Fabrication and characterization of Kevlar/Jute Reinforced Epoxy

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Abstract - With a specific end goal to ration common assets and conserve vitality, weight decrease has been the principle center of vehicle producers in the present situation. Weight decrease can be accomplished fundamentally by the presentation of low thickness materials. So the Industry has demonstrated increment enthusiasm for supplanting of steel material with that of composite material. The point of this work was to decide the rigidity, Modulus of versatility, flexural quality, affect quality, weight and cost of Kevlar-Jute composite. Epoxy SE 70 grid was utilized for the composite of Kevlar and Jute. Test tests were readied utilizing pressure shaping. This is an outstanding method to create composite items. Diagnostically, the volume portion and weight division, rigidity, modulus of versatility, weight and cost of composite example was figured. Trial test led on example utilizing Universal Testing Machine (UTM). The outcomes demonstrated that the properties of Kevlar-Jute composites can be extensively enhanced by joining of Kevlar in jute fiber composites upgrading the properties of coming about half breed composites. Stacking arrangement (modifying the position of Kevlar handles) altogether influences the flexural quality. For a similar relative weight division of Kevlar and Jute fiber, layering grouping has little impact on tractable properties. The Kevlar to jute proportion builds the ductile, flexural quality, affect vitality, strain vitality and lessens the heaviness of example. Progressively the Kevlar rate brings down the epoxy rate so the cost is lessened of example.

Key Words: Kevlar, Woven Jute, Epoxy, UTM Machine

1. INTRODUCTION

Keeping in mind the end goal to moderate common assets and manage vitality, weight decrease has been the fundamental concentration of car makers in the present situation. Weight diminishment can be accomplished principally by the presentation of better material, plan improvement and better assembling forms. The presentation of composite materials made it conceivable to diminish the heaviness of part with no decrease on stack conveying limit and soli...
flexural tests showed increase in some mechanical properties of the composite, such as strength values, maximum tension and deformation, mainly for composites PP matrix with two layers of fabric jute in flexural tests as compared to PP matrix without fabric jute.

Sanjay et al. [4] worked on E-glass, Jute and epoxy and found that the impact, flexure, and laminar shear strength of the specimen L4 are more than the L1, L2 and L3 specimen. Ahmeda et al. [5] taken a shot at E-glass, jute and polyester and found that the properties of jute composites can be impressively enhanced by consolidation of glass fiber as outrageous glass handles. The layer arrangement has more prominent impact on flexural and bury laminar shear properties than the ductile properties. A general correlation between the properties of the considerable number of covers uncovered that the half and half overlay with two extraordinary glass handles on either side is the ideal blend with a decent harmony between the properties and cost.

3. OBJECTIVES

The objectives of this project are as follows:

- The primary objective of the present work is to fabricate composite laminates with:
  Jute fabric + Kevlar fiber + Epoxy resin using simple hand layup technique.
- To prepare test specimens for flexural test from the above fabricated laminates.
- To conduct 3-point flexural tests.
- To acquire different outcomes for these tests i.e. Flexural Strength in Mpa and Displacement at Ultimate Load in mm for the examples utilized and to think about the qualities got for these examples.

4. EXPERIMENTAL DETAILS

4.1 MATERIALS

<table>
<thead>
<tr>
<th>Reinforcing Fiber</th>
<th>Jute Fiber &amp; Kevlar Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix System</td>
<td>Epoxy Resin (lapox L-12) and Hardener K-6</td>
</tr>
<tr>
<td>Molding Process</td>
<td>Hand lay-up followed by Room temperature molding.</td>
</tr>
<tr>
<td>Reinforcement s: matrix ratio</td>
<td>65:35</td>
</tr>
</tbody>
</table>

4.2 MANUFACTURE OF THE TEST LAMINATES

Test overlays of 300 mm X 300 mm were at first created to get ready mechanical test examples by Hand lay-up followed by Room temperature.

4.3 PREPARATION OF THE RESIN HARDENER SYSTEM

The resin and hardener were to be blended in a proportion of 100:10 by weight, as follows:

- An empty bowl and brush were taken and weighed.
- Resin was added to the bowl and the brush setup and was placed on the electronic balance, till it registered the constant weight.
- The hardener was added to the bowl and bowl was removed from the balance.
- The resin and hardener were blended completely utilizing brush and is utilized. Quickly in the preparation of the laminate, from now on this mixture will be referred to as a “resin system”.

