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A Study on Compressive Strength Characteristics of Sisal Reinforced Concrete

Amrutha M[1]

[1]Assistant professor, Dept. of Civil Engineering, The Oxford College of Engineering, Karnataka, India

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Abstract - *This work investigated to find the compressive strength of sisal reinforced cement concrete with different mix proportions and different percentage of fiber addition. Fibers were brushed, lined up and cut to obtain 1cm length. Materials were hand mixed with different percentage of addition of fiber, the fibers were chemically modified in order to improve their workability. Sisal fibers were treated with super plasticizer in M20 mix design and casted in cubes. The obtained specimens were subjected to tests aimed to evaluate the property (compressive strength) of the sisal reinforced concrete.*

Key Words*: *Sisal fiber, compressive strength

1. INTRODUCTION

Conventional concrete is weaker in tensile strength and stronger in compression strength. Steel reinforcement is provided to compensate the weakness of the tensile strength. In conventional concrete to increase the tensile strength, natural fibers is used such as sisal, coir, straw, elephant grass, palm leaf etc. So that there will be reduction of using traditionally steel reinforcement in the concrete. And also attempt has been made to inherit the tensile property by introducing the synthetic fibers like polypropylene, glass fibers, carbon fibers, asbestos, steel fibers etc. but they tend to be expensive [1].

The natural fibres has numerous benefits over artificial or manmade such as glass, steel and carbon fibres are of renewability, recyclability, biodegradability, lower cost, low density, comparable specific tensile properties, non irritation to the skin, non abrasive to the equipment, reduced energy intake, lesser health risk, high elasticity modulus, nonabrasive, nontoxic, and can be easily modified by chemical agents, abundant and comes from renewable sources which make its consumption extremely interesting. Vegetable fibers reinforcement like jute, sisal, coconut etc. can be used such that the quality of concrete medium or physical properties of the natural fibers will not result any of the shortcomings.

The study have been made to find the physical properties of conventional concrete with sisal fiber reinforced and to raise the concrete properties by incorporating sisal fiber with its respective percentages and finding out the compressive strength variation in the fiber reinforced concrete.

2. MATERIALS AND METHODOLOGY

2.1 Sisal

Sisal fibers is one of the natural fibers which can be easily cultivated, used widely in the world and it grows wild in the hedges of railways tracks and fields [1] .All over the world, sisal fibers are produced approximately 4.5 million tons every single year. Sisal fibers were broadly produced by the two countries in the world that stands Brazil and Tanzania [5].

Figure 1 shows the sisal plant from which sisal fibers are obtained, sisal plant is alike massive pineapples, the leaves are cut down nearby to the ground for the period of harvesting and sisal fiber is drawn out from its leaves. From the total natural fibers estimated, half of the sisal fibers is the first natural fiber that are used for the commercial applications. The sisal fibers is of fundamental fibers of 4 to 12µ diameter.Sisal fiber percentage addition- 0.2 %, 0.4 %, 0.6 %, 0.8 %, 1.0 %,1.2 %,1.4 %,1.6 % and 1.8 %

Fig 1- Sisal plant

2.2 Cement

Ordinary Portland Cement (OPC) is the regular cement used in concrete for construction. Here OPC 53 grade (IS 12269:1987) is used, cement used was free from any lumps and it was not hardened in any form, the tests on the cement are accepted as per IS 4031:1991

Table 1- Results of Tests on Cement

Sl no	Particular	Result
1	Normal consistency in percentage	31 %
2	Setting time in minutes	
	a)Initial setting time	30 min
	b)Final setting time	600min

2.3 Fine Aggregate

Fine aggregate are the particles which passes through 4.75mm IS sieve. It is labelled as Sand. Typically measured minor size is of 0.07 mm. The particles among 0.06 mm and 0.002 mm is identified as silt. The silt particles are named as clay. Properties of FA is determined by carried tests. For the present work, nearby accessible fine aggregate was used. It was free from moisture and stored well. Fine aggregate was procured and checked if any lumps are there and was sieved to get the required size of aggregate and unwanted materials and stones were removed. Fineness modulus of FA from sieve Analysis test is 4.285

2.4 Coarse Aggregate

CA is well defined aggregate maximum permits by 4.75 mm IS sieve. Manmade crushing/natural disintegration of rocks follows to the formation of aggregate. Crushed stone is the common coarse aggregate. Aggregates fundamentally used are 20 mm down size IS sieve. Rounded, partly rounded, flaky angular elongated established on its structure and texture classification of aggregates are named. All in all angular aggregates affect the workability of the mix which differs on interlocking of particles. Locally obtainable hard angular coarse aggregate following by Table 3 of IS 383:1970 was used.

