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Mechanical Properties of Sandwiched Layers of Natural Fibers of Sisal and Jute for Automotive Application

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Abstract - *Environmental concerns encourage us to use natural fibers in an automotive sector due to its light weight when compared to materials such as Steel, Aluminum and Synthetic fiber based polymer. An eco-friendly composite is developed for diverse applications such as Sports goods, Automotive and Marine etc. Other natural fibers include Jute, Banana, Flax, Hemp, and Sisal, because of the excess availability, eco-friendly in nature, and economical to possess remarkable and satisfactory properties. Both structural and non structural fabrication can be applied in industrial products like Sisal and Jute fibers for different matrix. This work will help us to find out the mechanical properties of sandwiched composites as per standards and failure from results obtained is discussed.*

Key Words: (*Natural composites, Mechanical properties, sandwiched layer, jute and sisal fibers*)

1.INTRODUCTION

A composites materials built from combination of two or more distinct materials with both physical and chemical properties that when joined to develop composite. The natural fiber as been considered herein due to its light weight and effective cost. The first phase of composites is called as matrix having a continuous character. Such matrix materials has a good binding property and fibers has the desired ability to arrange itself in position by transferring the loads to reinforcement. Commonly bio-fibers are classified as Ligno-celluslose /cellulose fibers further classification as shown in Figure 1 [1].

The recent progress among various natural fiber composites the mechanical properties on sisal fiber reinforced -polymer composites was founded [2]. The botanical name for sisal fiber is formally called as Agave sisalana. It is a widely used natural fibers having various application like cementitious and reinforced composites. And which could be easily cultivated in any part of the land. Hence, this article is mainly focused to explore some mechanical properties of jute and sisal fiber sandwiched composites.

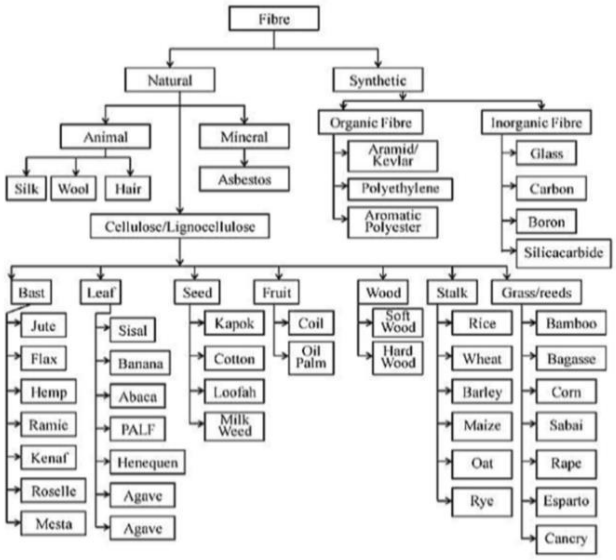

Fig -1: Complete structure of fibers. [1]

1.1 LITERATURE REVIEW

So far may authors are presented work on jute fiber for the application of house holding like chair tables etc [1]. The fabrication of hybrid natural fibers as made us to interest, among them Sivakandhan studied the sandwiched mechanical properties of sisal and jute fiber that are chopped randomly and had them with various percentage with epoxy resin and obtain the test results they compared that materials with co- axial and Tran axial properties, with various test conducted as per ASTM standards [2].

Based on the literature of various reputed journals and publications , synthetic fibers , carbon fibers/ glass fibers are based polymers are widely used for building automotive parts, industrials applications, mechanical properties are comparatively strong [3].

Therefore natural fibers have received great interest in application of automotive industries for interior and exterior for examples particulates vegetal fibers reinforced composites [1]. not only vegetal ,jute, and sisal offer such benefits as reductions in weight and cost, and also they are recyclable . Nowadays, in the automotive industries there is increase in pressure to fulfill performance demands and environmental aspects.

In the last decade, the green technology in the field of materials science in developed of bio-composites materials considerably. In this work, we have selected natural fiber like sisal and jute fiber and combined fiber mat to perform the different orientation sandwiched with fibers are fabricated by hand-lay-up techniques, and obtain the mechanical properties like flexural , tensile stress of that materials as per ASTM standards.

