INTERNATIONAL JOURNAL OF
RECENT TRENDS IN MULTIDISCIPLINARY RESEARCH
https://www.doi.org/10.59256/ijrtmr.20250503002
May-June 2025, Vol 5(03), 17-29.
ISSN No: 2583-0368

Evaluation of Sugarcane Bagasse ash as a bio-based admixture in concrete

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OPEN ACCESS
Article Citation:
Sanjana R. Kothare[1], A. B Dehane[2], "Evaluation of Sugarcane Bagasse ash as a bio-based admixture in concrete", International Journal of Recent Trends in Multidisciplinary Research, May-June 2025, Vol 5(03), 17-29.

Abstract: Bio-based admixtures (BBAs) are emerging as a promising class of additives for concrete, offering a more sustainable and environmentally friendly alternative to conventional chemical admixtures. Derived from various natural or biological sources, including plants, animals, and microorganisms, BBAs have shown potential in enhancing the performance characteristics of concrete in several key areas. Some bio-based admixtures are Recycled waste which are produced by various industries like thermal power plant, steel plants, brick & stone industry, coal industry & sugar industry etc. sugarcane Bagasse ash (SCBA) is one of the main sources of recycled waste for civil engineering construction backgrounds. Sugarcane bagasse is an agricultural waste that can be transformed by incineration into a cement replacement material for various cementing purposes. Sugarcane bagasse is a fibrous by-product of the sugar refining process. The residual sugarcane, known as bagasse, is burned at high temperatures under uncontrolled conditions to produce ash after the juice from the sugarcane has been extracted. In this project the bio-based admixture, Sugarcane bagasse ash (SCBA) will be used for enhancing the properties like physical, chemical and mechanical by partially replacement of cement. The replacement of cement is carried out at different percentages, such as 5%, 10%, 15%, 20%, 25% and 30% and its impact on the characteristics of concrete such as compressive strength will be examined.

1. Introduction

Now a days the rate of population is increasing and as per the current data India's population is 1,453,933,524 which is about 17.78% of world's population. This population growth demands for the basic services, infrastructure, and affordable housing. As a result, the construction sector will need to expand rapidly in order to meet the demand. Environmental challenges such as global warming, natural resource depletion and ecosystem destruction which are caused by the construction industry, have put the construction sector under a spotlight. Out of the concrete-making materials, admixtures make up the smallest proportion when compared to the other ingredients (aggregates, cement, and water). Furthermore, due to the rapid destruction of the environment, the sustainability of natural resources is a prominent challenge. The primary focus of investigators is on reducing the use of raw materials and increasing the use of renewable alternatives. Sugarcane bagasse ash is one of the available side products in India, and it is produced by burning bagasse in boilers to generate energy.

2. Literature Review

Introduction

This literature survey is an imperative part of investigation to analysis the experimental work completed in the area of concrete replaced by bio-based admixture i.e. sugarcane bagasse ash. To take up specific need to design, the literature survey of papers, journals and books required to refer and to govern the scope of work and recognize the present status of planned study.

Research Review

Research works on Cement Replaced by Sugarcane bagasse ash has been done many investigators in research area as;

1] Md. Habibur Rahman Sobuz a, *, Al-Imran a, Shuvo Dip Datta a, Jannat Ara Jabin a, Fahim Shahriar Aditto a, Noor Md. Sadiqul Hasan b, Mahamudul Hasan a, Ahmad Akib Uz Zaman (2024)

The slump, ball penetration, compacting factor, K-slump, and air content values of the SCBA concrete increase with the percentage replacement of SCBA particles, which defined the better workability with the SCBA particles. The 10 % replacement of cement by SCBA provides an optimum solution in terms of modulus of elasticity, compressive, splitting, and flexural strength due to the pozzolanic activity of the SCBA, whereas after 10 % replacement, the porosity in the concrete matrix overcomes the pozzolanic activity and decrease the mechanical property drastically.

2] Pratyush Kumar Goyal1, Meena Murmu (2024) Sugarcane bagasse ash from different sugar processing industries displays varying properties, often characterized by an asymmetrical size, irregular shape, and rough surface. Concrete strength typically increases with up to a 10% SCBA replacement level, but beyond this, there is a decrease in strength due to the complete utilization of free lime. The lack of free lime hinders the formation of calcium silicate hydrate (C-S-H) from SCBA. According to the literature, incorporating Portland cement substitutes in the range of 5% to 15% by weight in sugarcane bagasse ash concrete leads to excellent mechanical properties.

