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Characterization and Investigation of Tensile Test on Sisal Fiber Reinforced Polyster Composite Material

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Abstract*--The use of natural fiber reinforced polyster composites play a prominent role in almost every application in our daily life due to their high strength and stiffness. The natural fibers serve as reinforcement; it not only improves the strength and stiffness but also reduces the weight of resulting bio-composite. In this present work investigations were carried out to know the performance and properties like tensile strength of 15%,25%,35% and45% SFRPC material with low cost, lightweight and apparently environmentally superior. this paper shows the developments of natural fiber composites used in medical implants for human tissue such as femur bone .the specimens are prepared according to ASTM D-3039 for tensile test using polyster resin as the matrix material, the material consisting of 15%, 25%, 35% and 45% of SFRPC material with fiber weight fraction, random continuous long fiber orientation and the specimens are prepared by using hand lay up fabrication technique. The tensile tests are conducted by varying the proportions of standard specimens. the human femur bone tensile strength in males is 39.74±4.80 N/mm^2 and in female it is 30.08±7.96 N/mm^2. Hence according to the results it is observed that there is an improvement in tensile properties of 15%, 25%, 35% and 45% SFRPC material. It is found that the 45% SFRPC material tensile strength may be suitable for the replacement of human tissues and it is observed that by increasing the percentage of fiber, the tensile strength of the specimen may increase. This results suggest that SFRPC material is low-cost, low density with high specific properties and high strength biocompatible material and may suggest for implant as for femur bone. By the experimental results, the 15%, 25%, 35% and 45% SFRPC materials will match for the tensile strength. In this connection, finally 45% SFRPC material can be suggested for femur bone Tensile strength. Hence further the work can be continued to test remaining mechanical properties.

***Keywords*-- sisal fiber reinforced polyester composite materials (SFRPC), femur bone, tensile test, hand layup technique.**

I. INTRODUCTION

A composite material is a combination of two or more constituents to give a unique combination of properties.

The constituents are combined at macroscopic level and are not soluble in each other. One constituent is matrix phase and the other is reinforcing phase. Composites are materials that comprise strong load carrying material known as reinforcement embedded in weaker material known as matrix. The reinforcement fills the matrix phase and gives it more strength and stiffness. Fibers occupy the most volume in a high performance composite and carry most of the applied load. Matrix surrounds the fibers and thus protects those fibers against chemical and environmental attack. The matrix material binds the fibers together and transfers the load to the fibers. It provides rigidity and shape to the structure. The matrix isolates the fibers so that individual fibers can act separately. This stops or slows the propagation of a crack. The matrix provides protection to reinforcing fibers against chemical attack and mechanical damage (wear).these composites are selected for certain applications due to its High strength to weight ratio (low density high tensile strength). High creep resistance. High tensile strength at elevated temperatures and High toughness.

II. LITERATURE SURVEY

Luo and Netravali *et al.* [1] paper presents the tensile and flexural properties of the green composites with different pineapple fiber content and compared with the virgin resin. Sisal fiber is fairly coarse and inflexible. It has good strength, durability, ability to stretch, affinity for certain dyestuffs and resistance to deterioration in seawater. Sisal ropes and twines are widely used for marine, agricultural, shipping, and general industrial use

Belmeres et al. [2] found that sisal, henequen, and palm fiber have very similar physical, chemical, and tensile properties

Joseph and Thomas [3] studied the effect of chemical treatment on the tensile and dynamic mechanical properties of short sisal fiber reinforced low density polyethylene composites. It was observed that the CTDIC (cardanol derivative of toluene disocyanate) treatment reduced the hydrophilic nature of the sisal fiber and enhanced the tensile properties of the sisal-LDPE composites.

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They found that peroxide and permanganate treated fiber-reinforced composites showed an enhancement in tensile properties. They concluded that with a suitable fiber surface treatment, the mechanical properties and dimensional stability of sisal-LDPE composites could be improved.

III. OBJECTIVES

- ❖ Fabrication of SISAL, based composites.
- ❖ Detail study on the effect of fiber on mechanical behavior of SISAL fiber reinforced polyester based composites
- ❖ Evaluation of mechanical properties of the composites such as tensile strength and compare the results with the properties of femur bone tensile strength.