Coarse aggregate was procured and tested if dust is there and was sieved to get the necessary size of aggregate and to eliminate the stones and other undesirable materials. Fineness modulus of CA from sieve Analysis test is 3.215

2.4 Mixing, casting and curing of the blocks

Mixing is an important process in which the ingredients of concrete are thoroughly mixed in order to get the identical mass of concrete. For this work, the tilting mixer was used to mix the concrete. The dry cement and sand are positioned in the mixer and the mixer is started and the mixer is rotated to about 30 seconds, then the further mixing is going on the sisal fiber is add together in the mixture. This mixture and the aggregate will be mixed for one minute by hand mixing and will be sustained to extend one minute while 80 percentage of water will be added. Mixing continued for extra one minute and to finish the remaining water will be added and then mixing continued additional two minutes then steadily place the concrete mix in the mould as in fig 2 and 3.

Fig 2- Hand Mixing of Concrete

The moulds used for casting are Cube mould of size 150 x 150 x 150mm, all the moulds are checked and bolts are tightened and well oiled with waste engine oil before use. The concrete mix is placed in layers in the moulds with 25 blows given to each layer for proper compaction using tamping rod. Compaction is completed by means of a suitable tamping rod and care is necessary such that there will be no segregation of concrete proceeds through the moulds and to inhibit honey combing of concrete in the moulds. The surface of the moulds were finished using dry cement to get good surface finish, nine moulds of each combination are casted for testing after 3rd, 7th and 28th day from casting. Degree of control is predictable statistically through deviations in test outcomes. Strength difference are the impact which gets from the deviations in properties of mix components and also due to shortage of control in precision and concreting operations such as in batching, mixing, transporting, laying, compacting and finally curing and this process is known as quality control.

Fig 3- Casting of moulds

3. RESULT AND DISCUSSIONS

3.1 Slump test

Workability is capability of a fresh concrete mix to fill the mould suitably with preferred work and without dropping

the concrete quality. The workability of concrete is tested and the result of this test is 75mm

3.2 Compressive strength

This is an ultimate test which gives an idea around all the characteristics of the concrete. Properties of concrete has affirm relationship with compressive strength i.e. these possessions are upgraded by enhancement of compressive strength. Rate of application of Compressive load is 140 kg/cm2/min and is tested in a Compression Testing Machine (CTM) as shown below

Fig4- Experimental Setup for Compression Test

Cube size 150*150 *150 mm is used. Concrete cubes are tested for 3, 7 and 28 days strength as per IS: 516 1959 for each percentage of sisal.

The compressive strength of concrete cube is given by

Cube strength = load(P)/Area of cross section(A)

Table 2: 28 Days Compressive Strength

Sl no	Sample (Sisal fiber in %)	Area in mm2	Failure load (p) in kN	Compressive strength in MPa
1	Concrete (0 % sisal fiber)	22500	830	36.88
2	0.2	22500	900	40.00
3	0.4	22500	925	41.11
4	0.6	22500	790	35.11
5	0.8	22500	725	32.22
6	1.0	22500	660	29.33
7	1.2	22500	590	26.22
8	1.4	22500	525	23.33
9	1.6	22500	405	18.00
10	1.8	22500	175	7.777

