

MECHANICAL PROPERTIES OF ALOE VERA-JUTE-GLASS FIBER REINFORCED POLYMER MATRIX COMPOSITES

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Abstract. In this current experimental work, composite material is fabricated using a combination of natural fibers such as aloe vera, jute and glass fiber reinforced in a Epoxy Resin (Polymer Matrix). The composite samples were fabricated by compression molding Technique. The fabricated composite samples are tested for its mechanical properties such as tensile, flexural and impact properties. The composite sample dimensions and the testing of the samples are carried out as per ASTM standards.

Keywords: Aloe Vera fiber, Jute fiber, Glass fiber, Epoxy Resin

1. Introduction

Over the last two to three decades composite materials have been used immensely in many engineering fields. Composite materials provide high stiffness, high strength to weight ratio. Modern composite materials are used in many applications ranging from low sophisticated to highly sophisticated applications. Polymer Matrix Composites are widely used in automotive industry especially in areas such as automobile window panel, vehicle doors etc., where the conventional materials have been replaced by composites. Natural fiber composites are attractive and most currently used materials, due to the cost effectiveness of the raw materials. Also, due to the easy availability of natural fibers many researchers are keen in conducting research in the field of composites. Composite material made up of combining a natural fiber with a synthetic fiber such as glass fiber is finding increased applications. Generally, a composite material is a material which is made up of two or more constituent materials. These constituent materials are physically and chemically distinct in nature. Polymer matrix composite is one type of composite material in which a polymer acts as a matrix. Epoxy resin is one of the important polymer matrix.

PongsathornKongkeaw et al studied and investigated the effect of fiber length on the tensile properties of epoxy resin composites reinforced by the fibers of bamboo. The composite samples were fabricated by manual layup method. The samples fabricated with five different fiber lengths. The tensile strength of the composite samples was cut according to ASTM standard. The samples were tested for its tensile strength using Universal Testing Machine and the fiber – matrix interaction was observed SEM micrographs. The result concluded that the tensile strength of the composite samples increases with the increase in the fiber length without affecting the elongation at break of the



composite. Also, the presence of voids, fiber length and the interfacial adhesion between fiber – matrix can affect the mechanical properties of the fabricated composites [1].

Soma Dalbehera et al fabricated a hybrid composite using jute fiber and glass fiber as reinforcing materials and epoxy resin as the matrix material. Hand Layup technique was adopted for the fabrication of the composite samples. Stacking sequence of the fibers was followed. The effect of stacking sequence on the tensile, flexural properties of the composites was investigated and it was concluded that the combined effect of natural and synthetic fibers into the polymer matrix enhanced the mechanical properties of the composite material [2].

TemesgenBerhanu et al fabricated Jute-Polypropylene composites by compression molding technique. The weight percentage of the fiber reinforcement was varied. The effect of weight percentage of jute reinforcement on the mechanical properties of the composite material was investigated and was reported that the mechanical properties of the composites substantially improved with the addition of 40% of jute fiber reinforcement [3].

Rajesh Ghosh et al investigated the effect of fiber volume fraction on the tensile strength of banana fiber reinforced vinyl ester resin composites. The composite fabricated were tested for its tensile strength and the samples were prepared cut according to ASTM standard. They concluded that with the increase in the fiber volume fraction the tensile strength of the fabricated composite material increases after an initial dip in the value of tensile strength [4].

Yamini et al investigated the impact behavior of natural based composites using coir and Aloe Vera. The composite materials were fabricated by hand layup technique. Charpy impact test was carried out in a un-notched specimen. The moisture absorption test was also carried out. It was reported that the impact value of the aloe vera fiber was comparatively lesser due to the fact that it has higher bond strength at the interface between the fiber and the matrix. Also, the moisture absorption test shows that the coir samples absorb more moisture than aloe vera due to the presence of micro-voids [5].

SudeepDeshpande et al investigated the mechanical properties such as ultimate tensile strength, flexural strength, inter laminar shear strength, impact strength etc of E-Glass fiber/jute fiber reinforced epoxy composites with bone and coconut powder as filler materials. The composite samples were fabricated using hand layup technique. It was reported that flexural strength, hardness, inter laminar shear strength were superior for the composites filled with 15% volume coconut powder. Also, the composite materials with 15% volume bone powder exhibited superior impact strength [6].

2. EXPERIMENTAL DETAILS

2.1. Materials Used

In the present investigation Aloe Vera, Jute and E – Glass fiber are used as reinforcing material and Epoxy resin (LY556) and a suitable hardener (HY951) are used as the raw materials.

2.2. Method of Fabrication

The composite material is fabricated in the form of a plate of dimensions 27cm x 27cm by compression molding technique. Stacking sequence of the fiber is followed in the fabrication of the composite material. The stacking is G-A-J-A-G. This means the composite sample consist of five layers of fibers in which the Glass fiber are placed in the top and bottom layer. The individual composite samples for the mechanical testing are cut from the prepared composite plate. The dimensions of the composite samples are as per ASTM standards.

