INFLUENCE OF FIBER ORIENTATION ON INTERLAMINAR SHEAR STRENGTH AND WATER ABSORPTION PROPERTIES OF RAMIE POLYMER COMPOSITE

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ABSTRACT

In this paper new investigation has remained approved out on ramie composite to describe interlaminar shear strength and water absorption property. Ramie composites remain measured materials of excessive possible for engineering application. unique benefit of ramie composite materials aimed at the fashionable remains that the possessions of a composite can remain in the direction of an exact to an important level by the high-excellence of fibers and matrix and through varying the alignment of the fiber. The possibility aimed at this modifying of the possessions of the material is significantly superior, nevertheless, once diverse types of fiber orientations are collective trendy the similar resin matrix. Four orientations viz. $0^{\circ}/0^{\circ}$, $0^{\circ}/90^{\circ}$, $45^{\circ}/-45^{\circ}$ and $0^{\circ}/45^{\circ}/-45^{\circ}/90^{\circ}$ remained considered aimed at studies. Mechanical possessions such as interlaminar strength and water absorption properties of ramie composite endured determined as per ASTM ethics. Hand lay-up procedure remained approved for the production of composite. it was experiential that orientation at $0^{\circ}/0^{\circ}$ exhibited substantial growth in ILSS possessions by way of related toward other and proportion of water absorption is less in the instance of $0^{\circ}/90^{\circ}$ orientation as compared to other.

KEYWORDS: Epoxy, Fiber Orientation, Hand lay-up & Interlaminar Shear Strength

Original Article

Received : Jun 09, 2020 ; **Accepted :** Jun 29, 2020 ; **Published :** Aug 13, 2020 ; **Paper Id. :** IJMPERDJUN2020762

1. INTRODUCTION

Composites in aerospace submissions, equally military and vendible, are book-keeping aimed at a huge part of the increasing fashionable market worth. Composite materials proposal various greater possessions that take permitted composites producers to improvement important market segment trendy a diversity of productions. Improved convention of composites trendy armed and planetary arrangements, as glowing by way of trendy profitable aircraft development, remains predictable to remain distant into the predictable upcoming. The stress interim happening the boundary of two composed layers trendy composites laminates remain named interlaminar stresses, Uniform currently here is no technique existing aimed at the particular determination of the strength possessions. But, an estimated worth of the ILSS named the deceptive interlaminar shear strength can remain strongminded through using numerous test means. Hence far short beam shear test technique takes remained glowing advanced and recognized to discovery obtainable ILSS. Short Beam Shear Examination remains a twisting test accepted arranged a short sample intended such that contravention happens below the active of the shearing weight and not rendering toward the normal stresses. Though, concerns rise near this assessment since of a non-even bending moment laterally the shear level and robust controlled damage trendy under the stacking rollers (1). Preceding lacking investigations persisted appropriate happening the explanation of spaces and to detection the relationships among the void satisfied and the ILSS (2-4) likewise inadequate detectives (5) take finished trials to protest the stimulus of universal testing machine

cross head speediness on interlaminar shear strength and flexural Strength of CFRP laminates. Popular this technique a laminate trial through a small worth of L/h ratio somewhere 'L' remains the measurement of the sustenance span and 'h' remains the sample thinness exposed to three-point loading founded on the traditional beam philosophy (6-7)

2. MATERIALS AND METHOD

2.1 Materials

Composites remain finished of reinforcing fibers or fillers and matrix resources. Matrix environs the fibers, acting as load transporting intermediate and therefore shielding those fibers in contradiction of biochemical and ecological attack. For the current learning, subsequent Materials have remained measured aimed at preparing composites. 1) Matrix material : Epoxy resin 2) Reinforcement material : Unidirectional ramie fiber.

2.2 Matrix

Epoxy remains the standard Materials used then it entails of intermediate viscosity epoxy resin [LY 556] and HY951 room temperature curing hardener. Altogether these ingredients remain provider by Hindustan Ciba Giegy Ltd, Mumbai, India. In overall, the thermo setting polymer epoxy resin comprises of greater possessions such by way of decent mechanical possessions, greater biochemical and erosion confrontation and effortlessness of processing. Owing to its widespread applications, epoxy resin was designated by way of the matrix material aimed at the present study.

2.3 Reinforcement

Ramie, one of the eldest texture fiber of plant origin governed the textile world by way of king of natural fiber. Ramie is recognized as the strongest of all natural bast fiber in the world which is known as riha in Assam, it is highly adorned for its luster, strength, excellent microbial resistance and valuable hygienic properties. Physical properties of ramie as revealed the table 1.

2.4 Composite Fabrication

The samples are made-up by hand lay-up procedure exposed mold of dimensions 300 mm X 250 mm the mold remains sophisticated and before a mold release agent remains applied proceeding the mold surface used toward permit comfortable exclusion of the composite subsequently the mold. The epoxy resin LY-556 and hardener HY-951 is mixed in a portion of 10:1 and then vital amount of epoxy resin was moved completed it. the procedure remains constant till the required width is gotten. Aimed at individually period roller applied used to roll complete the composite in demand to eliminate the air bubbles by way of it. Before remains cured at room temperature predictable at 24 hours. The manufacture processes are exposed in figure 1. Subsequently curing samples are made-up as each the ASTM D 2344 standard as exposed in figure 2.

