Mechanical Behaviour of E-Glass Jute Fiber Reinforced Epoxy Composites

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Abstract- **Hybrid materials of any class are essential for current demands. This paper deals with the hybrid effect of composites made of jute/Glass fibers which are fabricated by hand layup method using LY556 Epoxy resin and HY951 hardener. The properties of this hybrid composite are determined by testing like Tensile, Compression, and Impact tests are carried out based on ASTM standards. The result of the test shows that hybrid composite of jute/Glass. Fiber has far better properties than that of glass fiber composite. However, it is found that the hybrid composite has Better strength as compared to jute fiber composite fabricated separately with glass fiber.**

INTRODUCTION

Fiber glass is a lightweight, strong, and robust material used in different industries due to their excellent properties. These composites may find applications as structural materials where higher strength and cost considerations are important. Glass/sugar palm composites are found to have an increase in tensile, compression, and impact properties with increasing fiber content and the weight ratio of glass/sugar palm fibers. Composite materials reinforced with natural fibers, such as flax, hemp, kenaf and jute, are gaining increasing importance in automotive, aerospace, packaging and other industrial applications. The natural fibres and types are given below table.

TABLE 1. NATURAL FIBRES AND TYPES

Fibre	Type
Bagasse	Cane
Bamboo	Grass
Banana	Stem
Coconut husk	Fruit
Flax	Bast
Hemp	Bast
Jute	Bast
Kenaf	Bast
Sisal	Leaf
Wood	Stem

TARGETED OBJECTIVES THROUGH THIS RESEARCH

1. Using renewable resources.
2. Reduce Health problems and Skin irritations during
3. Increase the cost/performance ratio.
4. Protecting our environment and its resources.

MATERIALS ABOUT E-CLASS,JUTE,EPOXY RESIN

Today, almost any specialization for structural material can be met by combination of glass fibre and plastic resin, which are characterized by many outstanding properties.

The glass fibre composites strength/weight ratios are higher than those of most other materials and their impact resistance is phenomenal. Further they possess good electrical properties, resistance to moisture and outdoor weathering and resistance to heat and chemicals. These properties are coupled with ease of fabrication.

PROPERTIES OF GLASS FIBRE

1. Incombustibility
2. Corrosion resistance
3. High strength at low densities
4. Good thermal.
5. Sound insulation
6. Special electrical properties.

JUTE FIBRE

Jute is a best fiber obtained from inner tissues of the plant stem. The fibers are bound together by gummy materials (pectinous substances) which keep the fiber bundles cemented with non-fibrous tissues of Jute bark. These encircling soft tissues must be softened, dissolved and washed away so that the fiber can be obtained from the stem. This is done by steeping the stems in water and it is known as retting. The optimum water temperature for retting is 80°F. Micro-organisms (mainly bacilous bacteria) decompose the gums and soften the tissues in 5 to 30 days depending upon temperature and the type of water used. It has been found that the presence of higher amounts of calcium and magnesium tend to increase the tenacity of fiber. We have used raw 'as received' jute fabrics without any further treatments. The approximate chemical composition of Jute fiber in wt% is: cellulose 71.5, hemicelluloses 13.4, pectin 0.2, lignin 13.1, water soluble compounds 1.2, fat and waxes 0.6.

FIGURE . JUTE

EPOXY RESIN

This article concerns the effect of polyamine functionalized carbon nanotubes (CNT, 0.4 wt%) used as filler in epoxy based nanocomposites on their mechanical and physical features. The functional chains present on CNT, containing one, three, or five amino groups, were bound in similar molar amount on the CNT external walls, as verified by characterization tests. Mechanical and physical properties of the nanocomposites were investigated by means of flexural, wet ability, calorimetric, morphologic, and electrical measurements. Experimental results highlighted that the presence of the amino groups attached on the CNT improves both their dispersion and chemical interaction with the matrix. Both these factors enhance the mechanical strength, deformability and wet ability of the nanocomposites compared to the neat resin which retains its thermal stability. The highest enhancement in maximum flexural strength and elongation at break (of +31% and of +110%, respectively) was observed in the nanocomposite containing the penta—amino chain while the glass transition temperature value increased of 27%.