2. MATERIALS AND METHOD

2.1 Materials

The present study deals with manufacturing of hybrid composites. the materials like sisal fiber and jute fiber is used to prepare a sandwiched composites composing of epoxy resin LY556 grade and hardener HY951. This process was carried out by using a hand layup process.

Fig- 2 (a): Sisal mat

Fig- 2 (b): Jute mat

The sandwich plate was prepared in the form of thin sheets mats as shown in Figure 2(a), & 2(b), is placed in different orientations.

Table -1: Stacking Sequence of Composite plate

SL NO	Laminated sequence	Fiber orientation in °
1	Jute	Jute-0°
2	Sisal	Sisal-0°
3	Sisal + Jute + Sisal	S-0˚+J-90˚+S-0˚
4	Jute + Sisal + Jute	J-0˚+S-90˚+J-0˚
5	Sisal + Jute + Sisal	S-0˚+J-45˚+S-0˚
6	Jute + Sisal + Jute	J-90˚+S-45˚+J-0˚

2.2 Mechanical testing

The specimens were subjected to flexural test & tensile test as per the ASTM (American society for Testing machine) standards. Table 2 represents size and shape of prepared specimens

Table -2: Dimension of samples as per ASTM standards

Sl. No	Types of test	Type of Standards	Dimension of the sample (mm)
1	Tensile	ASTM D3039	250×25×3
2	Flexural	ASTM D790	127×13×3

2.3 Flexural test

The flexural strength is found out by using a three point bend testing to express the failure by inter-laminar shear as per ASTM D790 standards.

The flexural strength is calculated using the equation (1) [1].

$$\sigma_f = \frac{(3\ Pmax\ L)}{2bh^2} \quad \text{.....N/mm}^2 \text{ ------- (1)}$$

2.4 Tensile test

Tensile test was conducted to measure the resistance force to break the specimen and to check the optimum yield point. According to ASTM D3039 the dimensions of the specimen as been considered with a gauge length of 50 mm.

3. RESULT AND DISCUSSION

For Tensile test specimen

Fig -3: specimens prepared as per ASTM D3039

For Flexural test specimen

Fig -4: specimens prepared as per ASTM D790

Specimens are prepared for mechanical testing as per ASTM standards shown in Figure 3, & Figure 4, and then specimens subjected to tensile and three point bending test for validate the strength of the fiber sandwiched laminates.

Fig -5: Tensile test arrangement at UTM

Fig -6: Flexural test arrangement at UTM

The figure .5 shows the specimens subjected to tensile loading until the laminates get failure and the readings are noted as a graph directly by the computerized universal testing machine and figure .6 shows three point bending test arranged at universal testing machine with the span length of 60 mm.

Table -3: Samples tested Results.

SL No	Samples type	Tensile Strengh (N/mm^2)	Flexural Strength (N/mm^2)
1	Jute-0°	19.67	5.273

2	Sisal-0°	11.94	36.06
3	S-0°+J-90°+S-0°	20.58	27.147
4	J-0°+S-90°+J-0°	28.49	31.187
5	S-0°+J-45°+S-0°	21.26	30.384
6	J-90°+S-45°+J-0°	18.37	22.848

Table 3, shows results obtained from tensile and flexural test for various orientations of fibers respectively.

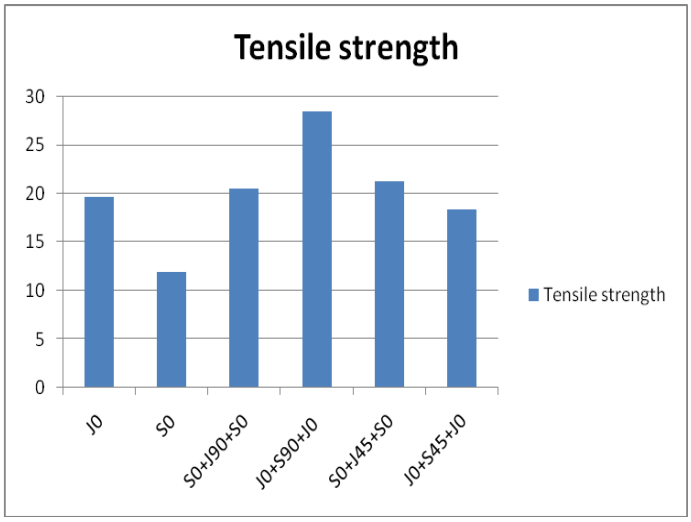

Fig- 7: Tensile strength of sandwiched composites

Figure 7 shows the variation of tensile strength with different orientation of fibers we can observe that sisal with 90° oriented fibers with jute 0° fibers has more tensile strength when compare to other orientations.