3] Yuvraj Rathaur, Yash Shukla, Arpita Yadav, Anand Bhatt (2023) The addition of Sugarcane Bagasse Ash in concrete affects the workability of concrete, especially at high replacement levels. In our study, we have observed that the increase in the percentage of SCBA can lead to a decrease in workability, which may require the use of chemical admixtures or modified curing procedures. However, replacing up to 15% would not affect workability. The use of SCBA in concrete can improve its durability, especially in terms of resistance to sulphate and chloride attack. The Compressive strength of concrete decreases with the increase in the percentage of bagasse ash, the reduction in strength may be attributed to the presence of clay, residual binder, and other impurities in a sugarcane bagasse ash. The degree of strength reduction depends on the proportion of sugarcane bagasse ash used in the mix.

4] Aasif M. Baig, Alaka Das, Veena A. Ganvir, Rakhi M. Shelke (2021) In this research paper they conclude that bagasse ash has potential for replacing cement upto 20% to 25% and also said that SCBA cannot be used in concrete without sieving or grinding or any other treatment methods this would affect the properties of concrete.

5] Muhammad Nasir Amin, Muhammad Ashraf, Rabinder Kumar, Kaffayatullah Khan, Daniyal Saqib, Syed Sajid Ali and Sajidullah Khan (2020) This research was carried out to study the potential use of ground bagasse ash (GBA) as a partial substitute for cement to produce an economical and sustainable engineered cementitious composite (ECC). For this purpose, three different percentages of GBA were selected (10ECC, 20ECC, and 30ECC). The addition of GBA in ECCs reduced the compressive strength at early ages (14 days), which was enhanced significantly at later ages. The mix containing 10% GBA (10ECC) exhibited the highest compressive strength among all the other ECC mixes, including control mortar, at the age of both 28 and 91 days.

6] Memon, S.A. Javed, U. Shah, M.I. Hanif, A. (2022). In this study, the effect of SCBA processed as supplementary cementitious material (SCM) in concrete was investigated. SCBA was incorporated by replacing cement in different weight fractions (10%, 20%, 30%, 40%) in concrete. The test results show that the workability of concrete increases with the incorporation of SCBA, while the density of the resulting concrete decreases. The results of mechanical properties, including compressive strength and hardened density, were improve d after cement replacement by SCBA. Concrete containing 30% SCBA can be used for structural applications because its 28-day compressive strength is 21 MPa, which complies with ACI 318-16 specifications.

7] Vikas Kumar, Pankaj Kumar (2022) This study presents the findings on the strengths, permeability, and structural behaviour of concrete beams containing sugarcane bagasse ash and laterite soil. The goal of the research was to combine traditional concrete with sugarcane bagasse ash to produce sugarcane bagasse ash laterised concrete, which could be used for the construction of low-cost housing. Ash from sugarcane bagasse and lateritic soil were used as blenders and blended with regular concrete materials. Cement was largely replaced with sugarcane bagasse ash in the following proportions by mass: 0%, 5%, 10%, and 15%. The impact of different degrees of material substitution on the workability and compressive strength of concrete was investigated using a concrete mixture with the proportions 1:2:4 and a water-to-cement ratio of 0.55.

8] Chandru.G, Vignesh.V, Dr. Saravanan. R (2019) The study was carried out by replacing cement with bagasse ash in fixed proportions. Four different experiments were carried out to determine the ultimate compressive strength and tensile strength in comparison with that of normal concrete using a grade partially replaced with bagasse ash at 0%, 5%, 10%, 15% and 20% by weight of cement. M-20 on the 7th and 28th. Test results show that the strength of concrete increases by up to 20% Substitution of sugarcane ash with cement

9] Sivakumar M, Mahendran N. (2013) The aim of this paper is to describe the chemical nature of some of these resources and to emphasize the fundamental properties of this class of material so that it can be best utilized in an appropriate manner. Ground bagasse ash can be used as a supplementary cementing material up to 20% by weight of binder in concrete and still yield satisfactory compressive strength as well as reduced heat evolution. Besides the increase in the ultimate compressive strength of concrete.

