Mechanical Orietation and Processing of Reinforced Jute-Epoxy Composites

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Abstract: *The aim of this study is to determine the mechanical properties of developed composite plates by varying percentage of jute. Composite materials and layered structures based on natural jute fibers are increasingly regarded as an alternative to glass fiber reinforced parts. One of their major fields of application can be found in structural components for the automotive industry. The composite plates are fabricated by hand layup techniques which is very economical. The flexural properties under three point bend test are investigated experimentally by using the theory of bending of beam. Experimental results shows that the composite plate made with jute (60%) have strength closely related to plate made up of glass fibre (100%), finally the developed reinforced composites are then characterized by flexural strength, bending stress and compressive strength. Also, impact test is performed on Charpy Impact testing machine to assess shock absorbing capability of material.*

Keywords *- Hand lay-up, composite laminates, load carrying capacity, impact energy*

I. INTRODUCTION

The potential and advantage of natural fiber as reinforcement material have been given significant attention for past few decades. This is due to fact that natural fibers are light weight low in cost and environmental friendly. Natural fiber composites with thermoplastic and thermoset matrices are now utilized for door panels, seed bags, head liners, dash boards and other interior parts by car manufacturers. Fiber reinforced polymer composites are now considered as an important engineering material. They offer outstanding mechanical property, unique flexibility in the design capability and ease of fabrication. Additional advantages include light weight, corrosion and impact resistance and excellent strength. Today, fiber composites are routinely used in diverse application such as automobile, air craft, space vehicle, offshore structure, containers, sporting goods etc. Fiber reinforced composites are not only mass of fiber dispersed with in a polymer. It consists of fibers embedded to a polymer matrix with distinct interfaces between two constituent phases. The fibers are usually of high strength and modulus and serve as principle load carrying members. The matrix acts as load transfer medium between fibers. This also protects fiber from environmental damage. A wide variety of fibers are available for use in composites. The most commonly

used fibers are various types of carbon, glass and are mid fibers. Besides natural fiber such as jute, sisal and Ceramic fibers like alumina, silicon carbide etc are used in composite making.

By natural fiber composite we mean composite material reinforced with fiber, particles, and plate lattes from natural renewable source. Natural fiber includes those made from plant and mineral sources. Plant fibers are generally comprises mainly of cellulose for example include cotton, jute, flax, sisal and hemp. Natural fiber composites are by no means new to the mankind. Already the ancient Egyptian use clay that was reinforced by claw to build the walls. In the beginning of 20th centaury wood or cotton fiber reinforced phenol were fabricated and used in the electrical application.

At present day natural fiber composites are mainly found in automotive and building industry. Natural fiber composites can be very cost effective for following applications such as

- Building and construction industries (panels for partition, wall, window, roof flies), prefabricated buildings which can be used in the times of natural calamities such as flood, cyclones or earthquakes.
- Furniture – table, chair, shower bath units.
- Electrical devices and appliances.
- Everyday application – helmet, suitcase, lamp shades.
- Transportation – automobile, railway coach, car interiors etc.

II. SELECTION OF MATERIALS

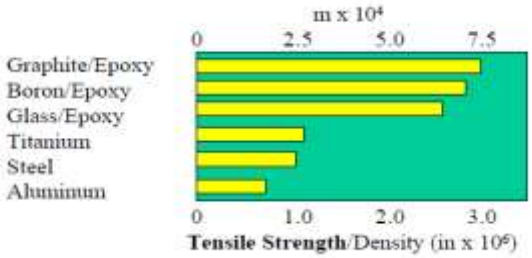
1) Selection of Glass Fiber

We can use the glass fiber for fabrication of jute reinforced composites. Glass fibers consist of two major

types E and S2. Although S2 fibers have better mechanical properties than E fibers, but the cost of E fibers is much lower than S2 fibers. So in the present work the E-glass/epoxy is selected base material.

Available density of glass fiber:

1. Glass fiber chopped strand mat (450gsm).
2. Glass fiber woven roving (450gsm).
   Some composite materials that can use for jute reinforced composites are as shown in following graph.



