Effect of Sisal Fiber in Concrete

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Abstract— Sisal fiber is an alternative class of fiber which can be used in concrete. The sisal fiber is prepared form plants and fibers have good mechanical properties. In present study, sisal fiber is mixed in different quantities to produce sisal fiber reinforced concrete. The effect of proportions of sisal fiber in concrete is studied by conducting experimental tests on slump value, compressive strength and flexural strength.

Key words: Compressive Strength; Concrete; Sisal Fiber; Flexural Strength

I. INTRODUCTION

Sisal fiber comes from the leaves of the plant. It's sometimes obtained by machine decortications during which the leaf is crushed between rollers so automatically scraped. The fiber is then washed and dried by mechanical or natural suggests that. The dried fiber represents solely four of the whole weight of the leaf. Once it's dried the fiber is automatically double brushed. The lustrous strands, sometimes creamy white, average from eighty to a hundred and twenty cm long and 0.2 to 0.4 millimetre in diameter.

Sisal fiber is fairly coarse and inflexible. it's valued for cordage use attributable to its strength, durability, ability to stretch, affinity sure enough dyestuffs, and resistance to deterioration in water. Sisal is employed by trade in 3 grades:

The lower grade fiber is processed by the paper trade attributable to its high content of polyose and hemicelluloses. The medium grade fiber is employed within the cordage trade for making: ropes, baler and binders twine. Ropes and twines square measure wide utilized for marine, agricultural, and general industrial use. The higher-grade fiber once treatment is born-again into yarns and employed by the carpet trade.

The fiber is additionally used for non-woven matting, brushing and roving. Brazil is that the largest world producer of sisal fiber with a hundred thirty thousand tons per year. Sisal is that the solely crop that resists the semi-arid climate and that is economically possible to the poor northeast region of the country wherever around 800,000 folks rely upon it. Besides Brazil sisal is additionally created in Mexico (45,000 tons/year); China (36,000 tons/year); United Republic of Tanzania (24,000 tons/year); African country (25,000 tons/year) and Madagascar (15,000 tons/year) [1].

Of Brazilian production seventieth is exported within the kind of raw fiber and made merchandise. The raw fiber is hierarchic as kind one, kind a pair of and kind three, continuously double brushed (DB) and crude. There are some residues normally sold to the paper and matting trade, cherish Bucha (wadding), crude or clean, and Refugo (waste) brushed or ungroomed. The mechanical property of sisal fiber prepared composites shows good agreement [2].

The fibers of any kind in concrete significantly affect the behaviour of hardened concrete - increasing the strength while and durability alongwith decreased workability [3]–[6]. The fiber strips are also used for external bonding of reinforced concrete [7] and are also used in concrete [8], [9].

The review study [10] showed that in reinforced cement concrete and other cement based composites suggested that further development and experiments are required for use of sisal fiber in cement composites.

The mechanical properties of sisal fiber in various reinforced concrete structure elements have been studied [1], [2], [11]–[14] and results show good agreement. The sisal fiber is as shown in Fig. 1

Fig. 1: Sisal fiber Achim Raschka / CC-BY-SA-4.0 http //commons.wikimedia.org/wiki/File:Sisal_fibers.JPG

In present study, the sisal fiber is mixed in concrete in various proportions and effect of amount of sisal fiber on property like compressive strength, slump and flexural strength is observed.

A. *Materials:*

For cement, standard Portland cement of fine quality obtained from provide is employed having . The physical and chemical properties of cement like relative density, soundness, lime, alumina, periclase content etc. square measure as reportable by provider.

The sand used as fine combination is obtained from native provider. The sieve analysis of sand is performed and sand is found to evolve to Zone-II of IS code (IS 383). The sand is checked to be free from organic materials etc. The wet content of fine combination was found to be 1 Chronicles. The coarse aggregates, obtained from suppliers, are of grade 20 mm, angular in shape. The crushing value, impact value etc. are found to be within limits specified in IS 2386. Water used for admixture of cement yet as for action is needed to be have restricted concentration of organic particles, inorganic particles and chemicals like sulphates, chloride etc. during this regard potable water provided by Municipal Corporation or H2O from lakes and stream is found satisfactory.

B. *Mix Design:*

The various mixes prepared and their designation are as given in Table 1 in which three different mix designs of concrete are shown.. The tests conducted on these mixes are - slump test, compressive strength test and flexural strength test. The flexural strength test is important in finding out effect of fiber of any type in concrete. The slump test is performed on fresh concrete using slump cone of height 300 mm. For compressive strength and flexural strength test, cubes and

beams of standard size are casted after mixing the concrete proportions.