Besides all these the main objective is to develop a low cost, low density with low weight and high tensile strength which can be used for medical appliances especially for femur bone.

IV. METHODOLOGY

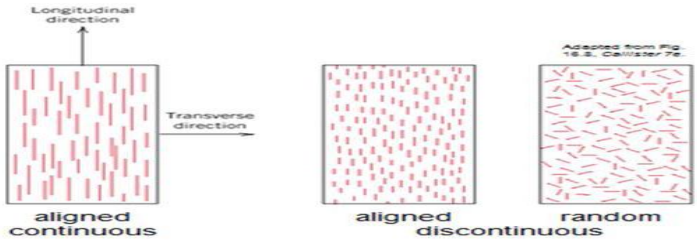
- *Extraction of fibers:*

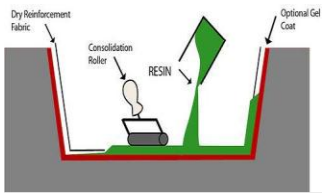
Sisal plant

Extracted sisal fiber

Sisal fibers are extracted from sisal plant by manually or by mechanical extraction method.

- Preparation of sisal fiber
- Materials used for fabrication
- Preparation of mould
- Fabrication process





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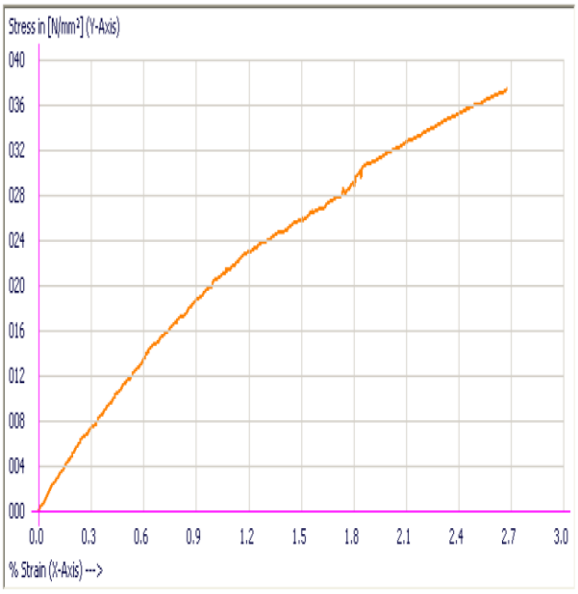
- *Experimental setup:*

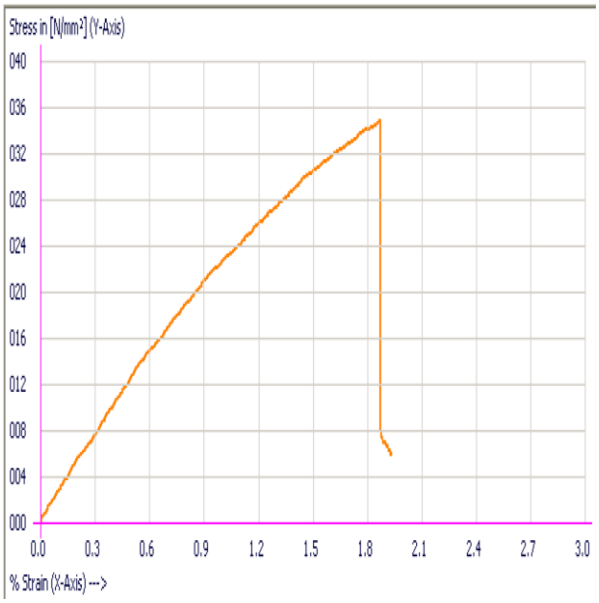
Tensile test is conducted by using universal testing machine.three samples have been tested and the average value is tabulated.

According to ASTM D3039 standard the tensile test samples were cut and carried out at room temperature and the test has been conducted until the sample fails.

