

Effect of Fiber Orientation on Tensile and Flexural Properties of Ramie Fiber Composite

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Abstract: *This current effort appraised the effect of fiber alignment on mechanical possessions of ramie fiber reinforced epoxy composites. In this study ramie fiber is used by means of reinforcement which treated with NaOH solution for improving the attachment strength among fiber and resin by eliminating moisture substances. Models of dissimilar alignments of ramie fiber reinforced composites remained made-up by hand – layup process and studied their mechanical possessions like tensile power and flexural power. The effort of this investigational study devises remained approved out to determine the mechanical properties. The results of this study indicate the orientation 0°/0° shows the enhanced mechanical properties compare to 0°/90°, 45°/-45° and 0°/45°/-45°/90°. It remained projected that the usage 0°/0° orientation of ramie fiber composite as the alternates for artificial fiber in the development of the automobile body and engineering structure.*

Keywords: *Epoxy resin, Fiber orientation, hand – layup, ramie fiber.*

I. INTRODUCTION

Fiber protected polymer combinations remain being used in nearly all type of presentations popular our regular existence and his practice remains to develop by a remarkable rate. The manufacture, usage and elimination of dated composite structures regularly finished of artificial threads are replicated analytically since of the rising ecological pollution. The situation makes cognizance now the usage of bio fibers by way of reinforcing components for thermoplastics and thermo sets. Ramie is believed by way of the toughest of all accepted bast fibres now the ecosphere which remains documented by means of riha in Assam. The situation is a constant plant of the urticaceae family flexible fibre since the bark of the wickers which proposals exceptional raw material aimed at combination with the natural and artificial fibres. This one remained create that the full developed-up plant reaches a tallness of around five to eight feet and diameter of stem three to five cm at 3 diverse levels, viz. lowest and topmost. The morphological features and biochemical examination presented their appropriateness as decent textiles materials. The physical possessions of Ramie fibre presented great obstinacy, great shine plus clarity. The situation takes Several of the vegetable fibers such as coconut coir, sisal, banana, hemp, etc. detection presentations by means of a basis for

industrial resources (Satyanarayanan et al. 1990b;Udo and Thomas.1997; Rowell et al. 1997) Good design of a composite system exposed to high loading rates can be capable only if the strain rate sensitivity of the material has been confrontation to heat, light, acid and alkali [1]. The blend results in better properties not displayed by the single materials. Several combined resources remain poised of just 2 stages some is named as matrix stage, which remains constant further surrounds the extra stage regularly termed the discrete stage [2-5]. Composites reinforced with natural fibers usual collective interest from industries in a wide field of application such as vehicle, building, aerospace and packing (Ku et al. 2011; Pickering KL et al, 2007). The main weakness of using regular fiber is their high level of moisture concentration, insufficient bond among unprocessed fibers besides the polymer matrix which can principal to deboning with age (Gassan J 2002). Several of the plant fibers such for example coir, sisal, banana, hemp, etc. discovery presentations as per a basis for engineering resources (Satyanarayana et al., 1990b; Udo and Thomas, 1997; Rowell et al., 1997) correct design of a composite system exposed to high loading rates can be proficient only if the strain rate sensitivity of the material has existed measured and the modes of failure and energy absorption are well categorised [6]. For case, sisal is a hard leaf fiber but jute and hemp are both bast fibres and are usually denoted to as ‘soft’ fibers to choose them from the stiff leaf fibers. Both leaf and bast fibres are multicellular with actual minor individual cells bonded together (Preston, 1963; Hearle, 1963 and Hegbom, 1990). Composites occupied with micro elements in epoxy arrangement expanded important reputation now the growth of thermosetting combinations. Epoxy resins the utmost significant medium polymer designated once the situation originates towards great presentation. This one grouping by glass fibers delivers an innovative composite through properties similar little weight, decent mechanical then tribological possessions [7-16]. The revision deals through the belongings of ordinary fibers arranged certain mechanical possessions of the Epoxy composite. Jayamol George [17] finished new revisions on Small Pineapple Leaf Fiber-Strengthened Little – Density polyethylene composite. The encouragement of fiber span, fiber loading, then alignment on the mechanical possessions takes moreover remained appraised. Dimension of fiber length is frequently appreciated on photographs of short fibers obtained from burning off or dissolving the matrix. Difference of the quantity of fiber length remained approved out and the physical worth of mean fiber length and the actual fiber length distribution were obtained [18].

