

AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF SUGARCANE BAGASSE ASH AND CORN COB ASH IN CONCRETE

Imdhadullah.H¹, Durai Pandi.M¹, Mr. K. Rajkumar², R. Gowrishankar², G. Gnanapragasam³

¹UG Students, Dept of Civil Engineering, VSB Engineering college, Karur, India

²Asst Professor, Dept of Civil Engineering, VSB Engineering college, Karur, India

³Assoc. Professor, Dept of Chemical Engineering, VSB Engineering college, Karur, India

Received: 16th Dec, 2025; Revised: 8th Feb 2026; Accepted: 12th Feb, 2026; Available Online: 28th Feb, 2026

ABSTRACT

Abstract: The increasing demand for sustainable construction materials has encouraged the utilization of agricultural waste as supplementary cementitious materials in concrete. Sugarcane bagasse ash (SCBA) and corn cob ash (CCA) are agro-industrial by-products that are often disposed of as waste, causing environmental concerns. Sugarcane is cultivated in more than 100 countries, with annual global production exceeding 1000 million tons. India ranks among the leading producers, generating over 300 million tons annually. Similarly, Corn (commonly referred to as maize) is one of the major cereal crops in India, ranking third after rice and wheat in recent years, India's corn production has been steadily increasing. This experimental investigation focuses on the partial replacement of cement with sugarcane bagasse ash and corn cob ash in concrete by conducting freshened and hardened stage tests to evaluate their effects on mechanical and durability properties.

Key Words: sugarcane Bagasse ash, corn cob ash Concrete, Workability Strength

How to cite this article: Imdhadullah H, Durai Pandi M, Rajkumar K, Gowrishankar R, Gnanapragasam G., An Experimental Investigation on Partial Replacement of Sugarcane Bagasse Ash and Corn Cob Ash in Concrete. Int J Drug Deliv Technol. 2026;16(45s): 156-161; DOI: 10.25258/ijddt.16.45s.17

Source of support: Nil.

Conflict of interest: None

1.Introduction

Study says that Sugarcane is cultivated in more than 100 countries, annual global production exceeding 1000 million tons India ranks among the leading producers, generating over 300 million tons annually. After juice extraction, approximately 30-45% fibrous residue known as bagasse is obtained. Large quantities of SCBA are generated annually, posing disposal challenges.

Similarly, Corn (commonly referred to as maize) is one of the major cereal crops in India, ranking third after rice and wheat. In recent years, India's corn production has been steadily increasing. According to USDA-reported data, Indian corn output was around 42.28 million tonnes (42.3 million tonnes) is

the year which also creates environmental concerns. Both SCBA and CCA contain significant amounts of silica and alumina, which exhibit pozzolanic properties when properly processed.

The present study aims to evaluate the performance of concrete when cement is partially replaced with SCBA and CCA. The investigation focuses on workability and strength characteristics to determine the optimum replacement percentage for sustainable construction applications.

2. Materials

2.1 Cement

Ordinary Portland cement (Grade 43) was used. Its physical properties are as given in Table 1

Table 1. Physical Properties of Cement

Physical property	Results obtained
Fineness (retained on 90µm sieve) cm ² /gm	2890

Normal Consistency	34%
Vicat initial setting time (minutes)	49
Vicat initial setting time (minutes)	451
Specific gravity	3.13

2.2 Aggregates

Nearby available local natural sand with 4.50 mm maximum size was used in and as fine aggregate, having s fineness modulus, specific gravity and unit weight as given in Table 2 and crushed stone

with 18-20mm maximum size having specific gravity, fineness modulus and unit weight are given in Table 2 was used in and as coarse aggregate. Both fine aggregate and coarse aggregate confirmed to Indian Standard Specifications IS: 383-1970

Table2. Physical properties of Course and Fine Aggregates

Physical test	Coarse aggregate	Fine aggregate	Ash	Ash
		M-sand	SCBA	CCA
Specific Gravity	2.83	2.65	2.25	2.15
Fineness moudulus	6.83	2.75	1.8	1.6
Bulk density(kg/mM ³)	1363	1600	650	550

