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Evaluation of Tensile Properties of Epoxy Composites Reinforced with combined hand layup of Sisal and Kenaf fibers

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ABSTRACT

Natural fiber composite materials are replacing the conventional materials as these materials are biodegradable, eco-friendly, durable, high strength to weight ratio, etc. Due to this, natural fiber composite materials are coming into the limelight and several types of research are going on in the improvement of these composites. There are several methods and procedures included in the preparation of different composites for different applications. This project is based on the usage of the hand layup technique in the fabrication of epoxy resin natural fiber composite made by using sisal and kenaf fibers in multiple layers as reinforcement material. In this composite, we use epoxy LY556, hardener HY951, and treated sisal and kenaf fibers. Two samples of composites and prepared and tensile properties of these two samples are tested and evaluated. These two samples are varied in their preparation. One sample is prepared by placing the fibers in unidirectional and the other sample is prepared by placing the fibers in bidirectional i.e., 0, 90 positions. These two samples are tested and compared.

KEYWORDS: ***Natural fiber composite material, hand layup technique, epoxy LY556, hardener HY951, Sisal and Kenaf fibers, Unidirectional,Bidirectional,tensile properties.***

1. INTRODUCTION

The usage of natural fiber composite materials is increasing day by day due to its wide range of characteristics. Due to these characteristics, there isa wide range of applications in different sectors, ranging from the preparation of furniture, construction material, packing, and automobile parts.[1]Synthetic fiber composite materials are used for several years because of their high strength and adaptability in replacing metals in different fields such as automobiles, but these materials are hard to recycle as the separation of components after their life span is quite difficult. Therefore, these components are disposed of improperly by incineration and disposing in dump yards, etc., so due to these reasons, the natural fiber composites have gained huge importance due to their biodegradability and are eco-friendly[2]. Natural fibers are plant-based fibers that are acquired by extracting fiber from plants. Natural fibers are used in three different ways. They are:

- In textiles, paper, and fabrics;
- For biofuel;
- Reinforcement materials for composites[3].

There are three different origins of natural fibers. They are:

- Animal Fibers;

- Lignocellulosic Fibers and;
- Mineral Fibers[4].

Our discussion is mainly based on lignocellulosic fibers i.e., plant fibers. Plant Fibers are classified as Seed Fibers, Leaf Fibers, Bast Fibers, Fruit Fibers, and Stalk Fibers.

In this project, we used Sisal and Kenaf as Reinforcement materials. Sisal is a type of Leaf Fiber that is derived from agave, “Agave sisalana”[5].

Figure1: Agave sisalana [6]

Kenaf is processed from Bast of the plant, “Hibiscus Cannabinus”[7].

Figure 2: Hibiscus Cannabinus[8]

Unidirectional fiber is a type of reinforcement that is non-woven and features all fibers running in a single, parallel direction. With this style of fabric, there are no gaps between fibers, and those fibers lay flat.

For bidirectional composites, ultimate strength is low but occurs in two unique directions. Since the direction of the fibers turn out to be more statistically diversified throughout the composite, decrease in ultimate strength, where the properties are consistent in all stacking/loading directions.

2. MATERIALS USED:

- Sisal Fiber
- Kenaf Fiber
- Aluminum molds (170 X 170 X10) mm
- Epoxy LY556 Resin
- Hardener HY951

3. PROPERTIES AND MIX RATIO OF RESIN & HARDENER:

Epoxy Resin and Hardener are mixed in a 10:1 ratio. Properties of Resin and Hardener are represented in table 3.1

Property	Specification	Unit	Araldite LY 556	Arad HY 951
Viscosity at 25°C	ISO 12058	MPa.s	10000-12000	10-20
Density at 25°C	ISO 1675	gm/cc	1.15– 1.20	0.97-0.99
Flash Point	ISO 2719	°C	>200	>180