10] Abdolkarim A, Amin Z (2013). The rheological tests were carried out with a stress-controlled rheometer equipped with a ball measuring system. In addition, mini-slump cone and the flow/spread table tests were carried out to determine the feasibility of evaluating the rheological properties of pastes and mortars from empirical tests in the ternary systems, the use of 20% of Fly ash combined with 10% and 20% of SCBA was beneficial producing lower yield stresses than those presented in the binary system. A mini-cone was used for evaluating the flow spread of pastes.This apparatus was developed by Kantro and consists of a mould in the form of a frustum of a cone, 60 mm high with diameters of 70 mm at the top and 100 mm at the base The results obtained with the mini-slump cone and the flow/spread table tests showed a certain relationship with the rheological measurements, but this could not be completely identified.

11] Montakarntiwong K, Chusilp N, Tangchirapat W. (2013) The study of strength parameter and heat evolutiontake a Two different sources of bagasse ash with low and high loss on ignition were used in this experiment. Ordinary Portland cement was replaced by bagasse ash at the levels of 20%, 30%, and 40% by weight of binder. The effects of Loss of ignition, fineness, and cement replacement of bagasse ash on the compressive strength of concrete were investigated. The replacement of cement by ground bagasse ash with low and high loss on ignition at 30% and 20% by weight of binder and the most important factor is Ground bagasse ash can be used as a supplementary cementing material up to 20% by weight of binder in concrete and still yield satisfactory compressive strength as well as reduced heat evolution. Besides the increase in the ultimate compressive strength of concrete, the amount of disposal waste in landfill and the cement usage are also reduced, resulting in a better environment

12]P V Rambabu, G V Rama Rao (2017) The present experimental investigation was carried on bagasse ash and has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 10%, 15% and 20% by weight of cement in concrete. The variable factors considered in this study were concrete of grade M60 for a curing period of 28 days, 60 days and 90 days of the concrete specimens in 1%, 3%, 5% H_2SO_4 and HCl solution. Test for compressive strength at the age of 28days, 60days and 90days were conducted and results are presented.

13]Rahul Jichkar M (2015) In view of utilization of agricultural waste in concrete and mortar, the present paper reviews, utilization of sugarcane bagasse ash (SCBA) in different compositions that were added to the raw material at different levels to develop sustainable concrete and mortar. Various physico- mechanical properties of the concrete and mortar incorporating sugarcane bagasse ash are reviewed and recommendations are suggested as the outcome of the study. The study in turn is useful for various resource persons involved in using SCBA material to develop sustainable construction material

14]Somna R, Jaturapitakkul C, Rattanachu P, Chalee W. (2012) studied the utilization of a pozzolanic material to improve the mechanical properties and durability of recycled aggregate concrete. Ground bagasse ash was used to replace Portland cement at the percentages of 20, 35, and 50 by weight of binder.Limestone in the mix proportion of conventional concrete was replaced by recycled aggregate. When GBA was used to partially replace cement in recycled aggregate concrete, the chloride penetration decreased and was lower than those of control concrete at the same immersed time. This result was similar to the result of concrete using natural aggregate. Compressive strength, modulus of elasticity, water permeability, and chloride penetration depth of the concretes were determined. The results revealed that the modulus of elasticity of recycled aggregate concrete with and without GBA was lower than that of conventional concrete by approximately 19%.

15] Kawade U, Rathi V. (2013) studied the effect of use of SCBA on strength of concrete by partial replacement of cement at the ratio of 0%, 10%, 15%, 20%, 25% and 30% by weight for compressive strength. If some of raw material having similar composition can be replaced by weight of cement in concrete then cost could be reduced without affecting its quality. It is found that the cement could be effectively replaced with SCBA up to maximum limit of 15%.

16] Modani P, Vyawahare M. (2013) Optimized the workability and flow ability. Bagasse ash was partially replaced in the ratio of 0%, 10%, 20%, 30% and 40% by volume of fine aggregate in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken along with hardened concrete tests like compressive strength, split tensile strength & Sorpitivity test. the Sorptivity coefficient increases with increase in percentage of SCBA and decreases with increase in compressive strength of concrete. The raw SCBA contains coarser, un burnt and half burnt particles which are porous hence absorb more water. It is reflected in the increase in the Sorptivity with increase in the percentage of baggase ash. On the basis of experimental investigation carried out.

17] Ganesan K, Rajagopal K, Thangavel K., (2007) The articles studied the effects of SCBA content as partial replacement of cement (0-30%) on physical and mechanical properties of hardened concrete. The test results indicated that SCBA is an effective mineral admixture up to 20% replacement was advantageous. the result shows The mean values observed in the mechanical compressive strength tests of the prisms, with and without SBA, were very close to each other; although the reference values were slightly higher, they cannot be considered statistically different. The increase in strength may be due partially to the pozzolanic reaction researchers. Ground bagasse ash is a suitable pozzolanic material for use in concrete.