2.3 Sugarcane bagasse ash

The sugarcane bagasse ash used in the experimental investigation is obtained from a Juice shop which is nearby. The sugarcane bagasse consists of approximately 45-50% of cellulose, 20-25% of hemicellulose and 25% of lignin

approximately in Each ton of sugarcane generates about 26% of bagasse (at a moisture content of40-50%) and 0.6% of waste in the form of ash. The residue after combustion shows a chemical composition dominantes by (SiO₂) silicon dioxide. Table3. shows the chemical composition of bagasse ash.

Table3. The Chemical Composition of Bagasse Ash

Slno	Chemical propreties	Values
1	S102	58.6
2	A1203	3.8
3	Fe2 03	6.1
4	CaO	1.1

5	MgO	0.8
6	Naz O	0.3
7	K2 O	3.1
8	Loss on ignition	17.3
9	TiO2	3.6
10	P2 O5	0.9

2.4 corn cub ash

The corn cob ash used in the experimental investigation is obtained from locally collected agricultural waste from nearby farms. The corn cob consists of approximately 35-45% cellulose, 30-

35% hemicellulose and 15-20% lignin. When properly dried and burned under controlled temperature (600-700°C), the residue obtained is known as Corn Cob Ash (CCA). The ash produced after combustion is rich in silica (SiQ:) and exhibits good pozzolanic properties

Table 4 shows the chemical composition of Corn Cob Ash.

S1 no	Chemical propeties	Values (%)
1	S102	65
2	A1203	7
3	Fe2 O3	4
4	CaO	8
5	MgO	2
6	Naz O	0.8
7	K2 O	6
8	Loss on ignition	10
9	TiO2	1.3
10	P2 O5	2

3. Experimental Work

The work consists of performing the sieve analysis of sugarcane bagasse ash and corn cob ash as per the Indian standard procedure and use the results for the concrete mix design to get the concrete of required strength and quality. Thereafter the concrete is tested for ability parameters by performing the slump cone test followed by casting the cubes of concrete for further investigations. For carrying out the strength moestigations a total 10 number of concrete cabs and 10 cylindrical

specimens, 10 beams were prepared Based upon the quantities of ingredient of the vixba the quantities of sugar cane bagasse ash and coru cob sab for 01%, 55%, 10%, 15% and 20% were replace andestimated. The water cement ratio was kept 0.40 and the dose of super plasticizer was kept constant at 1%. The casted concrete specimens were cured under standard condition in the laboratory and tested for 7 days , 14 days, 28 days flexural strength, 7 ,14, 28 days split tensile strength and compressive strength.

Table 5 Mix proportion

AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF SUGARCANE BAGASSE ASH AND CORN COB ASH IN CONCRETE

Mix No	Cement (Kg/m)	CA (Kg/m)	FA (Kg/m ²)	% SCBA	% CCA	W/C Ratio	SP%	Slump
M0	400	1200	650	0	0	0.40	1	80
M1	380	1200	650	5	5	0.40	1	75
M2	360	1200	650	10	10	0.40	1	70
M3	340	1200	650	15	15	0.40	1	65
M4	320	1200	650	20	20	0.40	1	60

4. Test Methods

At the end of every curing period, a total of 3 specimens were tested for all 3 concrete property. The compressive strength test was carried out on

the 150mm cube specimens, while the split tensile strength test was conducted out on the 150mm diameter and 300mm height cylindrical specimens and test carried flexural strength 100mm 100mm 500mm as per Indian standard

5. Results and Discussion

The table o gives the results of various tests performed on the samples

Sample	Avg compression strength N/mm			Avg split tensile strength N/mm			Flexural strength N/mm		
	7days	14days	28days	7days	14days	28days	7days	14days	28days
M0	18.5	23.5	28.5	1.80	2.30	2.80	2.80	3.50	4.20
M1	20.5	25.2	30.8	1.95	2.45	3.0	3.00	3.80	4.50
M2	21.5	27.0	32.5	2.10	2.65	3.20	3.20	4.10	4.80
M3	19.8	24.8	29.6	1.90	2.40	2.90	2.90	3.60	4.30
M4	17.5	22.5	27.2	1.70	2.20	2.70	2.70	3.30	4.0

