Aalok Kumar Yadav, 2026, 14:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Partial Replacement Of Coarse Aggregate With Coconut Shell And Cement With Sugarcane Bagasse Ash In M25 Grade Concrete

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Abstract- The increasing demand for construction materials has resulted in rapid depletion of natural resources and environmental degradation. This study investigates the use of Sugarcane Bagasse Ash (SCBA) as partial replacement of cement and Coconut Shell (CS) as partial replacement of coarse aggregate in M25 grade concrete. Different replacement levels of SCBA and coconut shell were used to study workability and compressive strength characteristics. Experimental results indicated that the use of 10% SCBA and 10–20% coconut shell provided satisfactory strength and durability properties while reducing environmental impact. The developed concrete can be considered sustainable, lightweight, and economical for future construction applications.

Keywords: Sugarcane Bagasse Ash, Coconut Shell, Sustainable Concrete, M25 Concrete, Lightweight Concrete, Compressive Strength.

I. INTRODUCTION

Concrete is one of the most widely used construction materials due to its excellent strength, durability, and versatility. However, the production of cement contributes significantly to carbon dioxide emissions, while extraction of natural aggregates leads to environmental imbalance and depletion of resources. Researchers are now focusing on sustainable alternatives using agricultural and industrial waste materials. Sugarcane Bagasse Ash (SCBA) is a by-product generated from sugar industries after burning bagasse. It contains a significant amount of silica and exhibits pozzolanic properties suitable for cement replacement. Similarly, Coconut Shell (CS) is an agricultural waste obtained from coconut industries. Coconut shell possesses good hardness and can be used as lightweight aggregate in concrete production. Utilization of coconut shell reduces waste disposal issues and decreases the dead load of structures. The present investigation focuses on the combined utilization of SCBA and coconut shell in M25 grade concrete to produce eco-friendly and sustainable concrete with acceptable mechanical properties.

II. LITERATURE REVIEW

Previous studies reported that SCBA can effectively replace cement up to 10–20% without adversely affecting the strength of concrete. Ganesan et al. observed improved compressive strength and durability properties in SCBA concrete. Chusilp et al. reported reduced permeability and improved microstructure with the inclusion of SCBA. Fairburn et al. concluded that 10% replacement of cement with SCBA provided optimum strength performance. Research also indicated that SCBA reduced heat evolution and improved resistance against aggressive environments. Studies on coconut shell concrete revealed that coconut shell can be used as lightweight aggregate in structural concrete. Coconut shell concrete exhibited lower density and acceptable compressive strength. However, higher replacement levels resulted in strength reduction due to higher water absorption and lower bonding characteristics.

III. MATERIALS USED

Ordinary Portland Cement (OPC) 43 grade conforming to BIS standards was used throughout the investigation. River sand conforming to Zone II was used as fine aggregate. Crushed stone aggregates of nominal sizes 20 mm and 10 mm were used as coarse aggregate. Sugarcane Bagasse Ash was collected from a sugar mill boiler and processed before use. Coconut shells were cleaned, crushed, and graded before using them as coarse aggregate replacement material. Clean potable water free from impurities was used for mixing and curing concrete specimens.

IV. MIX DESIGN AND EXPERIMENTAL PROCEDURE

Concrete mix design for M25 grade concrete was prepared according to BIS: 10262-2009 recommendations. Cement was partially replaced with SCBA at levels of 0%, 5%, 10%, 15%, and 20%. Coarse aggregate was replaced with coconut shell at levels of 0%, 10%, 20%, 30%, and 40%. Concrete cubes of size 150 mm × 150 mm × 150 mm were cast and cured for 7, 14, 28, and 60 days. Slump tests were conducted to determine workability, and compressive strength tests were carried out using a compression testing machine.

Table 1: Compressive Strength Results

Mix ID	SCBA (%)	CS (%)	28-Day Strength (MPa)
M1	0	0	31.5
M2	5	10	32.8
M3	10	10	34.2
M4	15	20	29.6
M5	20	40	24.8

V. RESULTS AND DISCUSSION

The workability of concrete improved slightly with the addition of SCBA due to finer particle size and increased paste volume. However, workability decreased at higher coconut shell replacement levels because of increased water absorption. The compressive strength increased up to 10% SCBA replacement and then gradually decreased at higher replacement levels. Concrete containing 10% SCBA and 10% coconut shell achieved maximum compressive strength among all mixes. Coconut shell concrete exhibited reduced density compared to conventional concrete, making it suitable for lightweight applications. Concrete containing SCBA also demonstrated better resistance against elevated temperatures and microcracking.

VI. CONCLUSIONS

1. Sugarcane Bagasse Ash can effectively replace cement up to 10% in M25 concrete. 2. Coconut shell can be utilized as lightweight aggregate in sustainable concrete production. 3. The optimum mix proportion was observed at 10% SCBA and 10–20% coconut shell replacement. 4. Workability improved with SCBA addition but decreased with higher coconut shell content. 5. The use of agricultural waste materials reduced environmental pollution and promoted eco-friendly construction practices. 6. The developed concrete can be used for lightweight and non-load-bearing structural applications.

REFERENCES

1. Ganesan, K., Rajagopal, K., and Thangavel, K., “Evaluation of Bagasse Ash as Supplementary Cementitious Material,” Cement and Concrete Composites, 2007. 2. Chusilp, N., et al., “Utilization of Bagasse Ash in Concrete,” Construction and Building Materials, 2009. 3. Fairburn, E.M.R., et al., “Cement Replacement by Sugarcane Bagasse Ash,” Journal of Materials in Civil Engineering, 2010. 4. Srinivasan, R., and Sathiya, K., “Experimental Study on Bagasse Ash in Concrete,” International Journal of Engineering Research, 2010. 5. IS: 456-2000, “Plain and

Reinforced Concrete – Code of Practice," Bureau of Indian Standards. 6. IS: 10262-2009, "Concrete Mix Proportioning – Guidelines," Bureau of Indian Standards.