18] G. C. Cordeiro, R. D. Toledo Filho (2008) This work investigates the pozzolanic and filler effects of bagasse ash residue in mortar. Initially, the effect of SCBA particle size on packing density, pozzolanic activity of bagasse ash and compressive strength of mortar was analyzed. In addition, the behavior of bagasse ash was compared to insoluble materials with the same packing density. The results show that bagasse ash can be classified as a pozzolanic material, but its activity is highly dependent on the particle size and fineness.

19] Fairbairn E, Americano B, Cordeiro C G (2010) Bagasse ash is a mineral resource, it is highly recommended to apply bagasse ash applications to avoid potential replacement of one of the environmental problems. Bagasse ash is a pozzolanic material suitable for use in concrete. The literature shows the beneficial applications of this by-product material. The compressive strength of mortar containing SCBA is inversely proportional to the size of the SCBA particles. It was concluded that SCBA is a good pozzolan for concrete cementation and its partial admixture with OPC can provide good strength development and other engineering properties in concrete. The cost of pozzolanic materials is usually lower than that of ordinary Portland cement.

Concluding Remark:

From the above literature survey, the following conclusion is drawn.

1. Up to M20 grade with replacement of SCBA experimental work is done
2. Up to 10% replacement of SCBA in concrete, the compressive strength increase, beyond 10% replacement compressive strength decrease.
3. As the percentage of replacement increase beyond 10% the workability was decreased.
4. Replacement of 5%, 10%, 20% & 30% with SCBA experimentally done with M20 grade by taken sample from different industries.

Objectives of the Work

The objectives of current experimental work are based on SCBA which coming from Manas Agro Industries and Infrastructure Ltd at Jamni, wardha

1. To identify the adverse effect of conventional construction material on environment
2. To study the cementitious properties of sugarcane bagasse ash.
3. To check the optimum percentage of partial replacement of conventional construction material with sugarcane bagasse ash.
4. Characteristics of sugarcane bagasse ash are analyzed in terms of chemical, physical, and mechanical properties.
5. To manufacture blocks with the suitable combination of conventional construction material and SCBA.
6. To study the Economical Evaluation of SCBA.

3. System Development

Experimental Programme

This chapter includes the experimental work and physical testing to study the effect of Sugarcane bagasse ash along with partial replacement of cement on various properties of concrete.

Material Used

For preparation of concrete cube, Coarse aggregate (20mm), Coarse aggregate (20mm), fine aggregate, cement, sugarcane bagasse ash and water. Tests performed on materials used are discussed below with IS code.

Cement:

- Cement is a popular binding material and it is very important civil engineering material
- Cement is a material which has cohesive and adhesive properties in the presence of water.
- Standard density of cement is 1440 kg/m^3 and volume is approximately 0.035 m^3 or 35 lit.

Physical Properties of Cement

Different blends of cement used in construction are characterized by their physical properties. Some key parameters control the quality of cement. The physical properties of good cement are based on:

- Fineness of cement
- Soundness
- Consistency
- Strength
- Setting time
- Heat of hydration
- Loss of ignition
- Bulk density
- Specific gravity (Relative density)

Table. 1. Various Physical Test on Cement

% replaced	% residue by weight	Consistency (mm)	Initial setting time (min)	Final setting time (min)	Soundness (mm)	Specific gravity
5%	8%	33	40	634	10	3.12
10%	8%	33	42.2	644	12.6	3.16
15%	7.8%	32	50	658	11.7	3.11
20%	7%	33	51.3	678.7	14-4	3.2
25%	5.67%	34	60.5	688.3	15.2	3.166
30%	4.03%	32	70	711.5	17	3

Aggregate:
- Aggregates are used as filler.
- They form body of concrete occupying 70% to 80% of volume of concrete
- They exert considerable impact on the characteristics and properties of concrete.