LITERATURE REVIEW

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4. Ajith G, Senthil KM, Elayaperumal A (2014) Experimental Investigations on mechanical properties of jute fiber reinforced composites with polyester and epoxy resin matrices. Procedia Eng 97: 2052-2063.
5. Konstantinos G (2013) Inelastic behavior of polymer composites, Doctoral Thesis, Lulea University of Technology, 9: 184.

DESIGN AND ANALYSIS

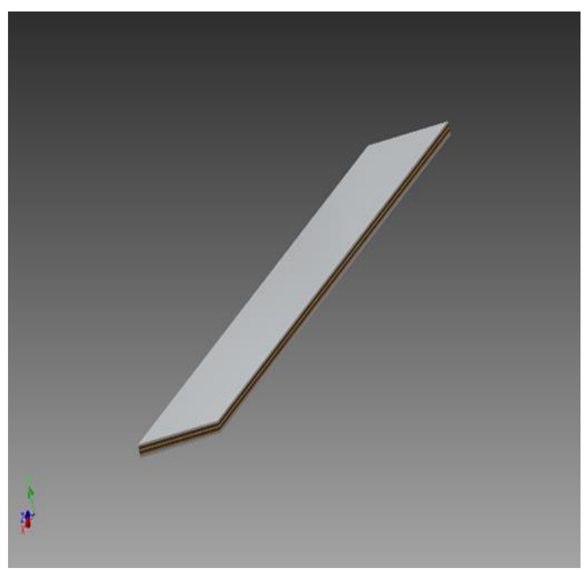


Figure. DESIGN OF 3D COMPOSITE MATERIAL

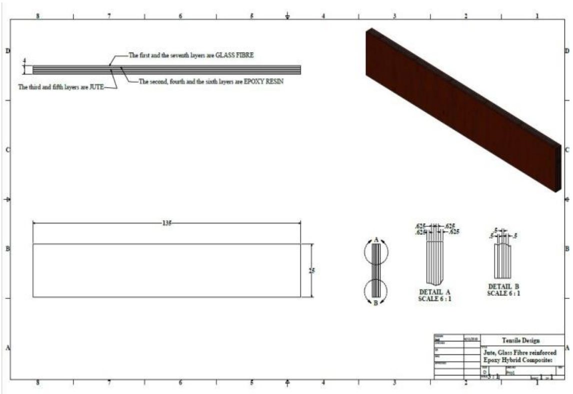
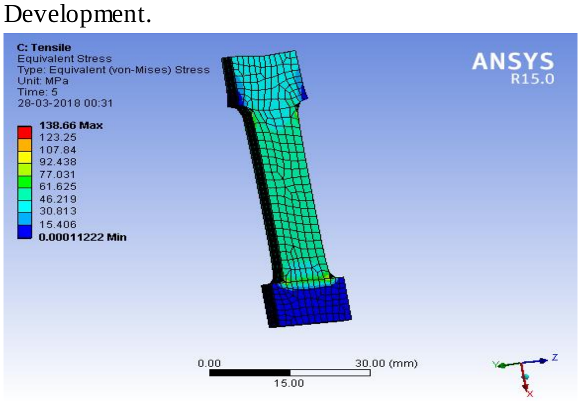


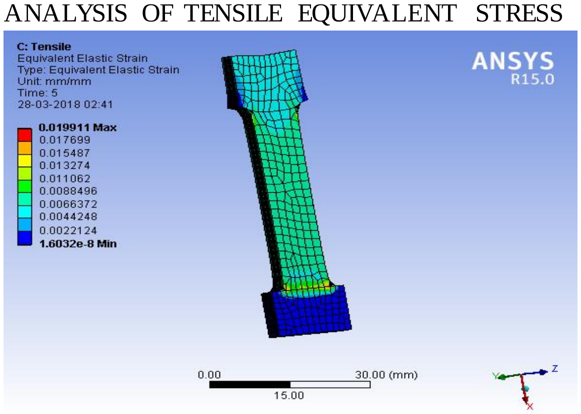
Figure. DESIGN OF 2D COMPOSITE

ANSYS Workbench Platform ;

