Research Paper Engineering

Application of Sugarcane Bagasse Fibres As Concrete Composites for Rigid Pavement

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ABSTRACT

Investigations to overcome the brittle response and limiting post – yield energy absorption of concrete led to the development of fiber reinforced concrete using discrete fibers within the concrete mass. Sugarcane Bagasse is a by-product of the sugar industry, the quantity of production in each country is in line with the quantity of sugarcane produced i.e., for each 10 tons of sugarcane crushed in a sugar factory produces nearly 3 tones of wet Bagasse. A concrete mix has been designed to achieve the grade of M25 as required by IS 44 – 2008. To identify the effects on mechanical strength properties due to the addition of this fiber the mechanical strength tests on standard specimens such as compressive strength and flexural strength are conducted. Totally 27 cubes and 27 beams specimens were cast and tested. Based on the experimental results mechanical strength studies, a different aspect ratio of 30, 60 and 90 and three volume fractions such as 0.5%, 1% and 1.5 % are chosen for further studies. Utilization of these fibers in concrete leads to an effective solid waste management

KEYWORDS | Sugarcane bagasse fiber, Concrete, Compressive strength, Flexural strength.

1. INTRODUCTION

The sugarcane cultivation has great economic significance in the rural sector in India. A statistical report shows India produced 298.42 million tonnes of sugarcane in 2002. The efficient use of sugarcane fibres obtained from the sugarcane wastes, can be made without creating problem to the environment and the same time meeting the quality requirements of the pavements by adding it in concrete mix.

As per Indians Standards IS 1196-1978, concrete is unaffected by dry sugar or solutions of low concentrations at normal temperatures. Sugarcane Bagasse is a by-product of the sugar industry, the quantity of production in each country is in line with the quantity of sugarcane produced i.e., for each 10 tonnes of sugarcane crushed in a sugar factory produces nearly 3 tonnes of wet Bagasse. In this study, it is proposed to investigate the influence of sugarcane fibres as stabilizing additive on engineering properties on Concrete mix for rigid pavement.

2. METHODOLOGY

- Mix Design of concrete as per IRC 44: 2008.
- Check out compressive strength of mixes with compression test carried out on cubes.
- Check out Flexural Strength of beams with flexural testing machine.
- Check out thickness reduction of concrete slab with IRC 58: 2002 guidelines.

3. EXPERIMENTAL WORK

3.1 Cement

Ordinary Portland cement of 43 grades conforming to IS 8112-1989 was used.

3.2 Fine Aggregate

Natural river sand was used as fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part- I). The results indicate that the sand conforms to Zone II of IS: 383 – 1970.

3.3 Coarse Aggregate

Crushed granite stones obtained from local quaries were used as coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of coarse aggregate were determined by conducting tests as per IS: 2386 (Part – III). The physical properties are tabulated in table 4.

Table 2. Physical Properties of Coarse Aggregate & Fine aggregate.

Physical properties	C.A.	F.A.
Specific gravity	2.6	2.6
Fineness Modulus	2.73	2.83
Water Absorption	0.5%	1%
Bulk density (kg/m3)	1590	1654
Free moisture content	Nil	Nil
Agg Impact value (%)	11.2	-
Agg. Crushing value (%)	25.12	-

3.4 Water

Portable water free from salts was used for casting and curing of concrete as per IS: 456 – 2000 recommendations.

3.5 Fibres

First the sugarcane was dried directly in sun light till it becomes dry, then it's were chopped off to size of Aspect ratio 30, 60 and 90. Place the chopped Bagasse in oven at a constant temperature of 50 to 60°C for an hour (this makes the Bagasse brittle).Finally the Bagasse used for the study.

Table 5. Properties of the Fiber

Properties of fiber	Sugarcane
Diameter	1.50 mm
Aspect Ratio	30, 60 % 90
Specific gravity	0.52
Water Absorption	286.6
Density in kg/m^3	260

3.6 Mix Proportion

A mix was designed as per IS 44-2008 to achieve a minimum target strength of 25 N/mm^2. The mix proportion was 1:1.38:3.09. A constant water cement ratio of 0.40 was used. The quantities of different Ingredients per cubic meter of concrete mix were given in Table 6.