V. EXPERIMENTATION

Graphs For Tensile Test For Sisal Composite:





15% SFRPC

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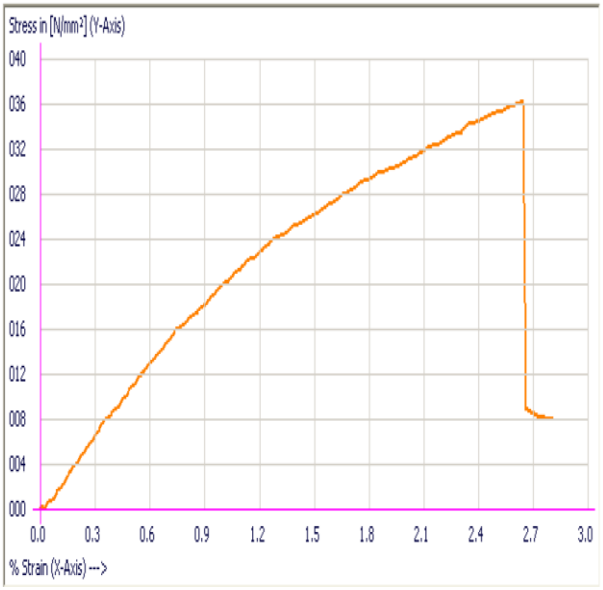
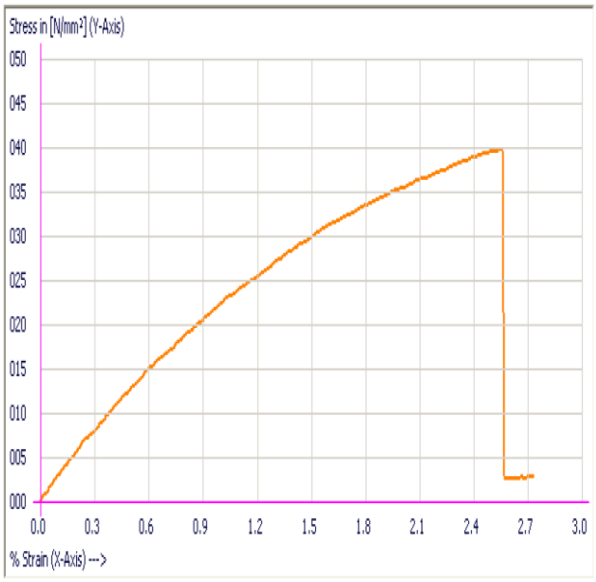
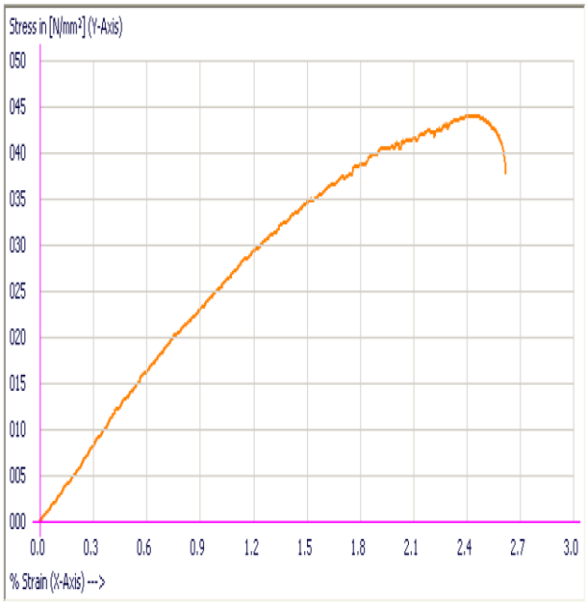
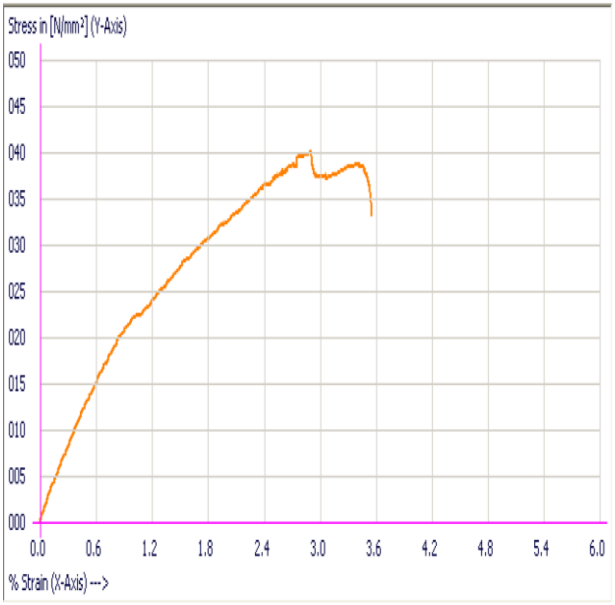