Table1: Properties of Resin and Hardener

4. METHODOLOGY:

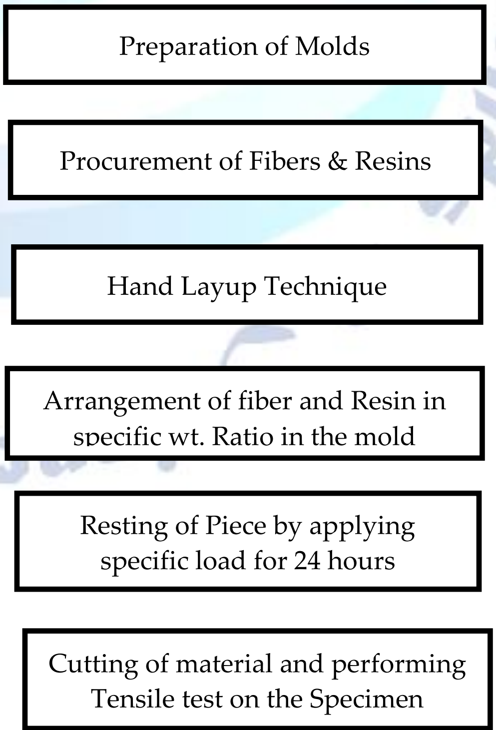

Figure 3: Flow chart of proposed method

5. PREPARATION:

- Mold is prepared by using an aluminum sheet by considering dimensions of 170mm x1 70mm x 10mm

Figure4: Aluminum Mold

- Sisal and kenaf fibers that are processed are procured for experimentation.

Figure5: Sisal and kenaf fibers

- Fibers will be cut to the size of the mold.

Figure6: Processed Fibers

- Epoxy Resin and hardener are mixed in a 10:1 ratio, i.e., 1 portion of hardener is mixed with 10 portions of resin.

Figure7: Resin and Hardener

- Resin hardener mix and fiber must be taken in a certain weight ratio. In this project, we took 60% of resin hardener mix and 40% of Fibre i.e., 20% of sisal and 20% kenaf.
- A cover is placed on the mold and grease is applied to the cover. Then the resin hardener mix is applied to the cover and the sisal fibre is placed in 0^{o} uniformly.
- After that, the resin hardener mix is applied to the layer of sisal, and the kenaf fibre is placed in the same direction uniformly.
- This procedure is followed up to three layers and the remaining resin hardener mix will be poured on the top and a cover applied with grease is placed on top and a weight is added to it for 24 hours. This piece is considered a composite with a unidirectional layout.
- One sample of the composite is prepared. For the other sample, follow the same procedure but place the fibers in differing directions, i.e., in 0^{o} and 90^{0}.

This piece is considered a composite with a bidirectional layout.

- These two pieces are left at room temperature for 24 hours to let them dry and get hardened.

Figure8: Fabricated pieces with the both unidirectional and bidirectional layout

- Now these pieces are sent to a tensile test to test the tensile strength of the prepared material.
- To test the ultimate tensile strength of the material; the piece must be divided into 3 pieces of 20mm width.

Figure 9: Unidirectional layout specimen

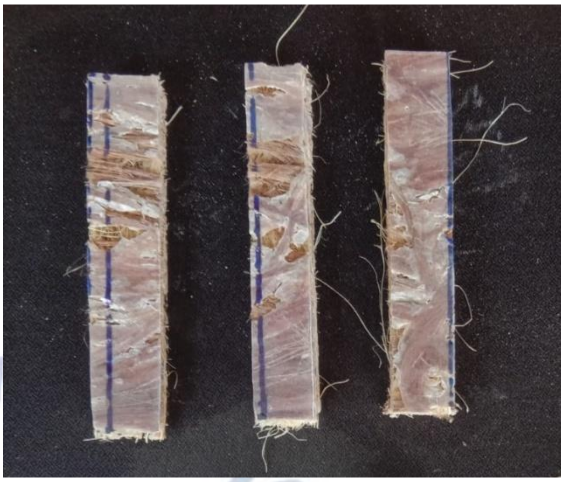

Figure10: Bidirectional layout specimen

- Each material is divided into 3 samples and is ready to test.
- These pieces are fixed in the tensile testing machine and the tensile strength of each piece is calculated.

Figure11: Tensile testing machine

- In this way the tensile strength of each material is calculated and described in a graphical form.