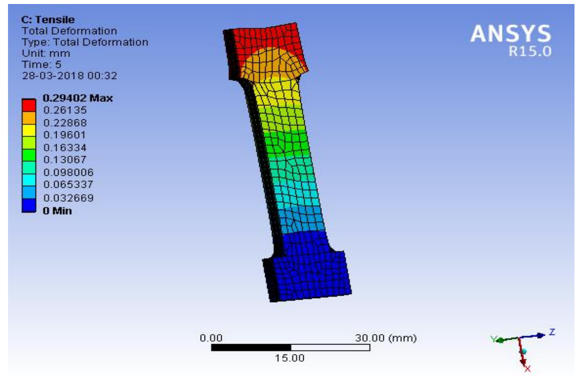
An innovative project schematic view ties together the entire simulation process, guiding the user through even complex multiphysics analyses with drag-and-drop simplicity. With bidirectional CAD connectivity, powerful highly-automated meshing, a project-level update mechanism, pervasive parameter management and integrated optimization tools, the ANSYS Workbench platform delivers unprecedented productivity, enabling Simulation-Driven Product Development.



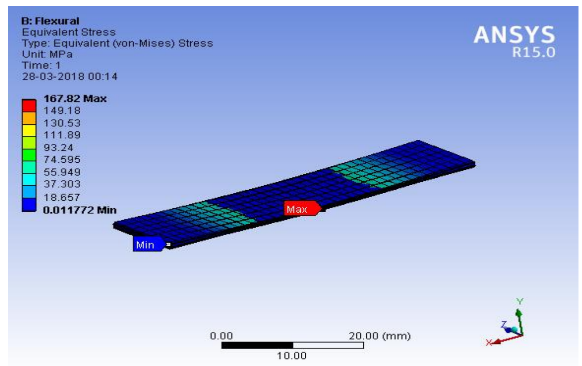
ANALYSIS OF TENSILE EQUIVALENT STRESS



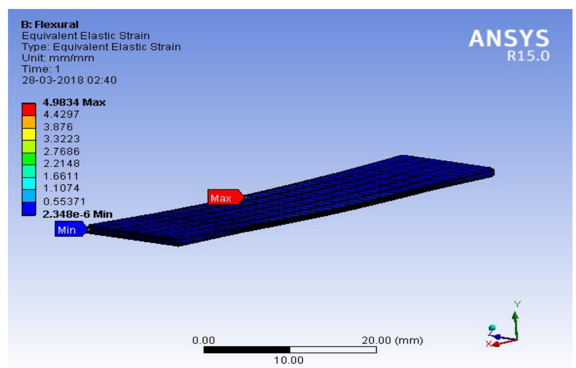
ANALYSIS OF TENSILE EQUIVALENT ELASTIC STRAIN



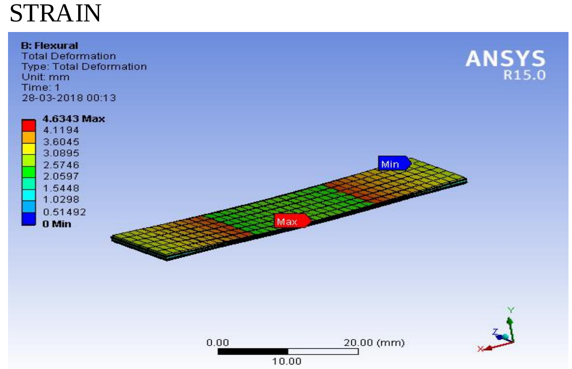
ANALYSIS OF TENSILE TOTALDEFORMATION



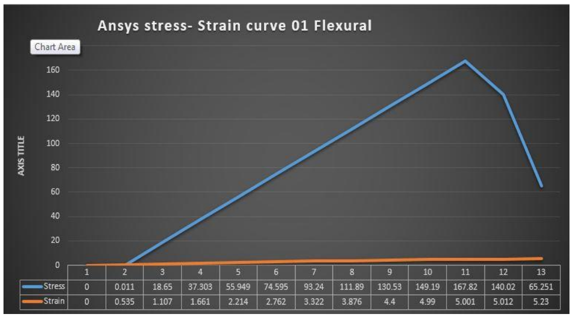
ANALYSIS OF FLEXURAL EQUIVALENT STRESS

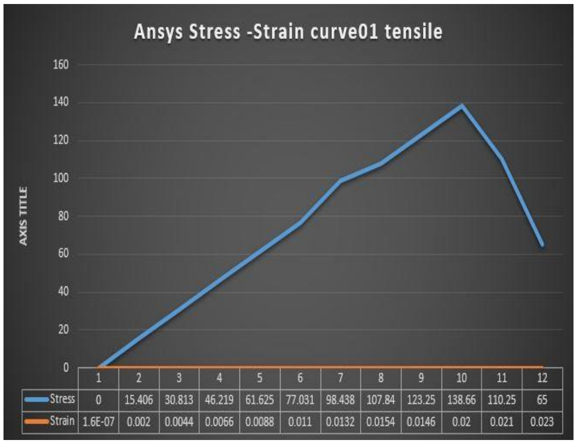


ANALYSIS OF FLEXURAL EQUILENT ELASTIC STRAIN



ANALYSIS OF FLEXURAL TOTAL DEFORMATION





ANALYSIS STRESS-STRAIN TENSILE AND FLEXURAL

FABRICATION METHOD

MATERIALS USED

1. Bidirectional Jute fiber mats of thickness 0.5mm.
2. Glass fibers in woven mat form of 280 GSM.
3. Epoxy resin LY556.
4. Aradur HY951 is hardner.

PROCEDURE

1. Then the mixture is thoroughly mixed for some time and is used for preparing laminates.
2. For each laminate nearly 300ml of epoxy-hardner mixture is taken. Hardner is taken in the ratio of 1:10 (i.e.; for every 10ml of epoxy 1ml of hardner is added).
3. Thin plastic sheets are used at the top and bottom of the mould plate to get a good surface finish of the product.
