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Behaviour of Blended Concrete Using Sugarcane Bagasse Ash as Partial Replacement of Cement

Mohammed Irfan Qureshi [*1], Mohammad Kalandarbasha[*2], Leelavardhan V[*3], Afzal Khan[*4]*

*[*1*2*3*4]UG Students, Department of Civil Engineering, Dayananda Sagar College of Engineering, Karnataka, India*

A B S T R A C T

The goal of this project is to see if sugarcane bagasse ash (SCBA) can be used as a partial cement replacement in concrete. For the experiment, M25 concrete was utilized. SCBA was used to partially replace cement in normal strength concrete at 0 percent, 5%, 10%, and 15% by weight. The purpose of this study is to compare and assess the performance of ordinary concrete and concrete with cement replaced by sugarcane bagasse ash. After 7, 14, and 28 days of curing, the specimens were examined for compression, split tensile, and flexural strength.

Keywords:SBCA, blended cement concrete, green cement concrete, sugarcane waste.

1. Introduction

As we all are aware that the manufacturing and production of cement cause significant environmental impact. There is a lot of emission of CO2 connected with other compounds. According to the studies, every 1000kgs of Cement production emits 500kgs of CO2, therefore there is an impact. This is a serious issue that triggers to limit on the usage of cement. wastes such as sugar cane bagasse are difficult to dispose of and hence harm the environment. To overcome this real problem, we can use ashes of agricultural waste as a partial replacement for cement in concrete. A variety of studies have been conducted to investigate the pozzolanic behavior of agricultural waste ashes and their applicability as binders that partially replace cement in concrete. As a result, sugarcane bagasse ash can be utilized as a partial replacement for cement, lowering total costs while conserving the environment.

2.Preliminary Investigation

Method and analysis which is performed in your research work should be written in this section. A simple strategy to follow is to use keywords from your title in first few sentences.

2.1 Materials

2.1.1 Cement

Ordinary Portland cement of 43 grade from a single batch was used for the whole project, and it was maintained in airtight containers to avoid being influenced by atmospheric and monsoon moisture and humidity. The purchased cement was evaluated for physical standards according to IS: 12269-1987 and chemical requirements according to IS: 4032-1977.

* *Corresponding author.* Tel.: +0-000-000-0000 ; fax: +0-000-000-0000.
E-mail address: author@institute.xxx

SL.No	Property	Value
1	Normal consistency	33mm
2	Fineness of cement	7 %
3	Setting times	
	Initial (Minutes)	85
	Final (Minutes)	240
4	Compressive Strength Test	
	3 days	28.68 MPa
	7 days	40.34 MPa
	28 days	54.62 MPa

Table 1 – Properties of cement

2.1.2 Sugarcane Bagasse Ash

Sugarcane bagasse is composed of approximately 50% cellulose and 25% hemicelluloses and ligin. Every tonne of sugarcane produces nearly 26% bagasse (with a moisture content of 50%) and 0.62 percent residual ash. The chemical makeup of the residue after burning is dominated by silicon dioxide (sio2). Despite being a material that degrades slowly and has few nutrients, ash is utilized on farms as a fertilizer in sugarcane harvests. Sugarcane bagasse ash was gathered from the sugar industry in Bellary, Karnataka, for this experiment.

SL.No	Property	Value
1	Density	575Kg/m3
2	Specific Gravity	2.2
3	Mean Particle Size	0.1-0.2 µm
4	Min. Specific Surface Area	2500m2/ kg
5	Particle Shape	Spherical

Table 2 – Physical properties of SBCA

SL.No	Component	Symbol	Percentage
1	Silica	SiO_2	63
2	Alumina	Al_2O_3	31.5
3	Ferric Oxide	Fe_2O_3	1.79
4	Manganese Oxide	MnO	0.004
5	Calcium Oxide	CaO	0.48
6	Magnesium Oxide	MgO	0.39
7	Loss On Ignition	LOI	0.71

Table 3 – Chemical properties of SBCA

2.1.3 Fine Aggregates

The M-sand, which passed through a 4.75 mm sieve and was retained on a 600 m sieve was selected as fine aggregate for this experimental analysis and study. The sand contains no clay, silt, or organic contaminants. In compliance with IS: 2386-1963, the aggregate was evaluated for physical specifications such as gradation, fineness modulus, specific gravity, and bulk modulus.