Graph 1 - 28 Days Compressive Strength

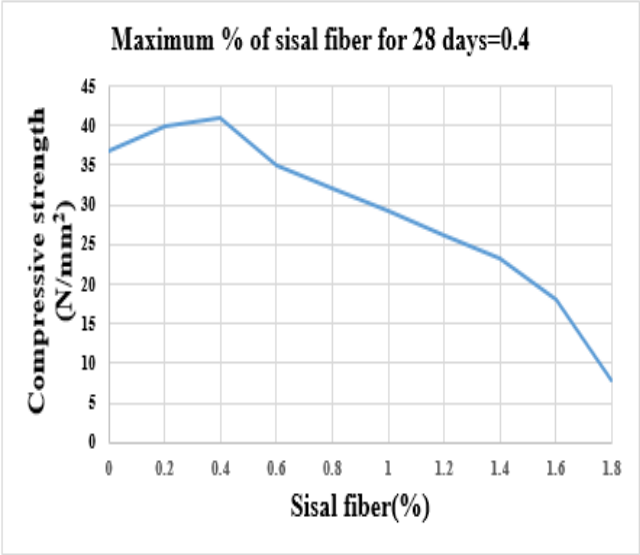
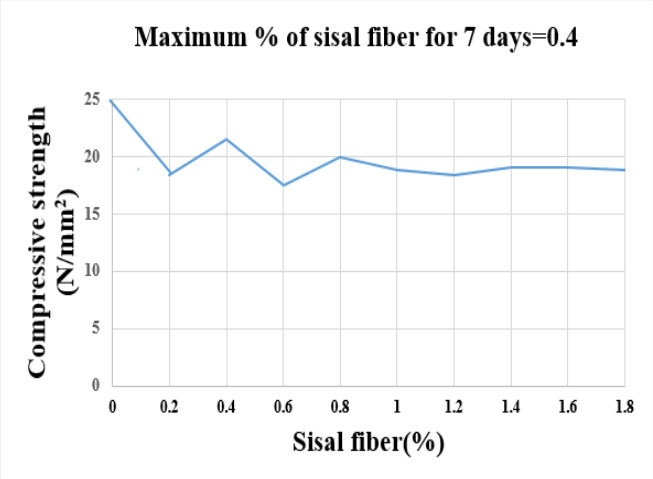


Table 3: 7 Days Compressive Strength

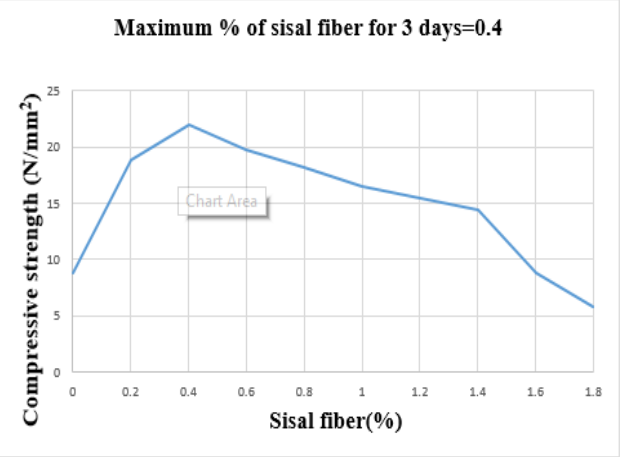
Sl no	Sample (Sisal fiber in %)	Area in mm2	Failure load (p) in kN	Compressive strength in MPa
1	Concrete (0 % sisal fiber)	22500	540	24.00
2	0.2	22500	415	18.44
3	0.4	22500	485	21.55
4	0.6	22500	395	17.55
5	0.8	22500	450	20.00
6	1.0	22500	425	18.88
7	1.2	22500	415	18.44
8	1.4	22500	430	19.11
9	1.6	22500	430	19.11
10	1.8	22500	425	18.88

From the outcomes of graph 2 it can be realized that the compressive strength rises for the sisal reinforced concrete sample compared to conventional concrete for 7 days test. Compressive strength has increased with respect to percentages of sisal up to 0.4 %. Compressive strength increases for percentage up to 0.4 % and varies with remaining percentages of sisal fiber.