5.1 Compressive Strength

The results obtained from compressive strength test for all the mixes are given in fig 1. It can be known from the figure that the compressive strength results telof of specimens at 10% replacement of SCBA and CCA were high than those at 0% SCBA. Further increase in SCBA and CCA percentage

results in decreasing strength along with significant fall in properties of concrete. It is also know that the rate of increase of strength of mixes with SCBA and CCA is higher at later days that is due to pozzolanic properties of SCBA & CCA.

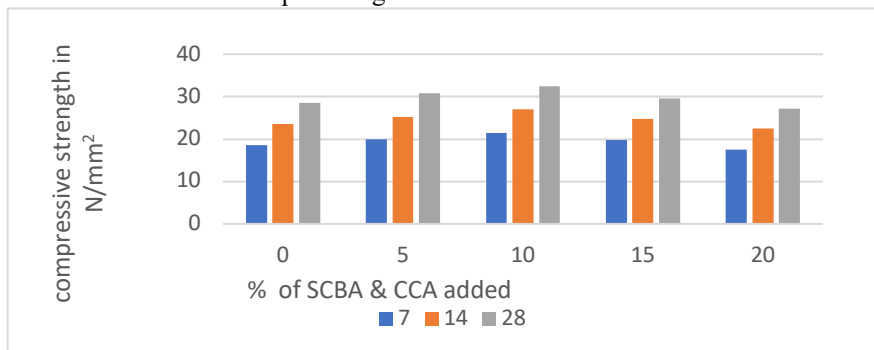


Fig. 1.7 ,14,28 Days Compressive Strength for All

Mixes

5.2 Tensile Strength

The tensile strength results for all the mixes for 7,14,28 days curing are shown in fig. 2. When the influence of SCBA on the tensile strength of

concrete was examined, it was observed that the development of tensile strength of mixes decreases as the replacement of SCBA and CCA increases.

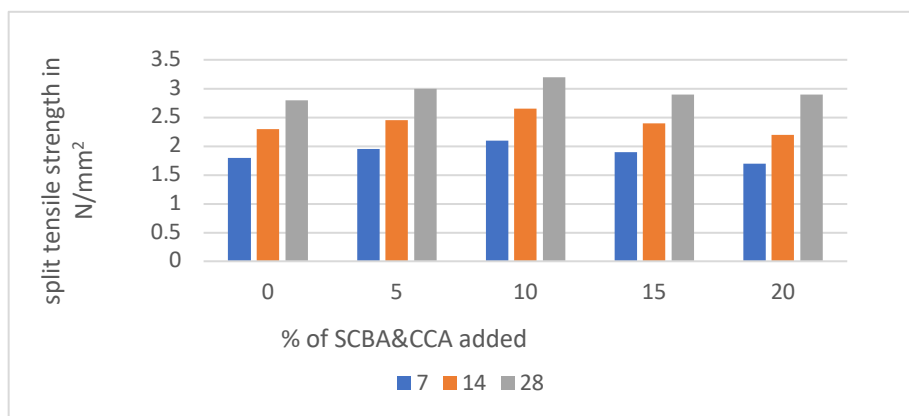


Fig.2. 28 Days Split tensile Strength Results for All Mixes

5.3 Flexural strength

The flexural strength results for all the mixes for 7,14,28 days curing are shown in fig5.3. When the influence of SCBA & CCA on the flexural strength of concrete was examined, it was observed that the

development of flexural strength of mixes decreases as the replacement of SCBA & CCA increases.

