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FIBER REINFORCED CONCRETE USIING SISAL FIBER

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Abstract - *This research work involves the topic of adding natural fibers to the concrete to study the strength properties and observe whether the propagation of shrinkage problems is reduced. Basically, there are two types of natural fibre. Natural inorganic fibres like asbestos, basalt, etc. as well as natural organic fibres like banana, bamboo, coconut, palm, pine, kenaf, jute, sisal, sugar cane, and so on. Natural fibres are studied as construction materials by different researchers and can be used in cement, mortar or concrete in building materials. This research work may include the characteristics of sisal fibre, its properties and also compatibility of fibre(sisal) and compares its nature of fibre- free concrete and concrete with natural fibre(sisal). But it also to compare and draw the conclusion of the proportion of different fibres cement. This study summarizes the comparison and difference between fiber-free concrete and concrete with natural fiber(sisal).*

Key Words: Sisal fiber, Fiber reinforced concrete, Natural fiber, Artificial fiber, Testing.

1. INTRODUCTION TO SISAL FIBER

Sisal fiber is the most commonly used plant fibers and is very easy to grow. Sisal is a strong fiber obtained from the sisal plants leaves. The plant of sisal fiber is officially called agave-sisalana. The plants having leaves like a sword-shaped rose that begins to have teeth and gradually wears mature teeth over time. All leaves have many straight and long fibers that can be eliminated by means of a method called peeling or decortication. During the peeling process, the leaves are broken to remove the pulp and plant material, left behind the strong fibers. For the production of twine and textile, fibers will be warped into thread, or pulped to make paper make paper products.

1.1 PROPERTIES OF SISAL FIBER

The actual content of the fiber elements is about 4% of the weight of the plant and can be extracted by a method as "decortication". In their natural life, typical plants generate 200 to 250 fruitfully available leaves. Also each leaf of sisal plants will produce approximately 1000 fibers.

In order to obtain a superior quality structure and good sustainability, it is preferable to use sisal fibers to develop several strength characteristics of the structure. Different plant fibers of sisal fibers of sisal were tested for its adequacy for the addition in cement concrete. The physical properties of the fibers do not show deterioration of the concrete structure. The leaves are dried out, brushed and bailed to produce fibers from sisal plant.

1.2 CHARACTERISTICS OF SISAL FIBER

Sisal fiber is the hardest cellulose fibers like coconut fiber. It contains cellulose about 70% in the fiber. With cellulose, this fiber also consists of hemicellulose, lignin, pectin and wax etc. the properties of this fiber are greatly affected by its chemical composition. In cellulosic fibers like sisal and coconut fibers, cellulose is the strongest organic constituent that imparts fiber stability, stiffness and strength, where sisal fibers contain 70% of cellulose only. Hence, we can say that sisal fiber is a one of the strongest fibres. Hemicellulose is a polysaccharide that binds together in a relatively short branch. Lignin is an aromatic hydrocarbon polymer-composite that gives stiffness to the sisal plant.

1.3 NEED OF STUDY

The application of concrete as a strengthening material in structural is somewhat limited by the disadvantage such as poor ductility and durability, fatigue, lower impact resistance, low tensile strength, brittleness. It is also very much restricted to absorb dynamic stresses caused due to shock loading. The brittleness is compensated in the structural member by adding a reinforcing bar or pre- stress in the tensile area. The development of steel bars solves the problem of lower tensile property of concrete. Lower tensile strength and higher strength requirements of the concrete is the main problems of steel and these problems are still existed, and will be improved through different types of reinforcement material. Further concrete also has lower ductility. In concrete, increasing the fiber- content will increase will increase the strength and decrease drying and plastic shrinkage by limiting the crack-expansion.

1.4 SCOPE

The scope pf this study work is to find out the gap in research of the FRC using sisal fiber band improvement in the physical and mechanical properties of SFRC (sisal fiber reinforced concrete). A limited number of additional tests are also performed to determine the tensile and flexure properties, compressive -and durability properties and also to check its suitability by comparing the concrete with sisal fiber and without sisal fiber.

2. RESULTS AND DISCUSSION

2.1 Compression Strength Test

The compression strength (cube strength) of concrete is that the strength of hardened concrete measured by the compression test. For testing at a single time 3 specimens were tested under ACTM (Accelerated Corrosion Testing Method) and average value of 3 specimen was taken as a final result. Concrete compression test was performed according IS 516-1959. Testing for compression strength was executed at 7, 28, 56, and 90 days age of curing.

