PARTIAL REPLACEMENT OF CEMENT BY SUGARCANE BAGASSE ASH AND AGGREGATE BY SISAL FIBER

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ABSTRACT

The Concrete increasing strength is used natural waste material SCBA and agriculture waste material sisal fibre. This research studies showed the better improvement in the flexural of sisal fibre and SBCA India produces around 24-25MT of sugar these days and also same is approximately the estimated sugar cane bagasse ash (SCBA) produce of India. The cement M25 grade used in concrete is replaced accordingly with the percentage of 5%,10 %, and 15% sisal fiber 2% added by aggregate and sugarcane bagasse ash 5% added by cement, the concrete cubes are testing at the 7,14, and 28 days curing.

KEYWORDS: Sisal fiber, Sugarcane bagasse ash, Compressive, Split tensile and Flexural strength.

INTRODUCTION

It is generally known that, the fundamental requirement for making concrete structures is to be produce good quality concrete. Good quality concrete is produced by carefully mixing cement, fine and coarse aggregate, water and combining admixtures as needed to obtain the optimum product in quality and economy for any use good concrete. SBCA incorporated concrete finds a wide range of applications in the production of high strength concrete with improved mechanical properties. In addition, the presence of sisal fibre provides nominal workability on the fresh concrete properties even at higher water to binder ratio. Tensile test of composite showed a decreasing trend of tensile strength and increasing trend of the Young's modulus with increasing fibre content. The flexural strength, flexural modulus, impact strength and hardness were found to be increased with increasing fibre loading up to 10% fibre reinforced composite results. The combined addition of polymeric fibres and polymer latex suspensions provided synergistic improvements on the concrete composites. Mechanical strength improvements in terms of compression and bending stress of fibre concrete mixes necessitates more detailed experimental investigations.

LITERATURE REVIEW

R. Srinivasan and K. Sathya [1]

conducted experiments on concrete cube, cylinder, and prism specimens in which cement was replaced with SBCA in 0-25% ratio. It was observed that the strength of concrete under compression, tension, young's modulus, and flexure increased up to 10% of replacement after that strength results was decreased.

Jayminkumar A. Patel, Dr. D. B. Raijiwala [2]

replaced the cement by 0 & 5% SCBA. 150X150X150 mm cubes were casted in M25 concrete and tested the specimen for 7th day, 14th day, 28th day and 56th day of curing in Compressive Testing machine. The results shows that the compressive strength of concrete can be increased reducing the consumption of cement indicating best use of SCBA instead of landfilling and making the environment clean.

U.G.Harshali S. Hire, Prof. V.S. Bhalerao [3]

they studied on "Partial replacement of cement by Sugarcane bagasse ash and there effect on Concrete". The chemical composition of Bagasse Ash was studied and its effects on compressive and tensile strength of concrete after replacement of cement in 0, 5, 10, 15% replacement. They found out that Bagasse ash is a valuable pozzolanic material and it can potentially be used as a partial replacement for cement and make construction cheaper. They also found out that the water requirement increases as the bagasse ash content increases. This could reduce the environmental problems and minimize the requirement of land fill area to dispose Bagasse Ash.

Prashant O Modania, M R Vyawahare [4]

they conducted experimental investigation on properties of concrete after the quantities of sugar cane bagasse ash is replaced by 0, 10, 20, 30 and 40% volume of sand. The water cement ratio was kept 0.40 and the dose of superplasticizer was kept constant at 0.8%. The casted concrete specimens were cured under standard condition in the laboratory and tested for 7 days and 28 days compressive strength, 28 days split tensile strength and sorptivity test. It was concluded that the fraction of fine aggregates i.e. 10% to 20% can be effectively replaced with a bagasse ash (untreated) without a considerable loss of workability and strength properties hence in its purest form the bagasse ash can prove to be a potential ingredient of concrete since it can be an effective replacement to cement and fine aggregate

Abdul Rahuman, SaikumarYeshika [5] (2015)

"Study On Properties Of Sisal Fibre Reinforced Concrete With Different Mix Proportions And Different

Percentage Of Fibre Addition" The present research was designed to check the workability and strength properties of sisal fibre reinforced concrete with different mix proportions and different percentage of fibre addition

P.Loganathan, Dr.G.S.Thirugnanam [6] (2015)

"Experimental study assessing the strength and crack resistant characteristics of sisal fibre reinforced concrete" Generally, cement concrete is weak in tensile strength and even the steel reinforced concrete has limited ductility and little resistance to cracking.

