrete Mixes

Standard: IS 456 : 2000

S. NO	CSA Replacement (%)	Slump Value (mm)
1	0%	90
2	2%	85
3	4%	78
4	6%	70
5	8%	60

Table 2 :- Slump Test

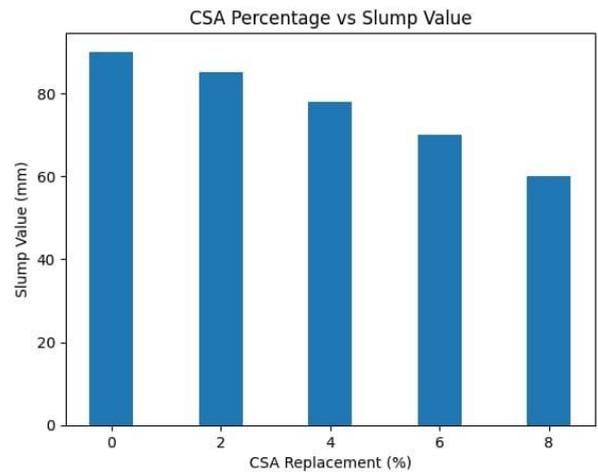


Fig 2 :- Graphical representation of slump test

VI. CONCLUSION

1. Based on the experimental investigation, the following conclusions are drawn:
2. Coconut shell ash can be used as a partial replacement of cement in concrete.
3. Workability decreases slightly with an increase in CSA content but remains within acceptable limits.
4. Compressive strength of concrete with CSA replacement up to 8% is comparable to conventional concrete.
5. Optimum replacement level of coconut shell ash for M30 grade concrete is found to be 2%.
6. The use of coconut shell ash contributes to sustainable and eco-friendly construction by reducing cement consumption and agricultural waste.

VII. REFERENCE

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