2.3. Preparation of Samples

The composite sample for the Tensile, Flexural and Impact (Izod) test is cut as per ASTM D3039, ASTM D790 and ASTM D256 respectively.

3. RESULTS AND DISCUSSIONS

The prepared composite samples are tested for its mechanical properties such as tensile strength, flexural strength and impact strength. The tensile test is carried out using a Universal Testing Machine (UTM). The three point flexure test is carried out to determine the flexural strength of the fabricated composite sample. Impact test is carried out using the Izod impact testing machine

The tensile test specimen loaded in the corresponding fixture in a UTM is shown in figure 1.



Figure 1. Tensile test specimen loaded in the UTM

Similarly the flexural test sample loaded in the three point flexure apparatus is shown in figure 2.



Figure 2. Flexural Test Specimen loaded in a three point flexure attachment

A representative plot of the Stress-Stain for the Tensile Test obtained from the UTM is shown in figure 3.

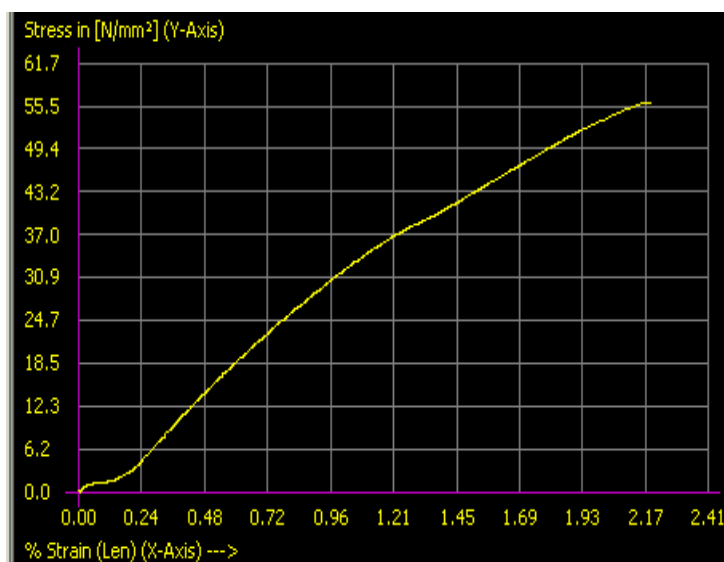


Figure 3. Representative plot of the Stress-Strain graph for the fabricated composite material obtained from UTM

A sample of the Load-Length plot for the Flexural Test obtained from the UTM is shown in figure 4.

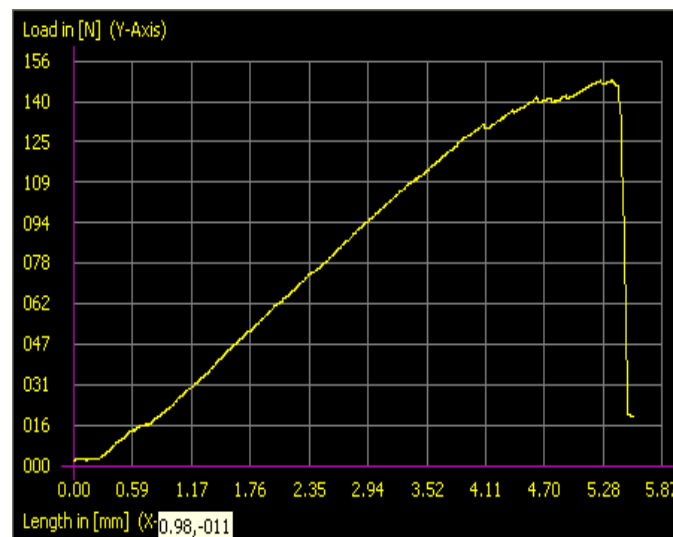


Figure 4. Representative plot of the Load-Length for the fabricated composite material obtained from UTM

The overall experimental result of the tested composite samples on an average of five samples for each test is shown in table 1.

Table 1 Experimental result of the tested composite samples

Tensile Strength (MPa)	Flexural Strength (MPa)	Impact Strength (J/mm ²)
60.017	107.896	0.026

4. CONCLUSION

In this present experimental work, Aloe Vera, Jute, Glass fiber reinforced Epoxy composites is fabricated by compression molding method. The fabricated composites are tested for its mechanical properties such as tensile strength, flexural strength and impact strength. ASTM standards are followed for the sample preparation as well as for the testing procedure. Based on the various mechanical testing carried out, it is concluded that the tensile strength, flexural strength and the impact strength of the Aloe Vera-Jute-Glass fiber reinforced epoxy composites is 60.017 MPa, 107.896 MPa and 0.026 J/mm² respectively.

5. REFERENCES

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