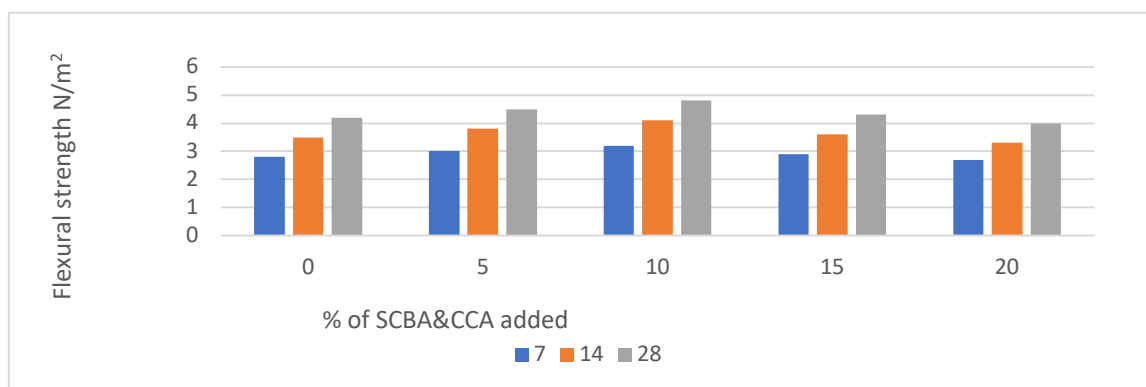


Fig.3. 7,14, 28 Days flexural Strength Results for All Mixes

6. Conclusions

From the experiments and analysis of results of findings in this research work, we established the following facts. Due to scarcity of natural sand and of high cost. As finer aggregate.cement in cement concrete for various reasons, search for alternative material like SCBA & CCA qualifies itself as a suitable substitute for sand at low cost.

On the basis of experimental investigation carried out, the following conclusions can be drawn.

- i)The amount of fine aggregates i.e. 10% to 15% can be easily replaced with a bagasse ash without a considerable loss of workability and strength properties.
- ii) The compressive strength results show that, the strength and workability of the mixes with 10% and 15% SCBA & CCA increases at later days (28 days) as compared to 7 days that is due to pozzolanic properties of SCBA & CCA.

References

- [1] R. Singh et al.. "Experimental and machine learning approaches on SCBA concrete," *Journal of Cleaner Production*, 2023.
- [2] M. A. Khan et al., "Optimizing concrete sustainability with bagasse ash," 2025.
- [3] L. Mirzaei et al., "Review of agricultural biomass ashes in concrete," *Processes Journal*, 2025.
- [4] N. Bheel et al.. "Combined effect of jute fiber and corn cob ash in concrete," *Scientific Reports*, 2024.
- [5] S. A. Stelmakh et al., "Influence of corn cob ash on concrete properties," *Construction Materials Journal*, 2024.
- [6] N. Rasidi et al., "Enhancing concrete properties with corncob ash." *Civil Engineering and Architecture*, 2025.
- [7] Y. E. Maghraby et al..ss "Utilization of untreated sugarcane bagasse ash in concrete," *Springer Journal*, 2025.
- [8] Cordeiro, G. C, Toledo Filho, R. D., & Fairbairn, E. M. R. (2009). Use of ultrafine sugarcane bagasse ash as mineral admixture for concrete. *Construction and Building Materials*.
- [9] Bahurudeen, A., & Santhanam, M. (2015). Influence of different processing methods on the pozzolanic performance of sugarcane bagasse ash. *Fuel*.
- [10] Kumar, R., et al. (2022). Mechanical properties of concrete incorporating agricultural waste ash. *Materials*
- [11] Ali, B., et al. (2021). Sustainable use of agricultural waste in concrete: A review, *Case Studies in Construction Materials*.
- [12] Aprianti, E. (2017). A huge number of artificial waste material can be supplementary cementitious material (SCM). *Journal of Materials Research and Technology*.
- [13] Mehta, P. K., & Monteiro, P. J. M. (2014). Sustainable development of concrete technology. *Sustainability*.
- [15] Chusilp, N., Jaturapitakkul, C., & Kiattikomol, K. (2009). Utilization of bagasse ash as a pozzolanic material in concrete. *International Journal of Concrete Structures and Materials*.