Revised Manuscript Received on October 20, 2019.

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II. MATERIALS AND METHODS

A. Ramie

Ramie, unique of the hoariest fabric fibres of plant beginning governed the fabric domain as ruler of natural fibres. Its endorsement in the fabric domain is narrow owing towards the effort in degumming and absence of information of automated dispensation. Growing environmental awareness consumes faster attention in ramie creating since plants that are harmless, decomposable and ecofriendly. Ramie is extremely decorated aimed at his shine, strength, exceptional bacterial fight and valued sterile possessions. Certain of the drawbacks remain coating sticky resources also his cohesiveness. Unknown the external imperfections can be covered, an uncertain varied variety of creation can remain caused through developing the inherent possessions of ramie. Physical properties of ramie fibre are listed in the table I.

Table. I. Physical property of ramie fibre

Property	Value
Average fiber length (mm)	40
Mean breaking load (g)	30.09
Tenacity (g/d)	10
Mean breaking elongation (%)	4.5
CV% breaking elongation (%)	20.5
Moisture region (%)	17.5
Density (g/cm ³)	1.5

B. Matrix

Epoxy remains a thermosetting polymer that preserves as soon as various with a hardener. Epoxy resin of the score LY556 and hardener HY 951 remained used in this study. The reinforced matrix material remained primed through a mixture of epoxy plus hardener at a ratio of 10:1.

C. Chemical Treatment

Alkali treatment by sodium hydroxide (NaOH) is the utmost typically used action for bleaching and cleaning the external surface of usual fibers toward yield great-excellence fibers. 5% sodium hydroxide solution remained prepared with sodium hydroxide pellets and purified water in figure1. Once the proportion of sodium hydroxide solution is improved it disturb the fibers possessions by decline the bonding ability in the course of research of composites. Ramie fibers remained at that moment immersed in the solution for two hour separately. Formerly it is wash away with running water. It remained then retained in sun light for twenty hour for drying as shown in figure 2.



Fig.1. Chemical Treatment



Fig.2. Dried in sun light

D. Composite preparation

The specimen is prepared by hand – layup process open mold of size 300 mm x 300 mm .the mould is refined and then a mould freeing mediator is applied on the exterior used to permit relaxed elimination of the composite from the mold. The epoxy gum LY - 556 and hardener (HY-951) is varied in a fraction of 10:1 through mass as used. The ramie fiber is sited finished the mold at essential alignment manually and then essential quantity of epoxy resin was transferred over it. The process is continuous until the necessary thickness is reached. For each period roller stayed used to roll finished the fiber in order to eliminate the air bubbles as of it. Than is dried at room temperature aimed at twenty four hour. The fabrication process is shown in figure 3.



Fig.3a. Uni - directional ramie



Fig.3b.Mixing of Resin



Fig.3f. 0°/0° Orientation Composite



Figure 3c Applying resin



Fig.3d Appling roller



Fig.3e Curing process

III. MECHANICAL CHARACTERIZATION

A .Tensile Test

Critical tensile strength, frequently mentioned toward tensile strength is extreme stress that materials that can resist though being strained or dragged previously rupture. The tensile examination aimed at the samples remained accompanied rendering to ASTM D 3039 [20].the sample of dimension 250mm X25mm X5mm.the fixture used for the tensile testing is exposed in figure 4. Ultimate tensile strength was determined using the equation (1)

$$\text{Tensile strength} = \frac{\text{Extreme load}}{\text{Cross sectional area}} \text{ in MPa} \text{ ----- (1)}$$



Fig.4. Universal testing machine [19]

B. Flexural Test

The usage of flexural test near regulate the mechanical possessions of polymer composite is commonly dominant since of the comparative ease of the examination technique, arrangement and testing apparatus essential. The flexural strength of the samples was resolute aimed at sample using the three-point bending test as per ASTM–D790[20].The samples of sizes 200 mm x 15 mm x 5 mm. the flexural test setup used in the experiment is presented in figure 5. The flexural strengths of the composites remained resolute using the equation 2.

$$FS = \frac{3PL}{2BD^2} \text{ in MPa} \text{ ----- (2)}$$

Where,

FS – Flexural Strength [N/mm²]

P – Highest Load [N]

L – Sustenance Length [mm]



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B – Breadth of the sample [mm]



Fig.5. Flexural test setup [20]

IV. RESULT AND DISCUSSION

A. Tensile Strength Result

Table.2. Illustrate the tensile test outcomes for different directions of dried ramie fiber reinforced composites are recorded and associate them. In this we take 2 trials of samples for testing tensile strength. Amongst these the alignment $0^{\circ}/0^{\circ}$ (unidirectional) displays maximum tensile strength.

