Characterization of Natural Fiber (Ridge gourd)

Luffa Acutangula

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Abstract—Natural fibres extracted from various parts of plants. Now research are motivated by environmental issues caused by several synthetic material. Synthetic fibres have certain limitations. These issues carved a path for the analysis of natural fibres in an option of cost effective, light weight, high strength to weight ratio material. Our research work is aimed to characterise the luffa acutangula plant. Luffa cylindrical plant fibre is a new biodegradable engineering material. However, the dynamic behaviours of these new green materials or their composites should be explored to consider them for practical applications. This paper presents the characterisation of the flexural, impact energy and water absorption of the luffa fibre. Our present work divulges the effects of volume fraction on the Tensile, Compressive, Flexural, Impact strength. Natural fibres have a distinct properties so we have choose fibres and try to make a characteristic study of it.

Keywords—Luffa fiber; Tensile test; Flexural test; Izod impact test.

I. INTRODUCTION

Fiber is natural or synthetic substance that is significantly longer than it is wide. Fibers are often used in the manufacture of other materials. The strongest engineering materials often incorporate fibers, for example carbon fiber and ultrahigh molecular weight polyethylene. Synthetic fibers can often be produced very cheaply and in large amounts compared to natural fibers, but for clothing natural fibers can give some benefits, such as comfort, over their synthetic counterparts. In today’s scenario, there is an increasing need for eco-friendly materials with relatively high strength to weight ratio. FRPs reinforced with synthetic fibres are of high strength to weight ratios and become excellent substitutes for conventionally used high strength materials. The poor biodegradability of synthetic FRPs is a serious issue, as of today. Natural fibre reinforced FRPs can solve both the performance and environment related issues. Murali et al carried out a research to study the possibilities of introducing new natural fibers as fillers in a polymeric matrix, to develop economic and light weight structural materials. Later, Techniques for extraction of fibres from plants like vakka (Roystonea regia), date and bamboo fibers were developed by researchers. The density and tensile properties of these fibers were almost as good as those of established fibers like sisal, banana, coconut and Luffa.

Refereed from: (R.Panneerdhasan, Mechanical properties of luffa fiber and groundnut reinforced epoxy polymer hybrid composite, 2014 (2042-2051))

II. MATERIALS USED

Some of the raw materials needed for experimental work are,
- Natural fiber
- Epoxy resin – Araldite LY 556
- Hardener – Araldite HY 951

III. MATERIAL PREPARATION

A. Experimental preparation

The natural fiber ridge gourd is cut into two half to remove the inner rough portion of the dry. The fiber is washed with water and KOH solution to remove the contaminants and adhering dirt. They were dried for 72hrs at room temperature and stored.

Figure 1

There are many potential natural resources, which India has in large quantity. Most of it comes from the agriculture and forest. Luffa cylindrica, locally called, as ‘Sponge-gourds’ is one such natural resource whose potential as fiber reinforcement in polymer composite has not been explored to date. It has a ligneous netting system in which the fibrous cords are disposed in a multidirectional array forming a natural mat.
B. Percentage of materials used
The composite fiber is prepared in hand lay-up technique. The luffa fiber which is taken as reinforcement is cleaned properly and cut to appropriate sizes.

A wooden mould with dimensions as (sizes in mm)
1) 250*25*3 for Tensile test.
2) 25*13*3 for Flexural test.
3) 16*13*3 for Impact test.

<table>
<thead>
<tr>
<th>Designation of material</th>
<th>Epoxy weight (%)</th>
<th>Luffa fiber (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single layer</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Single layer</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>Single layer</td>
<td>65</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 1
X axis – Fiber content in percentage (for all graph)

C. Test for Luffa fiber
Some of the tests undergone to find the physical factors of luffa fiber are.
- Tensile test
- Compressive test
- Izod impact test

D. Equations

**TENSILE TEST**

% of elongation = \[ \frac{(L_f - L_i)}{L_i} \times 100 \]

Where, 
- \( L_f \) = Final length of specimen 
- \( L_i \) = Initial length of specimen

Yield stress = Load at yield point / Area of cross section.
Ultimate stress = Ultimate load / Area of cross section.
Breaking stress = Breaking load / Area of cross section.

**COMPRESSIVE TEST**

Ultimate stress = Ultimate load / Area of cube.

**IZOD TEST**

Impact = Energy absorbed / Area of cross section

IV. EXPERIMENTAL TESTING

Considering factors such as type of reinforcement and matrix materials, size, shape, quantity and cost, there are many specialized processes available. The most commonly used process is the hand layup method. The set-up for hand lay-up technique is shown in figure 3. The mould used for the composite is made of mild steel with stainless sheet placed in the inner surface.

E. Tensile test and Flexural test

The tensile tests were conducted according to ASTM D 3039-76 standard on a computerized Universal Testing Machine. The loading arrangement for the specimen and the photograph of the machine used are shown in figure 4. The specimens with dimensions of length 250mm and width 25 mm were used. The test was conducted at a crosshead speed of 5 mm/min using 10 kg load cell. In each case, 3 samples were used and the average values were reported. The flexural strength is usually obtained experimentally by means of a compressive test with using UTM.
**F. Izod impact test**

The material is cut into specimens with dimensions 120mm x 13mm x 3mm and a notch was made at the center of the specimen at 45 degrees angle for impact testing as per ASTM D256-88 specifications. The impact strength of the specimen is determined using IZOD impact tested. The IZOD Impact tester consists of a pendulum of known mass and length that is dropped from a known height to impact a notched specimen of the material.

**III. RESULT AND GRAPH**

**A. Tensile test**

*Figure 6*

The graph shows that the resultant values of tensile test experiment.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Peak Load (N)</th>
<th>% Elongation</th>
<th>Break load (N)</th>
<th>UTS (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>787</td>
<td>0.81</td>
<td>498.9</td>
<td>10.48</td>
</tr>
<tr>
<td>2</td>
<td>607.6</td>
<td>0.843</td>
<td>89.57</td>
<td>8.03</td>
</tr>
<tr>
<td>3</td>
<td>936.1</td>
<td>0.89</td>
<td>279.8</td>
<td>12.43</td>
</tr>
</tbody>
</table>

*Table 2*

**B. Compressive test**

*Figure 7*

The graph shows that the resultant values of compressive test experiment.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Peak Load (N)</th>
<th>Flexural strength (Mpa)</th>
<th>Break load (N)</th>
<th>Flexural modulus (Gpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42.1</td>
<td>30.4</td>
<td>40.9</td>
<td>2982.9</td>
</tr>
<tr>
<td>2</td>
<td>37.5</td>
<td>26.9</td>
<td>35.5</td>
<td>2652.7</td>
</tr>
<tr>
<td>3</td>
<td>68.2</td>
<td>49.2</td>
<td>65.6</td>
<td>3854.1</td>
</tr>
</tbody>
</table>

*Table 3*

**C. Izod impact test**

*Figure 8*

The graph shows that the resultant values of Izod impact test experiment.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Izod impact value in (j)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.21</td>
</tr>
<tr>
<td>2</td>
<td>0.26</td>
</tr>
<tr>
<td>3</td>
<td>0.33</td>
</tr>
</tbody>
</table>

*Table 5*
D. Comparison of Tensile, Flexural, Impact strength

The comparison of Tensile, Flexural and Impact strength shows the greater value difference according to the percentage of fiber used in plate.

Figure 9

REFERENCE