2) Selection of Jute

The jute we have used here for reinforcing the composite was taken from gunny bags which are used for storing rice or wheat.

Natural fiber jute From Gunny Bags

3) Selection of Resin

NETPOL 1011 (General Purpose Polyester Resin)
Fibre glass reinforced Netpol 1011 laminates display excellent physical, mechanical & electrical properties besides thermal & acoustic insulation properties. Articles moulded out Netpol 1011 are light weight, dimensionally stable & resistant to heat &water.

III. METHOD FOR FABRICATION.

1) Mixing Ratio

For the fabrication of jute reinforced composite the mixing proportion of the Resin and hardener plays an important role. First of all we have taken general purpose resin as base chemical according to our requirement and then we added hardener and accelerator in proportionate ratio.

Resin used - Netpol 1011 (General purpose resin)
Hardener – MEKP (Methyl Ethyl Ketone Peroxide)
Accelerator used – Cobalt Naphthanate
Percentage of Hardener – 4%
Percentage of Accelerator – 1%

During the preparation of solution (GP + Hardener + Accelerator) we have to be careful on mixing ratio. If the hardener and accelerator ratio is more in resin the solution will become hard within 5 minutes. While, if the hardener and accelerator ratio is low then our final product will not become hard.

2) Hand Layup Technique

The oldest and simplest moulding technique in which reinforcing materials and catalyzed resin are laid into or over a mould by hand. These materials are then compressed with a roller to eliminate entrapped air.

- Clean the mould with cotton cloth.
- Remove the unwanted resin and gel coat present on the mould of previous trip.
- Do the papering of the mould with hot water if necessary.
- Wipe out the water with dry cotton cloth till the moisture is totally removed.
- Apply mansion wax polish and remove with cotton cloth.
- Wait for 2-5 min and then apply P.V.A
- After P.V.A is dry apply first coat of gelcoat and wait till it get gelled.
- Apply second coat of gelcoat and wait till it gets gelled.
- Apply resin coating and immediately place glass fibre. Again apply resin coating over the glass fibre.
- Next place the natural fibre and again apply the resin coating.
- Impregnate it using roller to remove air bubbles.

Fig.9. Applying roller on the laminate to remove entraped air.

IV. EXPERIMENTAL WORK.

Three-Point Bend Test

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture.

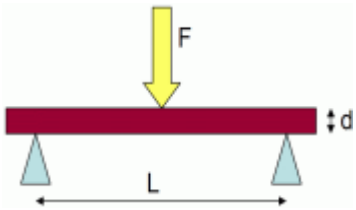


Fig.01 - Beam under 3 point bending

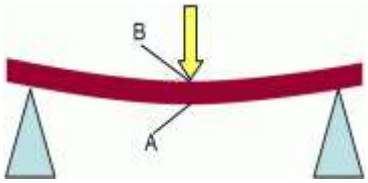


Fig. 02 - Beam of material under bending.