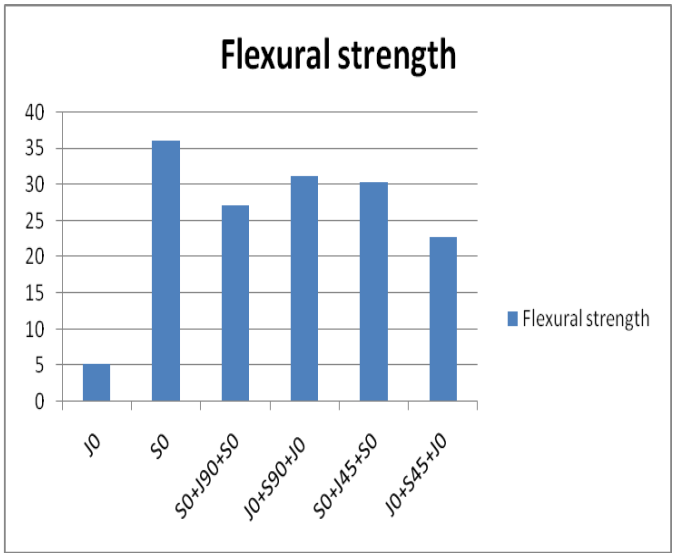

Fig- 8: Flexural strength of sandwiched composites

Figure 8 shows the variation of flexural strength with different orientation of fibers we can observe that sisal with 90° oriented fibers with jute 0° fibers has more flexural strength when compare to other orientations but in this case sisal with single layered has more strength than other but it is not laminates it is single layered.

The results of (J+S+J) sample is has higher performance for tensile and flexure when compared the (S+J+S) sample.

4. CONCLUSIONS

In this work, mechanical properties of sisal fiber and jute fiber are sandwiched by hand layup technique is done successfully and evaluated and the following conclusion are drawn:

1. The tensile strength was increased by 38.9% and flexural strength was increased by 17.3% of sandwiched layer compare to sisal at 90^0 orientation and jute at 90^0 directional orientation among all other fiber orientation.
2. Tensile and flexural strength behaviour of materials are successfully studied on the sisal and jute fiber reinforced with epoxy resin sandwiched with different orientation of composite material.

REFERENCES

[1] Harpreet Singh, Jai Inder Preet Singh,1,*,Sehijpal Singh , Vikas Dhawan, Sunil Kumar Tiwari, A brief review of jute fiber and its composites (2018) Materials today: Proceedings pp 28427-28437.

[2] C. Sivakandhan , G. Murali , N. Tamiloli ,L. Ravikumar 'Studies on mechanical properties of sisal and jute fiber hybrid sandwich composite' (2019) article in press. Materials today: proceedings pp 2214-7853.

[3] Dawit Getu, Ramesh Babu Nallamothu, Muluken Masresha, Seshu Kishan Nallamothu 'Production and characterization of bamboo and sisal fiber reinforced hybrid composite for interior automotive body application' (2020) article in press. Materials today: proceedings pp 2214-7853.

[4] C K Aravinda Pandian , H Siddhi Jailani and A Rajadurai 'Natural fabric sandwich laminate composites: development and investigation' 2017 'published on Bull. Mater. Sci., Vol. 40, No., pp. 139–146.

[5] Balachandar M, Vijaya Ramnath B, Barath R, Bharath Sankar S 'Mechanical Characterization of natural fiber polymer composites' article published on © 2019 Elsevier, All rights reserved.

[6] Paulo Peças, Hugo Carvalho, Hafiz Salman and Marco Leite, 'Natural Fibre Composites and Their Applications: A Review' journal public on J. Compos. Sci. 2018.

[7] Venkatesha B. K., Saravanan R., Anand Babu, K., "Effect of moisture absorption on woven bamboo/glass fiber reinforced epoxy hybrid composites" :Materials Today Proc (2020) pages 216-221