Nidhi Relan and Dr. A.K. Saxena [7]

conducted an experimental study by replacing the cement in concrete by SCBA in 5-25% ratio and conducting compressive strength test and slump test on resulting concrete. The test results indicated that the cement could be advantageously replaced with SCBA up to a maximum limit of 12.5%.for M35 concrete, also the study revealed that the compressive strength increased up to 10% replacement whereas beyond 15% replacement the strength was found to be decreasing.

Sirirat Janjaturaphan and Supaporn Wansom [8]

Studied on, "The Pozzolonic Activities of Industrial Sugar Cane Bagasse Ash". They find out the chemical composition of the Sugarcane Bagasse Ash and compared them with the other pozzolanic material that is, rice husk ash and concluded that the SCBA is suitable for the partial replacement of cement.

METHODOLOGY

Review of literatures
↓
Material collection
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Material studies
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Mix design (M25)
↓
Fresh concrete testes
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Workability test
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Casting of specimen
↓
Result

Cement

The cement used in this study was ordinary Portland cement (OPC) of grade 43. The specific gravity of cement is 3.15. It has been possible to upgrade the qualities of cement by using high quality limestone, modern equipment's, and closer on-line control of constituents, maintaining better particle size distribution, finer grinding and better packing. Although they are little costlier than low grade cement, they offer 10-20% saving in cement consumption and also, they offer many other hidden benefits.

Chemical properties of cement

S.NO	COMPONENTS	WEIGHT
1	Lime (CaO)	63%
2	Silica (SiO_2)	22%
3	Alumina (Al_2O_3)	6%
4	Iron oxide (Fe_2O_3)	3%
5	Magnesium oxide (MgO)	2.5%
6	Sulphur trioxide & loss of ignition (SO_3)	1.5%

Sugarcane bagasse ash

Sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicelluloses of lignin. Each ton of sugarcane generates approximately 26%of bagasse (at a moisture content of 50%) and 0.62% of residual ash. The residue after combustion presents a chemical composition dominates by silicon dioxide (sio2). In spite of being a material of hard degradation and that presents few nutrients, the ash is used on the farms as a fertilizer in the sugarcane harvests. In this sugarcane bagasse ash was collected during the cleaning operation of boiler in the sugar factory, located inthetownofAnakapalli,AndhraPradesh.

Physical Properties of SCBA

S. No	Property	Value
1	Density	575Kg/m3
2	Specific Gravity	1.90
3	Mean particle size	0.1-0.2 µm
4	Min specific surface area	2500m2/.kg
5	Particle shape	Spherical

Chemical Properties of SCBA

S No	Component	Symbol	Percentage
1	Silica	SiO2	63 2
2	Alumina	Al2O 3	31.5 3
3	Ferric Oxide	Fe2O 3	1.79 4
4	Manganese	MnO	0.004 5

	Oxide		
5	Calcium Oxide	CaO	0.48 6
6	Magnesium Oxide	MgO	0.39
7	Loss on Ignition	LOI	0.71

Chemical Properties of Sisal Fibre:

S No	Component	Percentage
1	Cellulose	65
2	Hemicelluloses	12
3	Lignin	9.9
4	Waxes	2

Sisal Fibre

Sisal fibre is a species of Agave. It is botanically known as Agave sisalana. The material is chosen to improve the various strength properties of the structure to obtain sustainability and better-quality structure. Short discrete vegetable fibre (sisal) was examined for its suitability for incorporation in cement concrete. The physical property of this fibre has shown no deterioration in a concrete medium. Leaves are dried, brushed and baled to form fibre.

Compression Test

The cube specimens were tested for compressive at the end of 7 days,14 days and 28 days. The specimens stored in water were tested after drying the specimens. The projecting fines were removed if any.

The bearing surfaces of the testing machine was wiped clean and again the surface of the specimen was cleaned from Sand and other materials, which may come in contact with the compression plates. While placing the cubes in the machine care was taken such the load was applied to opposite sides of the cubes as cast. The axis of the specimen was carefully aligned with the centre of thrust of the spherically seated plate.

The load was applied without shock and increase continuously until the resistance of the specimen to the increasing load brake down and the greater load could be borne by the specimen. The maximum load by the specimens was recorded.

The compressive Strength of the specimen was calculated by dividing the maximum load applied to the specimen by the cross-section area.

Split Tensile Test

This is also sometimes referred "Brazilian". This test was developed in Brazil in 1943. At about the same time this was independently develop in Japan.