Name	Concrete target strength of design (N/mm²)	Sisal fiber percentage (%)
MI2	20	0.2
MI4	20	0.4
MI6	20	0.6
MI8	20	0.8
MI10	20	1.0
MII2	25	0.2
MII4	25	0.4
MII6	25	0.6
MII8	25	0.8
MII10	25	1.0
MIII2	30	0.2
MIII4	30	0.4
MIII6	30	0.6
MIII8	30	0.8
MIII10	30	1.0

Table 1: Mix type with their naming and concrete strength for design mix and sisal fiber amount

II. RESULTS AND DISCUSSIONS

Results of various experimental tests conducted are given below.

A. Slump Value:

The slump test conducted on sisal fiber is given in Table 2 and result is plotted in Fig. 2. Due to rough nature of fibers, the workability of concrete is found to reduce when sisal fibers are used, at higher concentration more than 1% the concrete was found to be very harsh and difficult to work.

Name	Slump (mm)
MI2	108.75
MI4	122.12
MI6	114.8
MI8	84.32
MI10	80.07
MII2	126.15
MII4	128.85
MII6	123.38
MII8	90.77
MII10	76.55
MIII2	121.53
MIII4	123.45
MIII6	117.9
MIII8	92.71
MIII10	84.56

Table 2: Slump test results

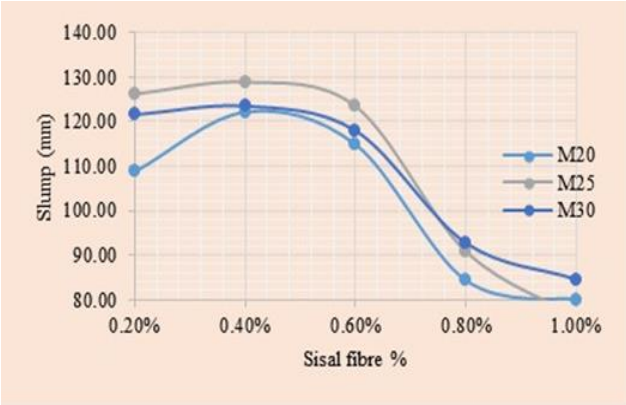

Fig. 2: Slump test result plot

B. Compressive Strength:

The compressive strength test result sisal fiber reinforced concrete is given in Table 3. In Fig. 3, the compressive strength result is plotted for different mix designs and it is found that in case of M 30 concrete, the increase in amount of sisal fiber increased the compressive strength while in other mixes the vice versa condition is obtained.

Name	Compressive strength (N/mm²)
MI2	32.87
MI4	27.44
MI6	29.18
MI8	29.78
MI10	30.35
MII2	37.21
MII4	33.07
MII6	35.63
MII8	40.35
MII10	40.8
MIII2	38.54
MIII4	40.81
MIII6	41.54
MIII8	42.82
MIII10	45.71

Table 3: Compressive strength test results

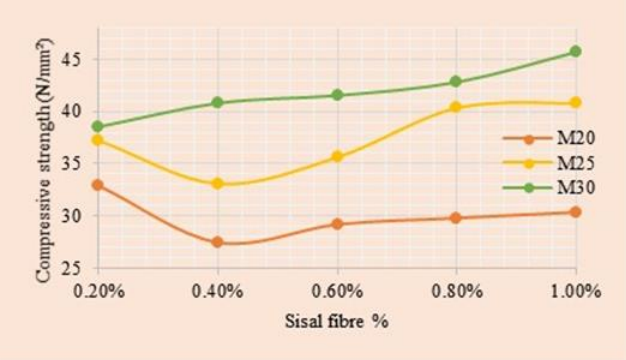

Fig. 3: Compressive strength test results

C. Flexural Strength:

The flexural strength test results of sisal fiber reinforced concrete are shown in Table 4. For different concrete mixed designs, the flexure strength is plotted with amount of sisal fibers. It is observed that in M 30 concrete there is secure increase in flexural strength with increase in sisal fiber.

Name	Flexural strength (N/mm²)
MI2	3.02
MI4	3.37

MI6	4.19
MI8	2.29
MI10	3.28
MII2	4.36
MII4	3.59
MII6	2.15
MII8	2.47
MII10	4.52
MIII2	2.1
MIII4	2.57
MIII6	3.86
MIII8	4.32
MIII10	5.55

Table 4: Flexural strength test results

Fig. 4: Flexural strength plot for different concrete mixes

III. CONCLUSION

In present study, effect of sisal fiber in concrete is studied experimentally by varying proportions of sisal fiber in three different type of design mix concrete and conducting tests of slump, compressive strength and flexural strength. It is observed that there is decrease in workability as fiber amount is increased. This decrease is similar to the decrease when other type of fiber are used which is due to roughness of fibers. In case of compressive strength and flexural strength, there is increase in strength in case of M 30 concrete with increase in amount of fiber. However, for concrete of lower grade, there is no substantial increase in both compressive and flexural strength.

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