Sr. no.	Name of test	IS Code used	Recommended result
1	Fineness test	IS: 4031 (Pat 1) – 1988	Residue less than10 %
2	Standard consistency	IS:4031 (Part 5) – 1988	26 - 33%
3	Initial setting time	IS:4031 (Part 5) – 1988	Between 30 – 90 min.
4	Final setting time	IS:4031 (Part 5) – 1988	Not more than 10 Hours
7	Compressive strength	IS:4031 (Part 6) – 1988	Not less than 90%

❖Coarse aggregate: forming main matrix of concrete
❖Fine aggregate: Forming filler matrix between coarse aggregate

Table.3. Physical properties of Coarse Aggregate

Sr. no.	Property	Coarse Aggregate
1	Specific gravity	2.65
2	Bulk Density	
	Loose	13.61KN/m3
	Compacted	15.71 KN/m3
3	Water absorption	0.5%
4	Flakiness Index	14.22%
5	Elongation Index	21.33%
6	Crushing Value	15.5%
7	Impact Value	14.03%

Fine Aggregate

Fine aggregate is the important component in concrete that contains of natural sand or crushed stone. The density of fine aggregate impact the hardened properties of the concrete. Collection of fine aggregate depend on grading zone, particle shape and surface texture, abrasion and absorption and surface moisture it made concrete more durable, stronger.

Table. 4. Physical properties of Fine Aggregate

Sr. no.	Property	Fine Aggregate
1	Specific gravity	2.64
2	Fineness modulous	2.9

Water

Water is an essential component of concrete as it enthusiastically participates in the Chemical reaction with cement and it benefits to form the strength giving Gel. When water is usable for drinking then also used for concrete. This usable water should be free from any acidic, organic substance and also clean portable water used for concrete. The investigation quantity and quality of water is to be selected carefully for the test Conduction. The Physical properties of water are shown in Table

Physical properties of water

Table. 5. Physical properties of water

Sr. no.	Parameter	Amount
1	pH	8.1
2	Taste	Agreeable
3	Appearance	Normal
4	Turbidity	3 (NT Units)
5	Colour	2 (Hazen Units)
6	Hardness	1(mg/l)
7	Sulphates	0.3(mg/l)
8	Chlorides	9(mg/l)

Sugarcane bagasse ash:

Sugarcane bagasse ash (SCBA) is a residual product of the sugar production industry, originating from sugar mills after the extraction of sugar from sugarcane. It is derived from bagasse, the substantial fibrous waste material that constitutes around 30%–34% of the weight of freshly harvested sugarcane. When bagasse is incinerated at a specific temperature in a cogeneration boiler, it produces a significant amount of ash, typically around 2%–3% of the bagasse's mass, known as sugarcane bagasse ash or SCBA.

Table. 6. Various Physical Test on Cement replaced with SCBA

Sr. No.	Name of test	IS Code used	Recommended result	Result
1	Finess test	IS:12089 – 1987	Residue less than10 %	4.5%
2	Standard consistency	IS:4031 (Part 5) – 1988	Between 30% - 35% (approx.)	32.5%
3	Initial setting time	IS:4031 (Part 5) – 1988	Between 30 – 90 min.	100 min.
4	Final setting time	IS:4031 (Part 5) – 1988	Not more than 10 Hours	690 min.
7	Compressive strength	IS:10262 – 2019	Not less than 90%	98.21%

Concrete mix design

Definition: Mix design can be defined as the process of selecting suitable ingredients of concrete (Cement, Water, Fine Aggregate, Coarse Aggregate) and determining their relative proportions for producing concrete possessing specified properties such as workability, certain minimum strength and durability as economically as possible.

Mix Design of M40 grade concrete as per IS 10262-2009A-I C1.
Stipulation for proportioning

a. Grade Designation: M25
b. Type of Cement: 53 Grade conforming IS 12269
c. Maximum nominal size of aggregate: 20mm

d. Minimum cement content: 300kg/m^3 (IS 456:2000)
e. Maximum Water-Cement Ratio: 0.45 (Table no.5 of IS456:2000)
f. Workability: 75mm Slump
g. Exposure Condition: Moderate (for reinforced concrete)
h. Method of concrete placing: Vibrator
i. Degree of supervision: Good
j. Type of Aggregate: Crushed angular aggregate

Test data for material

a. Specific gravity of cement: 3.125
b. Specific gravity: Coarse aggregate (20mm): 2.65 & Fine Aggregate: 2.64
c. Water Absorption: Coarse aggregate:0.68% & Fine Aggregate:2.23%
d. Free (surface) Moisture: Coarse aggregate: Nil & fine aggregate: Nil
e. Sieve Analysis (¼): Coarse Aggregate: conforming to all in aggregate of Table no.2 of IS:383 fine aggregate: conforming to grading zone -I of Table no.4 of IS:383

Target Strength for mix Proportion:

f'ck = fck + 1.65 S Where,
F'ck: Target average compressive strength at 28 Days Fck: Characteristics compressive strength at 28 Days S: Standard Deviation
From table no.1 of IS: 10262:2009, Standard Deviation= 4 N/mm^2
Target strength= 25 + 1.65 × 4 = 31.60 N/mm^2

Selection of Water-Cement ratio

Adopted maximum water-cement ratio= 0.45 from table no.5 of IS:456-2000 for Moderate exposure condition Water-cement ratio is 0.45

Selection of water content

From table no.2 of IS: 10262:2009
Maximum water content for 20mm Aggregate = 186 lit
(For 50 to 100mm slump range) Estimated water content for 75mm slump = 191.58 lit.