Graph 2 : 28 Days Compressive Strength



Graph 3 : 28 Days Compressive Strength



Sl no	Sample (Sisal fiber in %)	Area in mm2	Failure load (p) in kN	Compressive strength in MPa
1	Concrete (0 % sisal fiber)	22500	200	8.88
2	0.2	22500	425	18.88
3	0.4	22500	495	22.00
4	0.6	22500	445	19.77
5	0.8	22500	410	18.22
6	1.0	22500	370	16.44
7	1.2	22500	350	15.44
8	1.4	22500	325	14.44
9	1.6	22500	200	8.88
10	1.8	22500	130	5.77

Table 4: 3 Days Compressive Strength

From the outcomes of graph 3, achieved compressive strength rises for the sisal reinforced concrete sample related to conventional concrete for 3 days tests. Compressive strength better with respect to percentages of sisal up to 0.4 % and drops then for remaining percentages of sisal fiber

4. CONCLUSIONS

The results of the investigation of the effect of surface treatment on the mechanical properties of sisal fiber reinforced concrete revealed that the chemical treatment actually enhanced the mechanical properties, the observed enhancement was due to the stronger bond that exists between the treated fiber and the matrix. The rate of increase in compressive strength is dependent on the percentage of sisal fiber varying between 0.5-1.5 percent. . At low fiber length the compressive strength is seen to be maximum, and will decrease the strength with the increase of fiber length. The optimum length of fiber is 10 mm to 150 mm .Addition of 3% volume fraction of sisal fiber which may be regarded as high fiber content and have created more voids volume in concrete.

REFERENCES

[1] Rahuman, Abdul, and Sai Kumar Yeshika. "Study on properties of sisal fiber reinforced concrete with different mix proportions and different percentage of fiber addition." International Journal Of Research in Engineering and Technology 4 (2015): 474-477.

[2] Mr. Jitendra D. Dalvi, Dr. Uttam B. Kalwane, Mrs. Pallavi Pasnur. "Effect of fiber length and percentage of sisal on strength of concrete".

[3] JML Reis and EP Carneiro "Mechanical characterization of sisal fiber reinforced polymer mortars: Compressive and flexural properties"

[4] M Aruna "Mechanical Behaviour of Sisal Fibre Reinforced Cement Composites

[5] Li, Yan, Yiu-Wing Mai, and Lin Ye. "Sisal fibre and its composites: a review of recent developments." Composites science and technology 60, no. 11 (2000): 203

[6] 7-2055.

[7] Mohammed, Mustafa Hauwa, and Benjamin Dauda. "Unsaturated Polyester Resin Reinforced With Chemically Modified Natural Fibre." IOSR Journal of Polymer and Textile Engineering (IOSR-JPTE) 1.4 (2014): 31-38

[8] Nwankwo, Patrick Oguguo, and Fredrick Olorunmeye Job. "Performance Evaluation of Sisal Fibre as Reinforcing Agent in Medium Strength Ternary Concrete." International Journal of Advancements in Research & Technology, ISSN 2278 7763 (2014): 132-136.

[9] Silva J, Rodrigues D, Dias. Compressive strength of low resistance concrete manufactured with sisal fiber. 51_ Brazilian congress of ceramics, Salvador, Brazil; 2007.

[10] Owen, M. M., C. O. Ogunleye, and E. O. Achukwu. "Mechanical properties of sisal fibre-reinforced epoxy compositeseffect of alkali concentrations." Adv Polym Sci Technol: Int J 5 (2015): 26-31.

[11] Sathish p, murugesh V. "Experimental study on sisal fiber reinforced concrete with partial replacement of cement by ground granulated blast furnace slag

[12] Ramakrishna, G., T. Sundararajan, and S. Kothandaraman. "Evaluation of durability of natural fibre reinforced cement mortar composite-a new approach." ARPN Journal of Engineering and Applied Sciences 5.6 (2010): 44-51.

[13] Tara Sen, H. N. Jagannatha Reddy "Application of Sisal, Bamboo, Coir and Jute Natural Composites in Structural Upgradation"

[14] S.Priyadharshini1, G.Ramakrishna" Strength and durability evaluation of latex mofdified sisal fibre reinforced concrete

[15] Faruk, Omar, et al. "Biocomposites reinforced with natural fibers: 2000–2010." Progress in polymer science 37.11 (2012): 1552-1596.

[16] John, K., and S. Venkata Naidu. "Sisal fiber/glass fiber hybrid composites: the impact and compressive properties." Journal of reinforced plastics and composites 23.12 (2004): 1253-1258.

AUTHOR

Amrutha M
Assistant professor, Dept. of Civil Engineering, The Oxford College of Engineering, Karnataka, India