The compression strength of each sample tested after 7, 28, 56 and 90 days of curing period. The average of three samples is taken as the compressive strength. The results of average compressive strength and also the percentage change in compressive strength with fiber reinforced concrete and normal concrete.

Table -1: Result of Compressive strength test

Compressive Strength results without fiber				Compressive Strength result with fiber		
Age	Specimen 1	Specimen 2	Specimen 3	Specimen 1	Specimen 2	Specimen 3
(Days)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)
7	16	16.44	16.22	15.95	15.42	15.68
28	23.91	24.22	24.01	22.2	23.46	23.91
56	27.2	27.6	28.49	27.46	27.07	27.64
90	30.66	30.22	31.73	30.53	30.36	30.84

Table -2: Average values of Compression strength

Average Compression Strength Test			
Age	Without fiber	With fiber	% Decrease
(Days)	(N/mm²)	(N/mm²)	
7	16.22	15.69	3.29%
28	24.04	23.53	2.16%
56	27.76	27.39	1.33%
90	30.87	30.57	0.90%

From table-2, we can say that the sisal fiber shows no improvement in compression strength when compares to normal concrete.

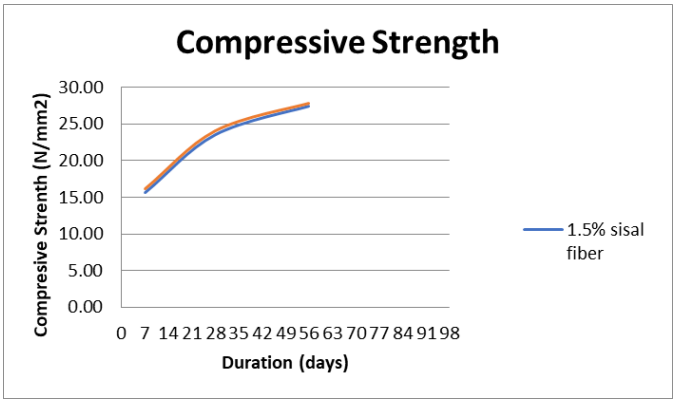

Chart -1: Comparison of compressive strength for both controlled and SFRC concrete

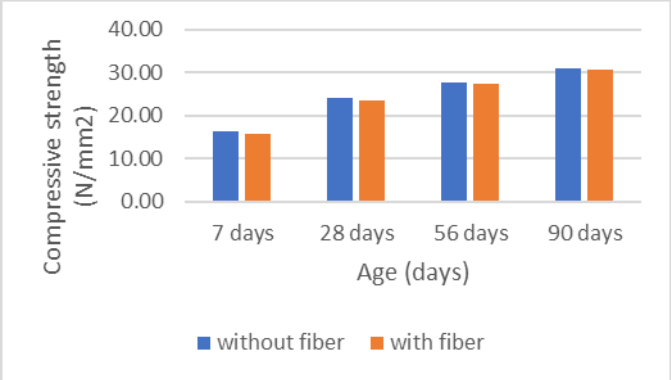

Chart -2: Comparison of compressive strength for both controlled and SFRC concrete

Chart -2 shows a slight decrease in compressive strength when adding sisal fibers to the concrete. At the age of 7 days the compressive strength was decreased by 3.29% and this reduction decrease with the time of curing. After that the difference of compressive strength between concrete with sisal fiber and without sisal fiber decrease with the increase of curing period. As show in chart-2 the compressive strength of SFRC after 56 days decrease the compressive strength was only 1.33 % and after 90days decrease in the compressive strength was only 0.98%.

Therefore, based on the results, Sisal fiber reinforced concrete is not suitable for compressive strength.

2.2 Flexural Strength Test

The flexural strength test was performed according to IS-516:1959. Flexural strength test was performed at 7, 28, 56 and 90 days age of curing.

The result test performed is given in the tabular form below. The flexural strength of each specimen f sample tested after the curing period of 7, 28, 56 and 90 days. The average of three specimens is taken as the Flexural strength or modulus

of rupture. The average Flexural strength and also the percentage change in flexural strength with fiber reinforced concrete and normal concrete.