SL. No	Property	Value
1	Specific Gravity	2.55
2	Bulk density gm/cc	1.542
3	Fineness Modulus	2.74
4	Zone	II

Table 4 – properties of fine aggregates

2.1.4 Coarse Aggregate

Crushed coarse aggregates of 20mm obtained from local crusher mills were utilized for the research. The aggregate was tested for physical standards such as gradation, fineness modulus, specific gravity, and bulk density as per IS: 2386-1963 and IS: 383-1970.

SL. No	Property	Value
1	Bulking Density (y) gm/cc	1.520
2	Specific Gravity (G)(20mm)	2.64
3	Fineness Modulus	7.18
4	Aggregate impact Value (%)	24.97
5	Aggregate crushing Value (%)	25.22

Table 5 – properties of Coarse aggregates

2.1.5 Water

The concrete is mixed with fresh potable water that is devoid of organic debris and oil. Water was measured and added to the concrete in the proper amounts using a graduated jar. Weigh batching was utilized to acquire the data from the remaining materials for producing the concrete mix. The pH level should be 7.

2.1.6 Effect of Bagasse Ash on Consistency and Setting Time

The variations in standard consistency, initial and final setting time with bagasse ash in cement is shown in Table 6 and Fig 1.

Serial No	Percentage Replacement	Standard Consistency	Initial Setting Time	Final Setting Time (min)
1	0%	30.00	104	218
3	5%	32.00	107	220
6	10%	35.00	115	248
7	15%	35.75	120	275

Table 6 - Variation in standard consistency, initial and final setting time with bagasse ash in cement

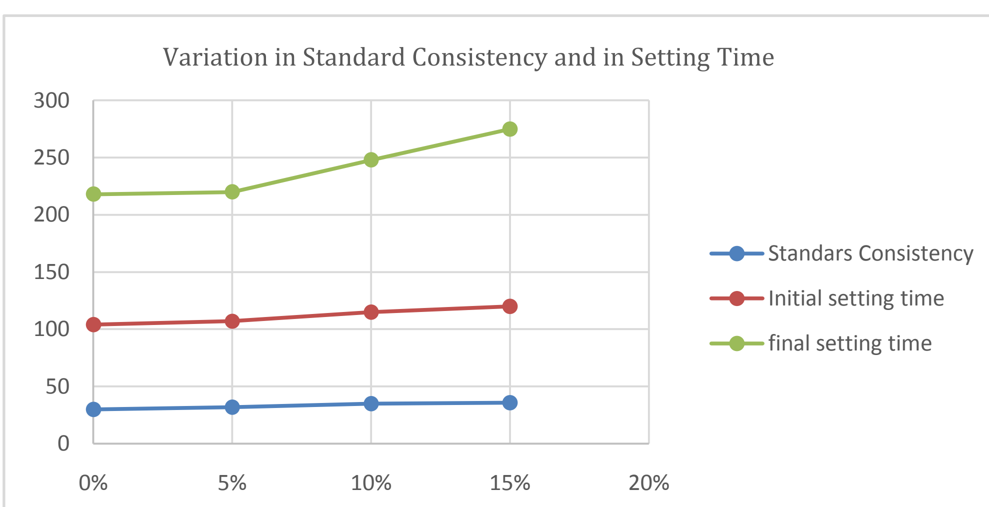

Fig 1 - Variation in Standard Consistency and in Setting Time

3. METHODOLOGY

The experimental part of the project consists of procuring the materials, determining the physical properties and chemical composition, designing the M25 mix, making concrete with different replacement levels (0, 5, 10, and 15%) of cement with SCBA, and finally determining their workability, strength and durability characteristics and properties.