25% SFRPC





35% SFRPC

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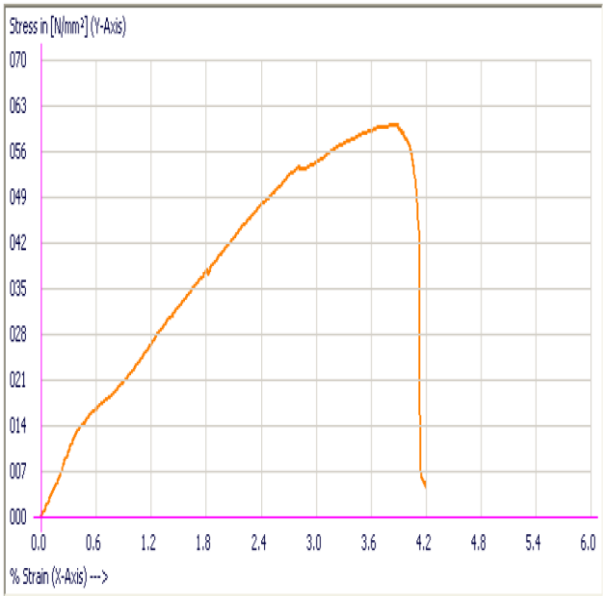

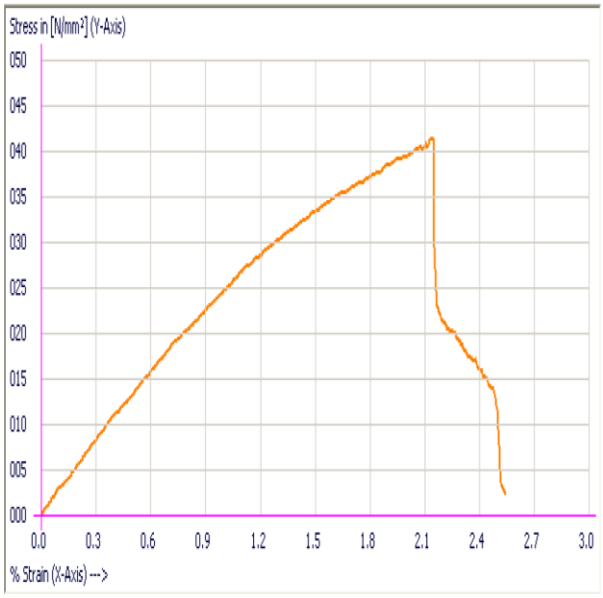

45% SFRPC

VI. Summary And Conclusions

SISAL FIBER REINFORMENT POLYESTER COMPOSITE	TENSILE STRENGTH N/mm^2
15% SFRPC	37.32
	34.82
	30.54
Average	34.22
25% SFRPC	36.17
	39.80
	30.62
Average	35.53
35% SFRPC	43.92
	39.91
	50.53
Average	44.78
45% SFRPC	31.45
	59.86
	41.48
Average	44.26

From the experimental results it is observed that, as the percentage of sisal fiber increases the tensile strength is also increased.

The tensile strength at 45% SFRPC material is 59.86 N/mm^2, And by this we can conclude that the experimental results for the tensile strength of specimen will match for femur tensile strength.

VII. SCOPE OF FUTURE WORK

There is a scope to natural fiber composites prepared at different volume fractions like 15% 25%, 35%, and 45% of sisal fiber. By increasing the volume fractions of sisal fiber the strength of the specimen may be increased. From the experimental results it is found that sisal fiber reinforced polyester composite will have good mechanical properties like tensile properties, and further the work can be carried out for other properties such as compression and bending tests. And the work can also be conducted for FEM analysis and water absorption test, wear test, corrosion test, SEM analysis.

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