Placing a cylindrical specimen horizontally between the loading surface of a compression testing machine carries out this test and the load is applied and failure of the cylinder along the vertical diameter

When the load is applied along the vertical diameter of the cylinder. It is subjected to horizontal stress of $2P/\pi Ld$

Where,

P – Compressive load on the cylinder

L – Length of the cylinder

D – Diameter of the cylinder

The loading condition produce a high compressive stress immediately below the two generators to which the applied. But the large portion corresponding to depth is subjected to a uniform Tensile stress is acting horizontally. It is estimate that the compressive stress is acting for about 1/6 depth and the 5/6 depth is subjected to tension.

In order to reduce the magnitude of high compression stress near the points of application of the load, narrow packing strips, of suitable such as plywood are strips should be soft enough to allow distribution of load over a reasonable area. Normally, a plywood strip of 25mm wide, 3mm thick and 30cm long is used. Splitting Strength give 5 to 10% higher value than the direct Tensile Strength.

Flexural Strength

The Flexural Strength for the Concrete is determined by using **Loading Frame**. The hydraulic jack loaded the beam and the load is measure by using the proving ring. The selected span was 1200mm and the 2-point loads were applied at 1/3 span.

Calculating

The Flexural Strength or modulus of rupture

$F=pl/bd^1$

$F= 3Pa/bd^2$

Where;

P – Maximum load (kg)

L – supported length (cm)

b – width of specimen (cm)

d – failure point depth (cm)

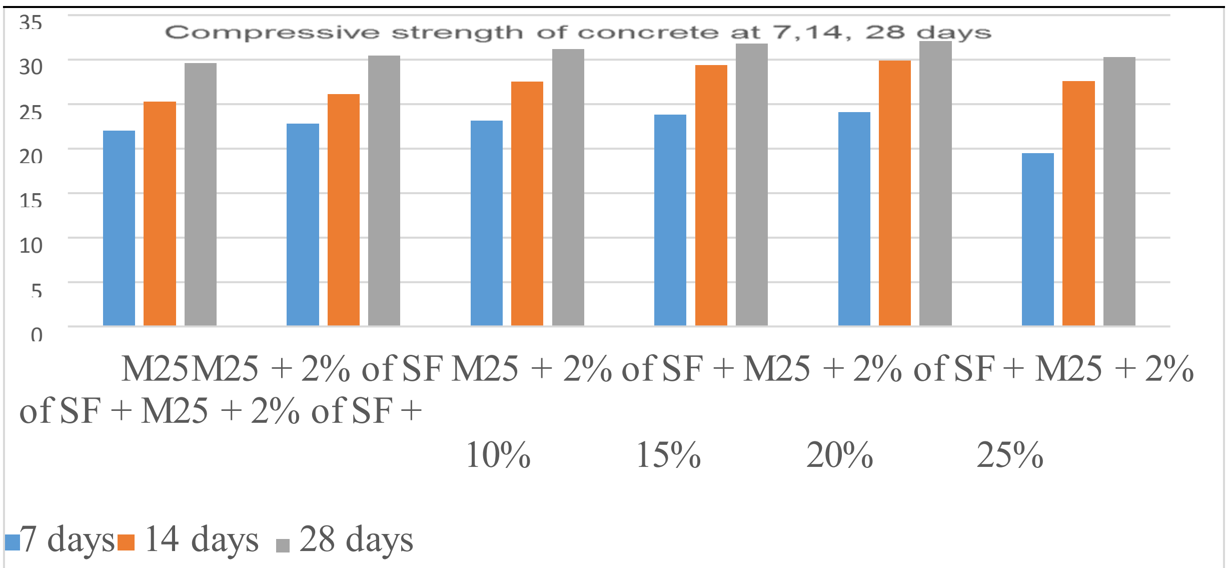
a – the distance between the line of fracture and the nearer support, measured on the centre line of the tensile side of the specimen.

COMPRESSIVE STRENGTH TEST RESULT

Compressive Strength of Cubes at 7,14, and 28 Days

MIX	M25	M25 + 2% of SF	M25 + 2 % of SF +10% of SCSFR	M25 + 2% of SF + 15% of SCSFR	M25 + 2% of SF + 20% of SCSFR	M25 + 2% of SF + 25% of SCSFR
7 days	22	22.8	23.1	23.8	24.1	19.5
14 days	25.3	26.1	27.51	29.4	29.9	27.6
28 days	29.6	30.45	31.15	31.8	32.1	30.3

Graphical representation of Compressive strength:

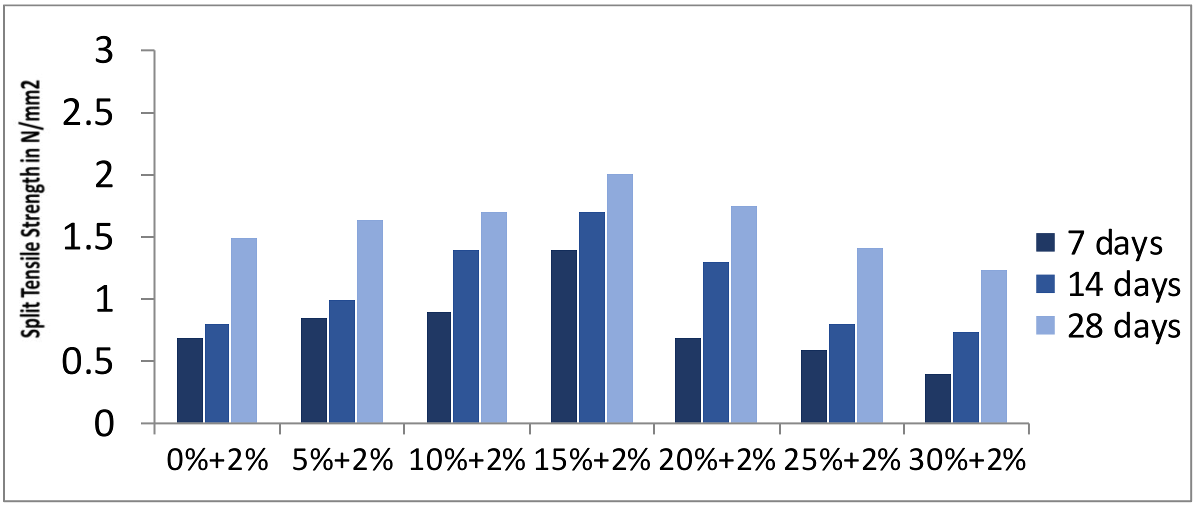


SPILT TENSILE STRENGTH TEST RESULT

Spilt Tensile Strength of Cylinders at 7 days ,14 days and 28 Days

MIX	M25	M25 + 2% of SF	M25 +2 % of SF +10% of SCSFR	M25 + 2% of SF + 15% of SCSFR	M25 + 2% of SF + 20% of SCSFR	M25 + 2% of SF + 25% of SCSFR
7 days	2.1	2.05	2.25	2.32	2.38	2.29
14 days	2.48	2.44	2.48	2.52	2.57	2.50
28 days	2.62	2.54	2.58	2.63	2.66	2.62

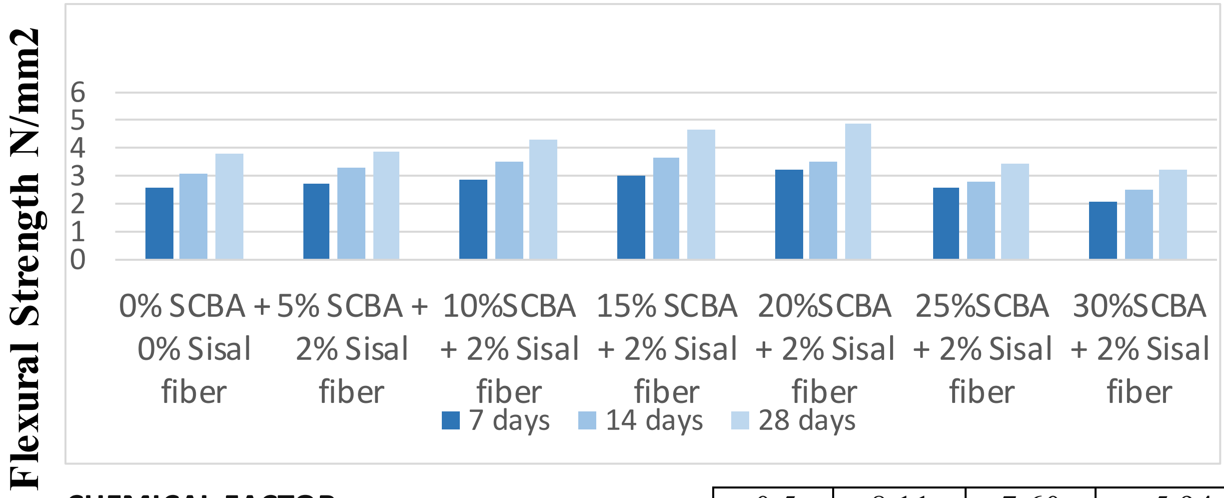
Graphical analysis of Split Tensile Test