Calculation of cement content

Adopted W/C = 0.45
Cement content = $\frac{191.58}{0.45}$ = 425.73 kg/m^3 from table no.5 IS:456

Proportioning of volume of Coarse aggregate and Fine Aggregate content

For pumpable concrete this value should be reduced up to 10%

Materials required for concrete (Mix Proportions SSD condition of aggregates)			
	Grade	**M25**	
	Concrete quantity	= **1** Cum	
Sr. No	**Material name**	**Quantity**	**Unit**
1	Cement	425.733	Kg
2	Fine Aggregate	671.490	Kg
3	Coarse Aggregate 20mm	632.555	Kg
4	Coarse Aggregate 10mm	421.703	Kg
5	Water	191.580	Litr
6	Admixture	0.000	Litr
7	Slump	50 – 100	Mm
9	W/C ratio	0.45	-

Therefore, the actual quantities of materials for mix required for 1 Bag of Cement are;			
1	Water	25.06	Litr
2	Cement	50.00	Kg
3	Fine aggregate	77.14	Kg
4	Coarse Aggregate		
	20 mm	73.79	Kg
	10 mm	49.19	Kg
5	Admixture	0.00	Kg

Cement Required per m^3	7.08 bags	Bags
Slump	78	Mm
W/C ratio	0.45	
Compressive strength of the concrete cubes (7 days)	23.15	N/mm^2
Compressive strength of the concrete cubes (28 days)	35.81	N/mm^2

4. Performance Analysis

Experimental Analysis

The results of testing of different mix designations for all parameter at 28 days age have been tabulated. Compressive strength test, flexural strength test, split-Tensile strength test has been performed on hardened concrete in the laboratory. These tests have been carried out as per the relevant standard and experimental test procedures stated in this chapter.

Compressive strength Test

Table: Compressive strength Test result for 28 days of curing

%	Days of curing	Weight (Kg)	Area (cm^2)	Load (KN)	Comp. strength (N/mm^2)	Average
0%	28	8.30	225	600.12	25.76	26.33
	28	8.51	225	598.34	24.88	
	28	8.4	225	654.35	28.34	
5%	28	8.45	225	525.00	23.33	23.77
	28	8.25	225	537.00	23.87	
	28	8.50	225	543.00	24.13	
10%	28	8.44	225	627.8	27.9	21.83
	28	8.79	225	375.2	16.67	
	28	7.58	225	471.1	20.93	

15%	28	8.30	225	496.0 0	22.04	22.62
	28	8.10	225	513.0 0	22.80	
	28	8.35	225	517.0 0	22.98	
20%	28	8.03	225	592.5	26.37	23.39
	28	8.12	225	411.0	18.26	
	28	7.62	225	525.7	25.58	
25%	28	8.20	225	695.0 0	30.89	31.38
	28	8.45	225	715.0 0	31.78	
	28	8.10	225	707.0 0	31.42	
30%	28	8.22	225	969.1	43.07	39.36
	28	8.25	225	788.0	35.02	
	28	8.34	225	950.0	40.0	

Split-Tensile Strength Test

Table: Split-Tensile Strength Test result for 28 days of curing

% of Replacement	Days	Weight	Load	Split-Tensile strength	Average
0%	28	12.67	75.33	3.25	3.213
	28	12.48	65.5	2.89	
	28	12.53	74.45	3.5	
5%	28	12.33	50.35	2.5	2.933
	28	12.7	70.5	3.2	
	28	12.55	68.4	3.1	
10%	28	12.69	73.0	3.24	3.587
	28	12.81	83.9	3.72	
	28	12.88	88.2	3.8	