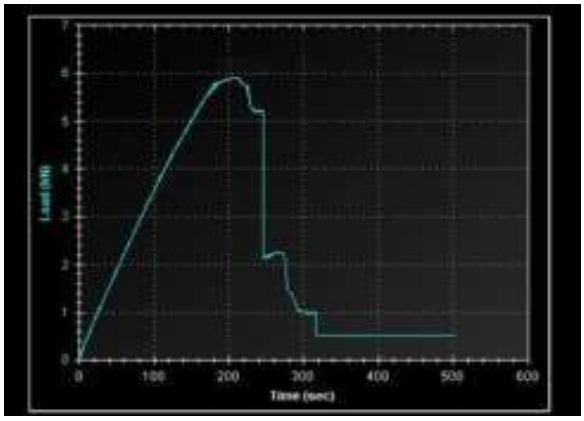


Fig.03. Load Vs Time Graph

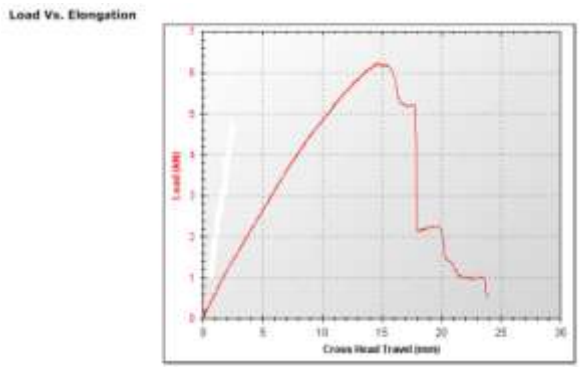


Fig.04. Load Vs Elongation Graph

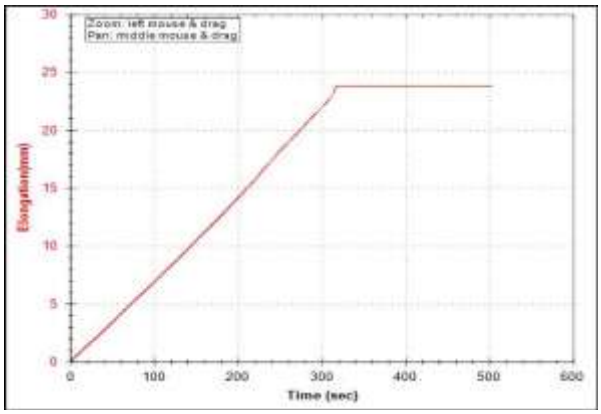


Fig.05. Elongation Vs Elapsed Time Graph

Charpy Impact Test

The Charpy impact test, also known as the Charpy v-notch test, is a standardized high strain-rate test which determines the amount of energy absorbed by a material during fracture. This absorbed energy is a measure of a given material's toughness and acts as a tool to study temperature-dependent brittle-ductile transition. It is widely applied in industry, since it is easy to prepare and conduct and results can be obtained quickly and cheaply.

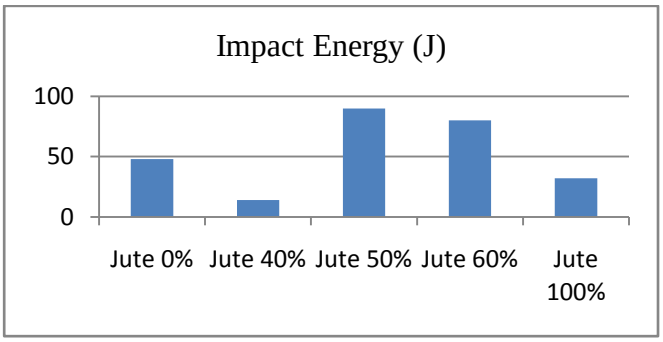


Fig.06.Graph between Impact Energy and Jute %

V. RESULT AND DISCUSSION.

Mechanical Characteristics of Composites

This chapter presents the mechanical properties of the jute reinforced epoxy composites prepared by varying jute percentage for the present investigation. Details of processing of these composites and the tests conducted on them have been described in the previous chapter. The results of various characterization tests are reported here. This includes evaluation of compressive strength, flexural strength; impact energy. The interpretation of the results and the comparison among various composite samples are also presented.

a) *Effects of varying percentage of jute on flexural Strength.*

The graph shows that the flexural strength of specimen increases with increasing jute percentages between 50-60% and gives increasing value from 63.72 N/mm^2 to 119.65 N/mm^2.When jute% varying from 60-100% flexural strength value decreases 119.65 N/mm^2 to 64.43 N/mm^2.Thus result shows better flexural strength near 60% jute with respect to thickness.

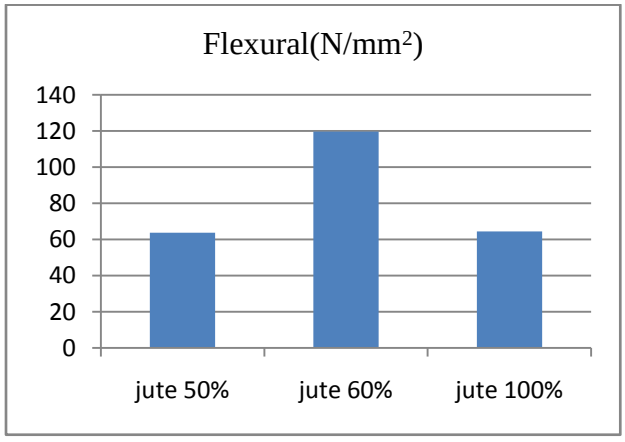


Fig.07. Graph between Flexure Strength and Jute %

b) Effect of varying percentage of jute on compressive strength.