The amount of concrete ingredients needed for each replacement level is weighed and mixed by hand. Slump and compaction factor tests are performed, and the results are tabulated in the figures below. Concrete specimens such as 150mm cubes, 150 x 300mm cylinders, and 100 x 100 x 500mm prisms are cast by compacting on a vibrating table. After 24 hours, the specimens are demoulded and stored in a pond for curing until testing. The specimens are tested for compression, split Tensile and Flexural Strength after 7 days, 14 days, and 28 days.

4. RESULTS AND DISCUSSION

The results obtained from the experimental analysis are as follows.

Effect of Bagasse Ash Content on

i. Workability

The slump test was performed for the concrete with and without SCBA to check the consistency of NMC and the observed result are reported in table 1.

Sample Designation	% of SBCA	Workability	
		slump	Compaction Factor
0A	0	55	0.96
1A	5	177	0.97
2A	10	195	0.97
3A	15	218	0.98

Table 7 - Tests for Workability

ii. Compressive Strength

Variation in 7 days, 14 days, and 28 days compressive strength is shown in Table 8, and fig 2

Percentage of (SCBA)	After 7 days of strength (N/mm2)	After 14 days of strength (N/mm2)	After 28 days of strength (N/mm2)
0%	12.555	14.729	25.072
5%	13.183	15.643	23.219
10%	10.241	12.965	14.587
15%	7.607	9.52	10.174

Table 8 - Compressive strength of different amount of replacement of cement by bagasse ash

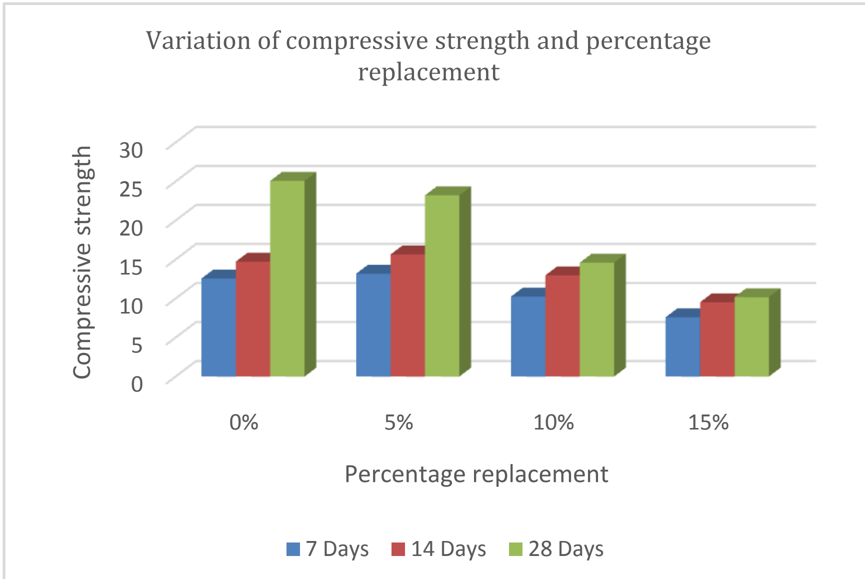

Fig 2 - Variation of compressive strength and percentage replacement

iii. Split Tensile Strength

Variation in 7 days, 14 days, and 28 days compressive strength is shown in Table 9, and fig 3

% OF SCBA ADDED	7 DAYS(N/mm2)	14 DAYS(N/mm2)	28 DAYS(N/mm2)
0	0.52	1.1	1.8
5	0.9	1.5	1.6
10	0.88	1.2	1.49
15	0.72	1.3	1.45

Table 9 – Split Tensile strength of different amount of replacement of cement by bagasse ash