15%	28	12.8	85.6	3.7	3.883
	28	12.76	99.2	4.3	
	28	12.6	82.23	3.65	
20%	28	12.54	104.7	4.65	4.203
	28	12.69	84.6	3.76	
	28	12.45	98.23	4.2	
25%	28	12.5	132.76	6.5	6.646
	28	12.67	133.33	6.43	
	28	12.7	148.57	7.01	
30%	28	12.8	162.8	7.23	7.297
	28	12.9	164.7	7.32	
	28	12.98	165.3	7.34	

Flexure Strength test

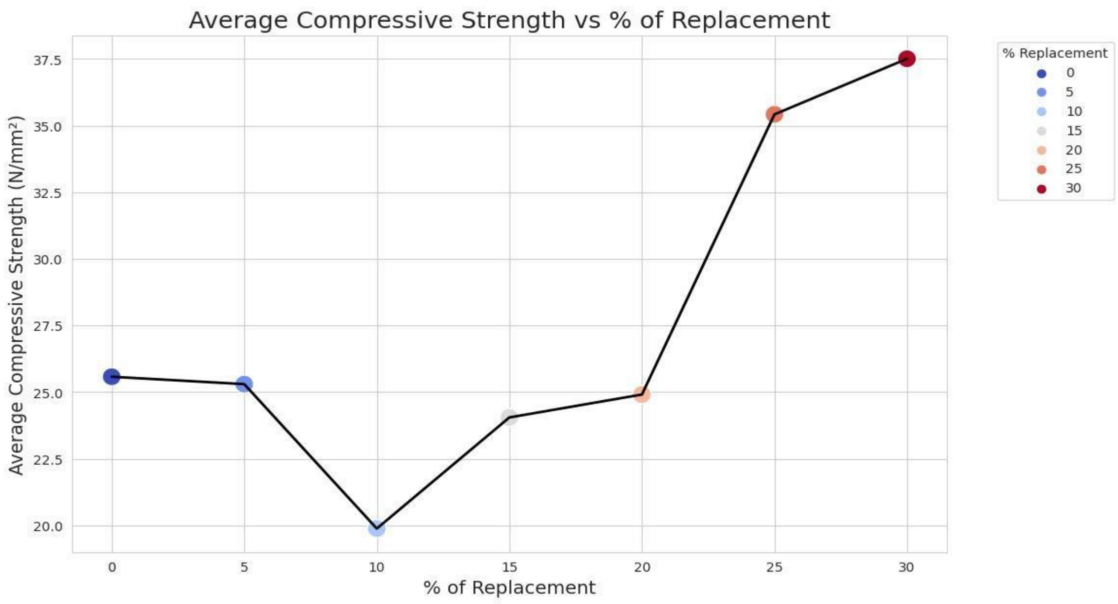
Table: Flexure Strength test result for 28 days of curing

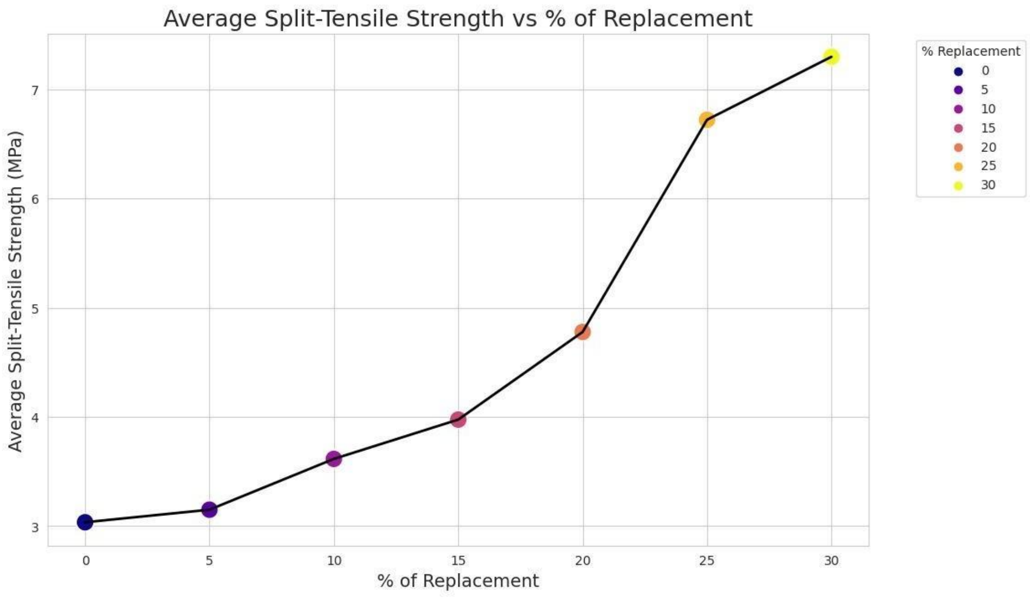
% of Replacement	Days	Weight	Flexure Strength	Average
0%	28	12.384	12.00	12.537
	28	12.56	13.50	
	28	11.197	12.11	
10%	28	12.56	9.10	9.073
	28	12.3	8.89	
	28	12.346	9.23	
15%	28	12.78	6.45	6.853
	28	12.65	7.22	
	28	12.33	6.89	
20%	28	12.44	6.55	6.257
	28	11.98	5.88	
	28	12.67	6.34	
	28	12.77	6.78	