The compression test of specimen was performed on UTM machine TUE-C-400.The graph shows that the compressive strength increases with the increasing jute percentage between 50-60% and compressive strength value increases from 3.117 to 5.85 N/mm^2.On the other hand compressive strength value decreases from 5.85 to 2.86 N/mm^2 with varying jute percentage from 60-100%.

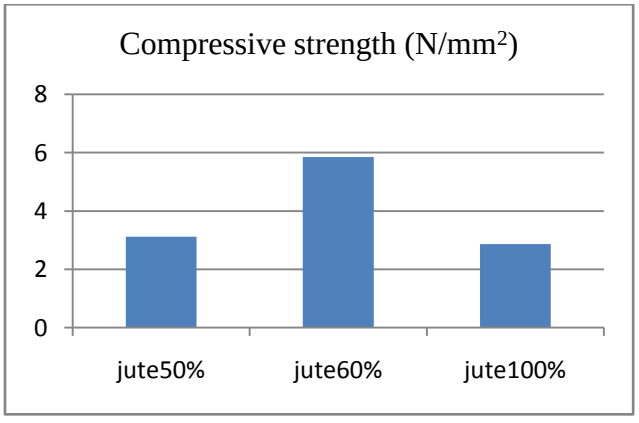


Fig.08.Graph between Compressive Strength and Jute %

c) *Effect of varying percentage of jute on Impact strength.*

The impact energy value of different composite recorded during Charpy impact test in table. It shows that the resistance to impact loading of jute fibre reinforced epoxy composite decreases in varying jute percentage from 50-60% and gives the value 90 Joule to 80 Joule. And again decreasing with increase in jute percentage 60-100%, it shows impact strength value 80 to 32 Joule.

High strain rates or impact loads may be expected in many engineering applications of composite materials. The suitability of a composite for such applications should therefore be determined not only by usual design parameters, but by its impact or energy absorbing properties.

From the above discussion better flexural strength and compressive strength comes in the range of jute percentage 50-60%. And better impact strength comes near 50% of jute with respect to total thickness of specimen.

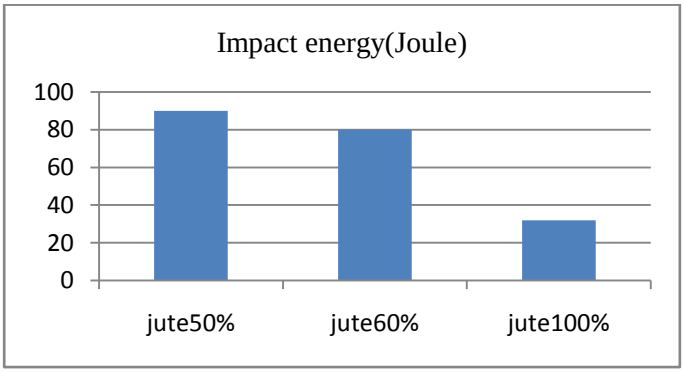


Fig.09.Graph between Impact Energy and Jute %

VI. CONCLUSION

This proposed investigation of mechanical behavior of jute reinforced epoxy composites leads to the following conclusions:

1. This work shows that successful fabrication of a jute reinforced epoxy composites with different jute percentage is possible by simple hand lay-up technique.
2. It has been noticed that the mechanical properties of the composites such as compressive strength, flexural strength, impact strength etc. of the composites are also greatly influenced by the jute percentage with respect to thickness of specimen.

3. Use of 100% jute in jute reinforced composite high brittleness nature of specimen.
4. Industry Importance: At present jute reinforced is a agricultural product can be used for industrial application like partition panels, packaging and automotive industry in addition to solving environmental problems related to the disposal of product.
5. 50-60%Jute reinforced having high impact resistance than 100% reinforced glass fiber.

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