Table 6. Quantities of ingredients of Concrete Mix

Water	Cement	Fine Agg.	Coarse Agg.
185 kg	350 kg	483 kg	571 kg

4. RESULTS AND DISCUSSIONS

4.1 Compressive strength study

Totally 27 cubes specimens of size 150 mm with 9 mixes were casted and tested. Three volume fractions were considered. Results for compressive strength based on the average values

of three test data for all mixtures are presented fibre wise in Table 7. A sample comparison graph for sugarcane fibre concrete is plotted to study the effect of fibre is shown in Fig. 1

Table 7. Result of Compressive strength of Cube at 28 days

Type of Concrete	Volume Fraction(%)	Aspect ratio	Result
SCBC	0.5	30	27.96
	0.5	60	28.44
	0.5	90	29.22
	1.0	30	27.58
	1.0	60	29.04
	1.0	90	30.78
	1.5	30	27.98
	1.5	60	28.63
	1.5	90	28.62

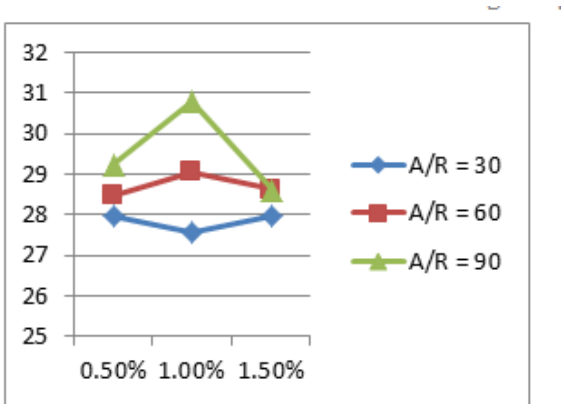

Figure 1 Comparison of Compressive strength results at 28 Days

4.2 Flexural strength study

The investigation is carried to study the flexural behavior of concrete. 27 simply supported beams consisting of balanced section are cast and tested. The cross section of the beam specimen is 100mm x 100mm x 700mm.

Table 8. Result of flexural strength of beam at 28 days

Type of Concrete	Volume Fraction(%)	Aspect ratio	Result
SCBC	0.5	30	3.39
	0.5	60	3.66
	0.5	90	3.79
	1.0	30	3.22
	1.0	60	3.47
	1.0	90	4.78
	1.5	30	3.49
	1.5	60	4.50
	1.5	90	4.73

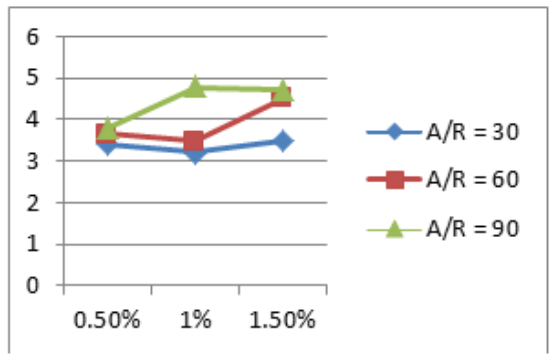

Figure 2 Comparison of Flexural Strength results at 28 Days

5. DISCUSSION

The aim of Mix Design was to make a concrete of desirable strength, durability and economy. The present study reveled the effect of size of fibres on compressive strength of M-25 concrete mix design. The waste product "sugarcane fiber" was mixed as ingredients of concrete and was studied in terms of compressive strength of concrete and following results were obtained. Figure- 1 and 2 shows that when volume fraction is 1% and Aspect Ratio is 90, Sugarcane Fibre by weight was allowed to mix with OPC for making concrete, its compression and flexural strength increased up to 9% and 6% respectively. It was also possible to increase other properties of concrete like durability, cracking resistance, fire resistance property etc. For different concrete structural works we hope that present study will act as guidance for the fiber use in concrete for strength, durability and economy.

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