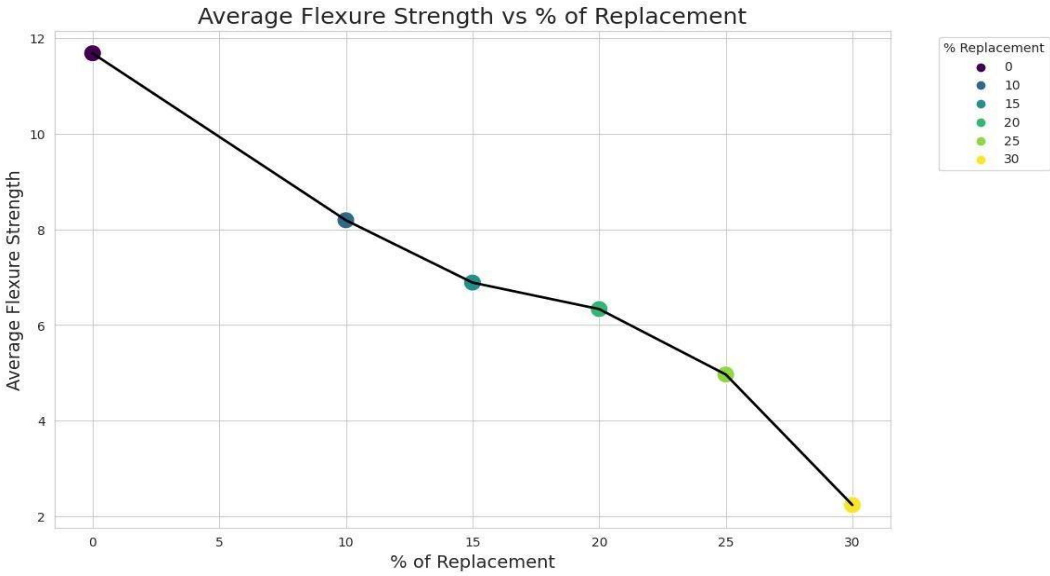
25%	28	12.89	6.46	6.377
	28	11.567	5.89	
30%	28	12.786	2.55	2.343
	28	12.56	2.61	
	28	11.345	1.87	

Result Analysis

Experimental tests result of various physical properties such as Compressive strength, split tensile strength and flexure strength have been tabulated below. Also, the comparison of conventional concrete with SCBA concrete shown below by graphical format.







5.Conclusion

1. Bio-based admixtures are promising alternatives to conventional chemical admixtures for concrete, as they can improve the rheological, mechanical, and durability properties of concrete while reducing the environmental impact of the construction industry.
2. Based upon the physical test of SCBA, as the percentage replacement increases, the initial and final setting time get increased. It indicates that the percentage og SCBA acts like retarding agent.
3. SCBA can be a good replacement for cement in concrete as well as mortar.
4. Physical properties like compressive strength improve at 30% replacement but as the percentage increase cement will act as retarding agent that's why the optimum percentage selected as 25% which give optimum result.
5. Split tensile strength reduced while increasing percentage of replacement.
6. Flexture strength result found that 10% replacement of cement by SCBA provide an optimum solution in comparison with 15%, 20%. 25% & 30% replacement but compared with conventional concrete the result found unsatisfactory
7. The use of sugarcane bagasse ash in concrete can be cost effective as it is a waste material that would otherwise dispose of. Also, the cost effectiveness depends on the availability and transportation of SCBA & it available at Manas Agro Industry at Jamni, Wardha which gave cost effectivity.

Future Scope

1. For the condition where plasticizer have to be used then SCBA 30% concrete can be suitable.
2. To calculate compressive, split tensile & flexure strength for 90 days curing for M25 grade.
3. To calculate mechanical, chemical & thermal properties of concrete for grade M30.

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