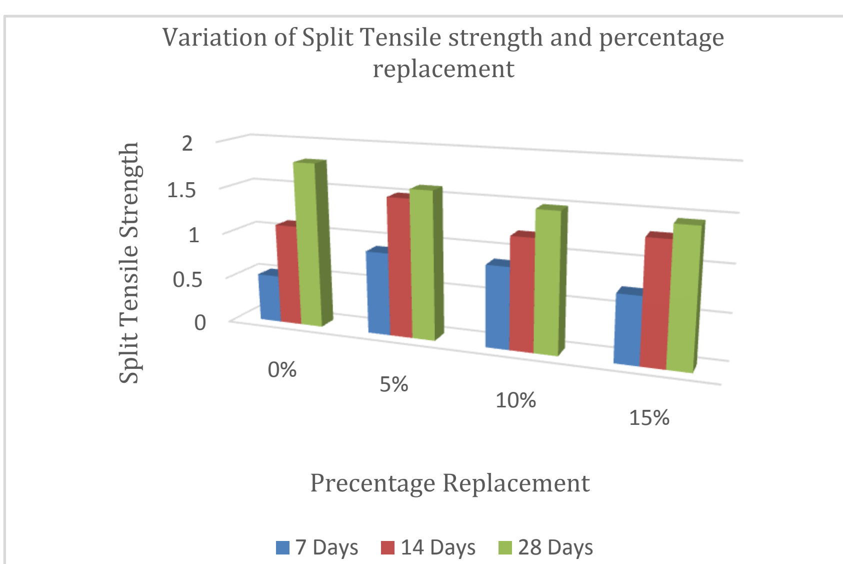

Fig 3 - Variation of Split Tensile strength and percentage replacement

iv. Flexural Strength

Variation in 7 days, 14 days, and 28 days Flexural strength is shown in Table 10, and fig 4

Percentage of SCBA added	7 DAYS (N/mm2)	14 DAYS (N/mm2)	28 DAYS (N/mm2)
0	3.56	3.12	3.7
5	3.32	3.5	3.55
10	3.15	3.32	3.52
15	2.98	3.12	3.35

Table 10 – Split Tensile strength of different amount of replacement of cement by bagasse ash

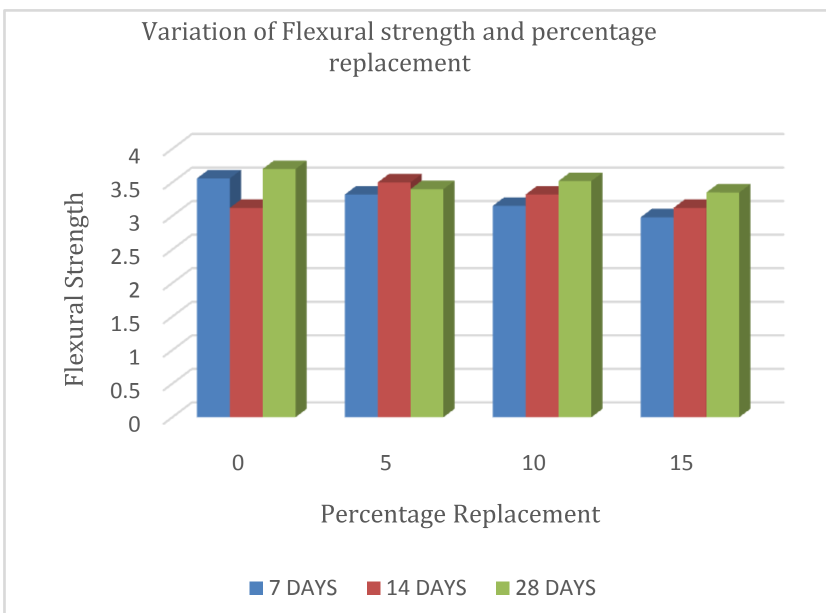

Fig 4 - Variation of Flexural strength and percentage replacement

5. CONCLUSION

The following conclusion can be made from the above experimental analysis.

a) The workability of concrete is little or not much affected by the increasing percentage of replacement of cement with SCBA
b) Concrete with cement partially replaced with SBCA has shown lesser strength as the conventional concrete in compression and almost same strength in tension and flexure.
c) As the percentage of SBCA in cement concrete increases, strength decreases.
d) The optimum level of cement replacement is 5% by weight with SBCA.
e) The usage of SCBA in concrete is not only a waste-minimizing technique, but also it saves the amount of cement.

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LIST OF IS CODES

[1] IS: 12269-1987
[2] IS 383-1970
[3] IS:2386-1963
[4] IS:456-2000
[5] IS: 10262-2009
[6] IS 516-1959