Table-3: Result of flexural strength test

Flexural Strength results without fiber				Flexural Strength result with fiber		
Age	Specimen 1	Specimen 2	Specimen 3	Specimen 1	Specimen 2	Specimen 3
(Days)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)
7	2.83	2.98	2.86	3.37	3.30	3.41
28	4.55	4.71	4.75	5.38	5.48	5.53
56	6.12	5.96	6.04	7.03	7.14	7.32
90	6.52	6.66	6.58	7.42	7.54	7.56

Table-4: Average values of flexural strength

Average Flexural Strength Test			
Age	Without fiber	With fiber	% Decrease
(Days)	(N/mm²)	(N/mm²)	
7	2.89	3.36	16.20%
28	4.67	5.47	17.09%
56	6.04	7.17	18.61%
90	6.60	7.54	14.47%

The result given in table 4 is point out that the flexural strength is improved with sisal fiber. The percentage increments in flexural with sisal fiber are 16.20%, 17.09%, 18.61% and 14.47% at the age 7, 28, 56 and 90 days respectively. It can also be concluded that with increasing age the % change flexural strength is also increasing.

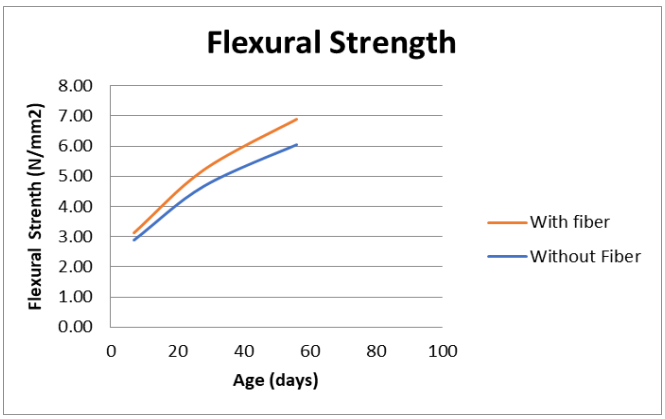

Chart-3: Comparison of flexural strength for both Controlled and SFRC concrete

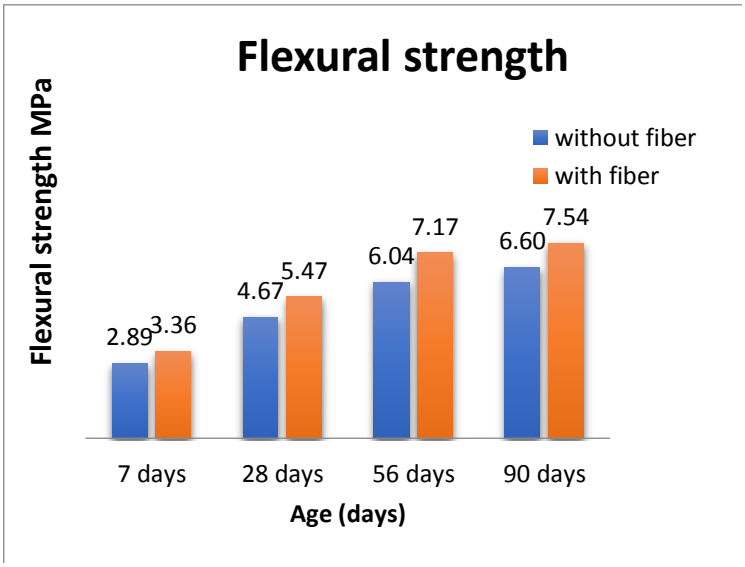

Chart-4: Comparison of flexural strength for both Controlled and SFRC concrete

Chart -4 shows that the flexural strength of SFRC is significantly enhanced as compare to normal concrete. The obtained Flexural strength at 90 days was 7.54 MPa.

2.3 Split Tensile Strength Test

Split tensile strength test were performed according to IS-5816:1999. Split tensile strength test was performed at 7, 28, 56 and 90days age of curing. Split tensile strength samples were tested at UTM (universal testing machine) with an average of 3 as the final results.

The result of test performed is given in the tabular form below. The split tensile strength of each specimen of sample tested after the curing period of 7. 28, 56 and 90 days. The average of the three specimens is taken as the split tensile strength of concrete sample. The average split tensile strength and also the percentage change in split tensile strength with fiber reinforced concrete and normal concrete.