6. OBSERVATIONS:

Specimen-1:

a.) Sample 1

Table 2: Parameter of sample 1 of specimen 1

layout	Unidirectional
Specimen type	Flat
Specimen width	19.60 mm
Specimen thickness	11.60 mm
C/S Area	227.36 mm^2
Original Gauge Length	0.00
Final Gauge Length	0.00

b.) Sample 2

Table 3: Parameter of sample 2 of specimen 1

Layout	Unidirectional
Specimen type	Flat
Specimen width	19.08 mm
Specimen thickness	10.40 mm
C/S Area	198.43 mm^2
Original Gauge Length	0.00
Final Gauge Length	0.00

c.) Sample 3

Table 4: Parameter of sample 3 of specimen 1

Layout	Unidirectional
Specimen type	Flat
Specimen width	20.10 mm
Specimen thickness	8.70 mm
C/S Area	174.87 mm^2
Original Gauge Length	0.00
Final Gauge Length	0.00

Specimen-2

a.) Sample 1

Table 5: Parameter of sample 1 of specimen 2

Layout	Bidirectional
Specimen type	Flat
Specimen Width	22.60 mm
Specimen thickness	10.80 mm
C/S Area	244.08 mm^2
Original Gauge Length	0.00
Final Gauge Length	0.00

b.) Sample 2

Table 6: Parameter of sample 2 of specimen 2

Layout	Bidirectional
Specimen type	Flat
Specimen width	19.73 mm
Specimen thickness	8.43 mm
C/S Area	166.32 mm^2
Original Gauge Length	0.00
Final Gauge Length	0.00

c.) Sample 3

Table 7: Parameter of sample 3 of specimen 2

Layout	Bidirectional
Specimen type	Flat
Specimen width	19.85 mm
Specimen thickness	8.33 mm
C/S Area	165.35 mm^2
Original Gauge Length	0.00
Final Gauge Length	0.00

NOTE: "These readings are calculated at Shikag's Engineering labs Pvt. Ltd. which is NABL accredited lab, An ISO: 9001, ISO: 45001 Certified Lab."

7. RESULTS

In this project, we conducted the tensile test on both specimens as per the standards and calculated the Ultimate Tensile Strength of the specimens.

Table 8:Ultimate Tensile Strength for Unidirectional layout of speciemen 1

Sample 1	12.77 N/mm^2
Sample 2	18.09 N/mm^2
Sample 3	15.26 N/mm^2

The average ultimate Tensile Strength of specimen-1 is

$$\frac{12.77 + 18.09 + 15.26}{3} = 15.37 N/mm^2$$

Table 9:Ultimate Tensile Strength for Bidirectional Layout of speciemen 2

Sample 1	2.97 N/mm^2
Sample 2	3.37 N/mm^2
Sample 3	4.88 N/mm^2

The average Ultimate Tensile Strength of specimen-2 is

$$\frac{2.97 + 3.37 + 4.88}{3} = \frac{3.74N}{mm^2}$$

The test procedure is done as per ASTM D 638 Standards and the model no. of UTM is MCS/UTE-1T.

8. CONCLUSION

In this paper, we conducted a tensile test on two different specimens and compared both of them. Through this, we came to analyze the difference between strengths in two specimens with similar weight ratios but different layouts i.e., both Unidirectional &Bidirectional. We came to know that the strength of composite material that is fabricated by a Unidirectional layout is more than the composite that is fabricated by a Bidirectional layout.So, if the requirement of the material to be fabricated is higher tensile strength, it is suggested to choose a Unidirectional layout during fabrication rather than a Bidirectional layout.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] Y. B. Chin CW, "Potential of kenaf fibers as reinforcement for tribological applications," p. 267(9–10), 2009.

[2] Edited by R.D.S.G. Campilho, Natural Fiber Composites. CRC Press.

[3] R.D.S.G. Campilho, Natural Fiber Composites. CRC Press. [Online]. Available: https://www.google.co.in/books/edition/_/YirSCgAAQBAJ?hl=en&gbpv=1&pg=PP1

[4] R.D.S.G. Campilho, Introduction to Natural Fiber Composites.

[5] M. F. Navin Chand, "Tribology of Natural Fiber Polymer Composites," vol. Second Edition, 2021.

[6] https://en.wikipedia.org/wiki/Sisal#/media/File:Plantsisal.jpg

[7] M. R. M. M.A. Alam, "Advanced High Strength Natural Fiber Composites in Construction," 2017, DOI: https:// doi.org/10.1016/B978-0-08-100411-1.00020-0.