Flexural Strength of Beam at 7, 14 and 28 Days

	M25	M25 + 2% of SF	M25 + 2% of SF + 10% of SCSFR	M25 + 2% of SF + 15% of SCSFR	M25 + 2% of SF + 20% of SCSFR	M25 + 2% of SF + 25% of SCSFR
7 days	2.6	2.7	2.9	3	3.25	2.62
14 days	3.1	3.3	3.5	3.7	3.5	2.8
28 days	3.81	3.9	4.3	4.7	4.9	3.43

Graphical Representation of flexural strength test result



CHEMICAL FACTOR

Acid Attack

Concrete is not fully resistant to acids. Most acid solutions will slowly or rapidly disintegrate Portland cement concrete depending upon the type and concentration of acid. Certain acids, such as oxalic acid and phosphoric acids are harmless. The most vulnerable part of the cement hydrate is Ca (OH)2, but C-S-H gel can also be attacked. Siliceous aggregates are more resistant than calcareous aggregates. Concrete can be attacked by liquids with pH value less than 6.5. But the attack is severe only at a pH value below 5.5. At a pH value below 4.5, the attack is very severe.

WEIGHT REDUCTION AFTER ACID ATTACK

Fiber and SBCA (%)	Initial Weight (Kg)	Weight after Acid attack (Kg)	Weight Reduction (%)
0	8.21	7.72	5.96
0.5	8.11	7.60	5.94
0.10	8.01	7.53	5.81
0.15	7.94	7.46	5.79

Chloride Attack

Chloride attack is one of the most important aspects for consideration when we deal with the durability of concrete. Chloride attack is particularly important because it primarily causes corrosion of reinforcement. Statistics have indicated that over 40 per cent of failure of structures is due to corrosion of reinforcement. The Bureau of Indian Standard earlier specified the maximum chloride content in cement as 0.05 per cent. But it is now increased the allowable chloride content in cement to 0.1 per cent. The amount of chloride required for initiating corrosion is partly dependent on the pH value of the pore water in concrete. At a pH value less than 11.5 corrosion may occur without the presence of chloride. At pH value greater than 11.5 a good amount of chloride is required.

WEIGHT REDUCTION AFTER CHLORIDE ATTACK

Fiber and SBCA (%)	Initial Weight (Kg)	Weight after Chloride attack (Kg)	Weight Reduction (%)
0	8.33	8.28	0.60
0.5	8.24	8.19	0.56
0.10	8.16	8.12	0.49
0.15	8.13	8.09	0.41

Sulphate Attack

Most types soil contain some amount of sulphate in the form of calcium, magnesium, potassium and sodium. Decay of organic matters in marshy land, shallow lakes often leads to the formation of H2S, which can be transformed into sulphuric acid by bacterial action. Solid sulphates do not attack the concrete severely but when the chemicals are in solution, they find entry into porous concrete and react with the hydrated cement products.

Sodium Sulphate attacking Calcium hydroxide is taken as an example:

$Ca(OH)_2 + Na_2SO_4.10H_2O \rightarrow CaSO_4.2H_2O + 2NaOH + 8H_2O$

The reaction with calcium aluminate hydrate is as follows:

$2(3CaO.Al_2O_3.12H_2O) + 3(Na_2SO_4.10H_2O) \rightarrow 3CaO.Al_2O_3.3CaSO_4.31H_2O + 2Al(OH)_3 + 6NaOH + 17H_2O$

WEIGHT REDUCTION AFTER SULPHATE ATTACK

Fiber and SBCA (%)	Initial Weight (Kg)	Weight after Sulphate attack (Kg)	Weight Reduction (%)
0	8.21	7.72	5.96
0.5	8.16	7.64	5.91
0.10	8.11	7.53	5.84
0.15	8.06	7.45	5.71

CONCLUSIONS

- Reinforcement of Concrete with 10 % of Sisal fiber and Sugarcane Bagasse Ash Increase the Compressive Strength, Split Tensile Strength and Flexural Strength.
- Sisal fiber and Sugarcane Bagasse Ash being low in Density Reduces the overall weight of the Fiber Reinforced Concrete thus it can Be used as a Structural light Weight Concrete.
- By Reinforcing the concrete with Sisal fiber and Sugarcane

Bagasse Ash are freely available, we can reduce the agricultural waste.

- The phase I ends up on the Compressive test and Split Tensile test.
- Th phase II Chemical admixture in concrete is beneficial for the better workability and strength it's reduces the water content up to 60%.
- Flexural Strength increase in the sisal fibre concretes showed significant increase in strength up to 4.9 MPa at 28 days, when compared to plain concrete 3.25aaa MPa.

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