Table 5: Result of split tensile strength test

Split tensile Strength results without fiber				Split tensile Strength result with fiber		
Age	Specimen 1	Specimen 2	Specimen 3	Specimen 1	Specimen 2	Specimen 3
(Days)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)	(N/mm²)
7	2.12	2.29	2.01	2.40	2.31	2.46
28	3.37	3.61	3.26	4.00	4.81	4.85
56	4.03	3.51	3.68	4.39	4.34	4.20
90	3.75	4.10	3.82	4.41	4.63	4.52

Table 6: Average values of split tensile strength

Average Split tensile Strength			
Age	Without fiber	With fiber	% Decrease
(Days)	(N/mm²)	(N/mm²)	
7	2.14	2.39	11.67%
28	3.41	3.89	13.97%
56	3.74	4.31	15.26%
90	3.89	4.52	16.12%

The results in table 6 is specific that the Split tensile strength is improved significantly with sisal fiber. The percentage increments in Split tensile strength with sisal fiber are 11.67%, 13.97%, 15.26% and 16.12% at the age of 7, 28, 56, and 90 days respectively. It can be concluded that with increasing age the % change flexural strength is also decreasing.

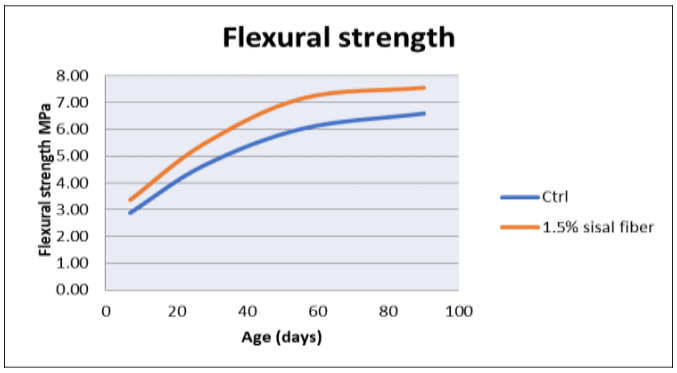

Chart-5: Comparison of Split Tensile strength for both Controlled and SFRC concrete

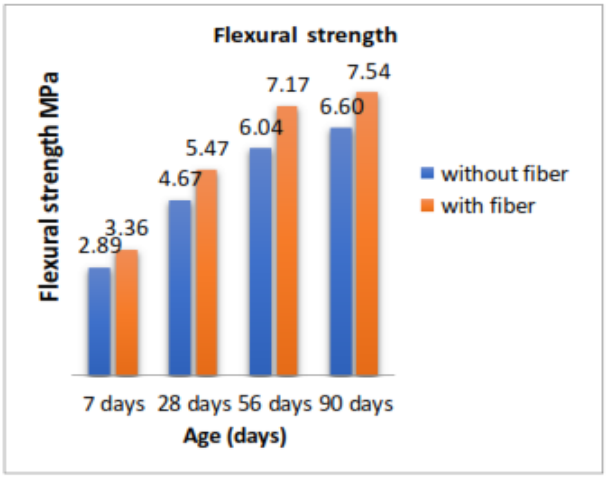

Chart-6: Comparison of Split Tensile strength for both Controlled and SFRC concrete

Chart-6 shows that the split tensile strength of sisal fiber reinforced concrete is significantly improved as compare to normal concrete. The obtained maximum Flexural strength improvement was 15.26% at the age of 56 days.

3. CONCLUSIONS

The compression strength was slightly decreased with the addition of sisal fiber. The compression strength loss at the age 7 days was 3.29% and loss decreases with the time of curing and at 90 days the loss in compressive strength was 0.98% only. Therefore, based on the obtained results. Sisal fiber reinforced concrete is not suitable for compressive strength purpose as it shows slight loss in compressive strength.

The percentage increments in flexural strength with sisal fiber are 16.20%, 17.09%, 18.61% and 14.47% at the age of 7, 28, 56, days 90 days respectively. Its concrete is significantly improved as compare to normal concrete.

The Split tensile strength is improved significantly with sisal fiber. The percentage increments in Split tensile strength with sisal fiber are 11.67%, 13.97%, 15.26% and 16.12% at the age of 7, 28, 56, and 90 days respectively.

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