Table.2. Tensile strength of ramie composite of different orientation

Sample	Orientation	Tensile Strength in MPa	Mean Tensile Strength in MPa
A	$0^{\circ}/0^{\circ}$	T1 = 40.26 T2 = 63.71	59.10
B	$0^{\circ}/90^{\circ}$	T1 = 22.05 T2 = 35.60	28.83
C	$45^{\circ}/45^{\circ}$	T1 = 22.61 T2 = 15.70	19.17
D	$0^{\circ}/45^{\circ}/-45^{\circ}/90^{\circ}$	T1 = 22.27 T2 = 35.52	28.40

Figure 5 Illustrate the Tensile power of cured ramie fiber reinforced composites on their different orientation. Among these the $0^{\circ}/0^{\circ}$ orientation (unidirectional) shows maximum tensile strength.

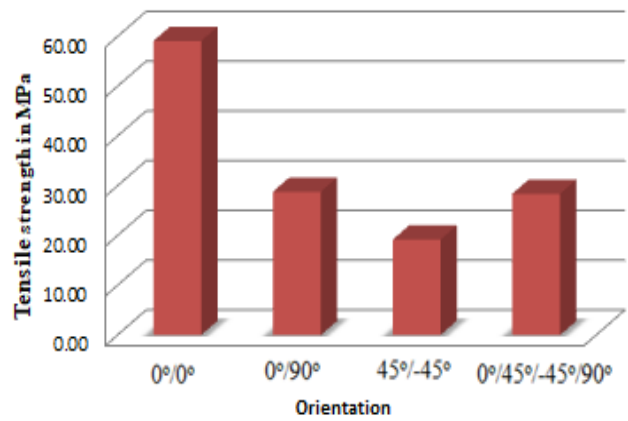


Fig.5. Tensile strength of ramie composite of different orientation

B. Flexural strength result

Table III displays the Flexural strength of treated ramie fiber reinforced composites on their different orientation. Among these the orientation $0^{\circ}/0^{\circ}$ (unidirectional) displays supreme flexural strength.

Table III. Flexural strength of ramie composite of different orientation.

Sample	Orientation	Flexural Strength in MPa	Mean Flexural Strength in MPa
A	$0^{\circ}/0^{\circ}$	T1 = 80.32 T2 = 84.40	82.36
B	$0^{\circ}/90^{\circ}$	T1 = 42.40 T2 = 52.96	47.58
C	$45^{\circ}/45^{\circ}$	T1 = 37.49 T2 = 34.14	35.82
D	$0^{\circ}/45^{\circ}/-45^{\circ}/90^{\circ}$	T1 = 55.72 T2 = 69.49	62.61

Figure 6 displays the flexural strength of treated ramie fiber reinforced composites on their different orientation. Among these the $0^{\circ}/0^{\circ}$ alignment (unidirectional) displays supreme flexural strength.

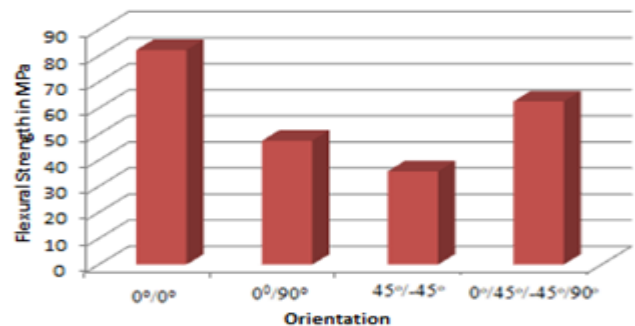


Figure 6. Flexural strength of ramie composite of different orientation.

V. CONCLUSION

In the current work four types of orientations were attained as per ASTM standards were used for testing. The investigational study on the outcome of fiber orientation preceding the treated ramie fiber reinforced epoxy composites indications to following decision. The mechanical possessions like as tensile properties and flexural properties shows the maximum value of 51.9 MPa and 82.36 MPa in the 0°/0° orientation (unidirectional) compared to others.

ACKNOWLEDGMENT

I stand glad towards the branch of mechanical engineering, UVCE For their endowment to bring out this research work.

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