III. MECHANICAL CHARACTERIZATION

3.1 Interlaminar Shear Strength (Ilss)

Interlaminar shear strength study remained approved ready at room temperature finished three-point bend Testing by means of stated in ASTM D 2344[9], using universal testing machine of capacity 5 KN as exposed in figure 3. the haste of the crosshead remained 2mm/min. double composite specimen remained confirmed for respectively sample interlaminar shear strength was considered from equivalence(1).

$$\sigma = \frac{P}{B \times D} \quad (1)$$

4BD

Where σ = ILSS in Mpa

P= Max load in N

B = Width in mm

D = Depth in mm

3.2 Water Absorption Test

To knowledge the behavior of water absorption of the ramie fiber reinforced epoxy composites, water absorption trials continued accepted accessible affording to ASTM D570. Composite models persisted absorbed in a water bath (deionized, 23°C) comprehensive a time period till the saturation remained touched. Two trials from individually fiber orientation with sizes 25 mm × 25 mm × 6 mm. An oven remained used, originally to dry altogether the trials at 50°C concluded 24 hours, and previously they endured cooled to room temperature. The drying development was frequent, until the weight of the samples was constant (mass). After 24 hours, the trials remained separate from the water and endured weighed (mass) by means of a digital scale directly after they endured dried through dry cloth. This arrangement remained frequent, to weigh the samples regularly (mass) until saturation point reached. At different periods of time, the percentage of weight gain was calculated. Water absorption is calculated as per Equation (2).

$$\text{Water absorption in \%} = \frac{W_w - W_i}{W_i} \quad (2)$$

Where, W_i = Initial weight

W_w = Wet weight

IV. RESULT AND DISCUSSION

4.1 Interlaminar Shear Strength Test Result

Table 2 indicates the outcomes of interlaminar shear strength properties appraised on ramie laminated composite for four dissimilar orientation i.e. [0°/0], [0°/90°], [45°/-45°], [0°/45°/-45°/90°]. In this we take 2 trials of sample for interlaminar shear strength. Between these the 0°/0° orientation (unidirectional) proposal higher interlaminar shear strength.

Figure4. Indicates the outcomes of interlaminar shear strength properties appraised on ramie laminated composite for four dissimilar orientation i.e. [0°/0], [0°/90°], [45°/-45°], [0°/45°/-45°/90°]. In this we take 2 trials of sample for interlaminar shear strength. Between these the 0°/0° orientation (unidirectional) proposal higher interlaminar shear strength.

4.2 Water Absorption Test Result

Table 3 shows the decisions of water absorption properties evaluated on ramie laminated composite for four different orientation i.e. [0°/0], [0°/90°], [45°/-45°], [0°/45°/-45°/90°]. In this we take 2 prosecutions of sample for water absorption properties. Among these the [0°/90°] orientation (unidirectional) proposal lesser percentage water absorption compares to the other.

Figure 5. shows the decisions of water absorption properties evaluated on ramie laminated composite for four different orientation i.e. $[0^\circ/0^\circ]$, $[0^\circ/90^\circ]$, $[45^\circ/-45^\circ]$, $[0^\circ/45^\circ/-45^\circ/90^\circ]$. In this we take 2 prosecutions of sample for water absorption properties. Among these the $[0^\circ/90^\circ]$ orientation (unidirectional) proposal lesser percentage water absorption compares to the other.

V. CONCLUSIONS

Fashionable the present effort four forms of alignments remained achieved as each ASTM values stayed used aimed at testing. The trial learning proceeding the conclusion of fiber orientation prior the ramie fiber reinforced epoxy composites suggestions to succeeding conclusion. The mechanical possessions alike interlaminar shear strength properties display the supreme value of 15.3 MPa in the $[0^\circ/0^\circ]$ orientation (unidirectional) compared to others and the percentage of water absorption properties is little less in the case $[0^\circ/0^\circ]$ orientation compared other

ACKNOWLEDGMENT

I *attitude* enthusiastic to the division of mechanical engineering, UVCE aimed at their grant to carry out this research effort

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Figure 1a: Unidirectional Fiber. Figure 2b: Weighing of Resin.

Figure 1c: Mixing of Resin. Figure 1d: Applying Resin.

Figure 1e: Applying Roller

Figure 1f: 0°/90° Orientation.

Figure 2: ILSS Sample. Figure 3: ILSS Testing Composite.

Figure 4: Interlaminar Shear Strength Properties of Ramie Composite of Different Orientation.

Figure 5: Water Absorption Properties of Ramie Composite of Different Orientation.

Table 1: Physical Properties of Ramie Fiber[8]

Properties	Values
Denier	3
Average fiber length (mm)	40
Mean breaking load (g)	30.09
Mean breaking elongation (%)	4.50
Moisture regain (%)	17.5
Density (g/cm ³)	1.5

Table 2: Interlaminar Shear Strength (ILSS) Test Result

SL. No	Sample	Orientation	ILSS in Mpa	Mean ILSS in Mpa
1	A	0°/0°	T1=15.5 T2=15.1	15.3
2	B	0°/90°	T1=8.8 T2=9.2	9.0
3	C	45°/-45°	T1=8.7 T2=8.5	8.6
4	D	0°/45°/-45°/90°	T1=4.2 T2=4.8	4.5

Table 3: Water Absorption Properties of Ramie Composite of Different Orientation

Sl.No	Sample	Orientation	24 hrs.	48 hrs.	72 hrs.	96 hrs.	120 hrs.	144 hrs.
1	A	0/0	2.36	4.13	5.04	5.56	6.11	6.3
2	B	0/90	2.27	3.91	4.37	4.84	5.33	5.67
3	C	45/-45	2.87	4.96	5.79	6.25	6.41	6.76
4	D	0/45/-45/90	2.37	4.19	4.94	5.7	5.99	6.25