4.4 PREPARATION OF THE REINFORCING MATERIAL

The texture utilized are jute fiber, Kevlar fiber as rolls. The texture roll is spread on the level surface and required measurement of 300 mm x 300 mm is checked utilizing the marker pen on the texture spread and cut utilizing a scissor physically. Required such layers of texture were sliced to get the required thickness of cover in this examination.

4.5 SPECIMEN CALCULATIONS

Ex: Jute, Kevlar / Epoxy:

- **Density of laminate** = (Weight fraction of Jute fiber × Density of Jute fiber) + (Weight fraction of Kevlar fiber × Density of Kevlar fiber) + (Weight fraction of resin × density of epoxy resin).
- **Mass of laminate** = Density × Volume of sample.
- **Mass of resin and hardener used (35%)** = Mass of laminate × 0.35
- **Ratio of mass of resin to mass of hardener** = 100:10
- **Mass of resin** = Mass of resin and hardener × (100 / 110).
- **Mass of hardener** = Mass of resin and hardener × (10 / 110).
- **Mass of jute and Kevlar fiber**

Number of fiber layers for each laminates:

- Jute + Kevlar + Epoxy laminate of 2mm thickness = 5 layers.
- Jute + Kevlar + Epoxy laminate of 3mm thickness = 7 layers.
- Jute + Kevlar + Epoxy laminate of 4mm thickness = 9 layers.
4.6 SPECIMENS PREPARED FOR FLEXURAL TESTS

5. RESULT AND DISCUSSION

5.1 TENSILE TESTS

<table>
<thead>
<tr>
<th>Material</th>
<th>Peak load (N)</th>
<th>Max. displacement (mm)</th>
<th>UTS (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANSYS Result</td>
<td>Experimental Result</td>
<td>ANSYS Result</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 2mm thick laminate</td>
<td>5539</td>
<td>3.2</td>
<td>3.14</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 3mm thick laminate</td>
<td>8702</td>
<td>3.72</td>
<td>3.57</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 4mm thick laminate</td>
<td>7961</td>
<td>5.20</td>
<td>5</td>
</tr>
</tbody>
</table>

5.2 COMPRESSION TEST

<table>
<thead>
<tr>
<th>Material</th>
<th>Peak load (N)</th>
<th>Max. displacement (mm)</th>
<th>Compressive Strength (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANSYS Result</td>
<td>Experimental Result</td>
<td>ANSYS Result.</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 2mm thick laminate</td>
<td>59</td>
<td>1.99</td>
<td>1.64</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 3mm thick laminate</td>
<td>390</td>
<td>9.78</td>
<td>12.28</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 4mm thick laminate</td>
<td>184</td>
<td>2.09</td>
<td>2.17</td>
</tr>
</tbody>
</table>

5.3 BENDING TEST

<table>
<thead>
<tr>
<th>Material</th>
<th>Max. displacement (mm)</th>
<th>Flexural Strength (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ANSYS Result</td>
<td>Experimental Result</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 2mm thick laminate</td>
<td>73</td>
<td>7.1</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 3mm thick laminate</td>
<td>143</td>
<td>9.58</td>
</tr>
<tr>
<td>Jute/Kevlar/Epoxy with 4mm thick laminate</td>
<td>102</td>
<td>8.1</td>
</tr>
</tbody>
</table>

The experimental results showed that:

- Tensile strength of composite for 3mm was more than that of 2mm and 4mm
- Compressive Strength of composite for 3mm was 65% more than that of 2mm and 53% more than that of 4mm
- Bending strength of 3mm thickness was 20.45% more than that of 2mm and 7.77% more than the one of 4mm.

6. CONCLUSION

Effect of stacking sequence on tensile, compressive, and Bending Strength of Kevlar-Jute fabric reinforced epoxy composites, have been experimentally evaluated and compared with results obtained from ansys. From the results of this study, the following conclusions are drawn.

- Incorporation of Kevlar in jute fiber composites enhances the properties of resulting hybrid composites.
- Stacking sequence (altering the position of Kevlar plies) significantly affects the flexural strength.
- For the same relative weight fraction of Kevlar and Jute fiber, layering sequence has little effect on tensile properties.
- The Kevlar to jute ratio increases the tensile, compressive, bending strength and reduces the weight of specimen.
- More the Kevlar percentage lower the epoxy percentage so the cost of specimen is reduced.
7. FUTURE SCOPE

In this work, the flexural strength investigation was carried out on different fibers but at the same time, this work can be extended to other natural fibers such as bamboo, banana etc. available in the market.

In addition, other test like

- Moisture absorption test
- Impact test
- FFT analysis
- Hardness test

Further work can also be done on different polymers and for different percentage of fiber and reinforcement fraction.

REFERENCES