4. The epoxy is uniformly spread with the help of the brush. The second layer of mat is then placed on the epoxy surface and a roller is moved with a mild pressure on the mat-epoxy layer to remove any air trapped as well as the excess epoxy present.
5. The process is repeated for each layer of epoxy and mat, till the required layers are stacked.
6. After placing the plastic sheet, release gel is sprayed on the inner surface of the top mould plate which is then kept on the stacked layers and the pressure is applied.
7. After curing either at room temperature or at some specific temperature at 60˚C - 80˚C, the mould is opened and the developed composite part is taken out and further processed.
8. For epoxy based system, normal curing time at room temperature is 24 - 48 hours

Schematic Representation

Fabrication of composite material

Tensile, flexural , charpy test of material

TABLE 2. RESULTS OF COMPOSITE SPECIMEN 01

Matrix of composites 01	Test Names	Experi me-ntal Result	Analytical Result (ANSYS)
Glass fibre +epoxy+jute+epoxy+JUTE+epoxy+GLASSFIBRE	Flexural Strength (N/mm² or Mpa)	152.28	167.25
	Ultimate Tensile Load (kN)	9.25	10.012
	Ultimate Tensile Strength (N/mm² or Mpa)	98	111

Table 3. RESULTS OF COMPOSITE SPECIMEN 02

ZMatrix of composites 01	Test Names	Experimental Result	Analytical Result (ANSYS)
Glass fibre +epoxy+jute+epoxy+glassfibre+epoxy+jute	Flexural Strength (N/mm² or Mpa)	154.25	167.02
	Ultimate Tensile Load (kN)	8.28	9.65
	Ultimate Tensile Strength (N/mm² or Mpa)	81	102.56

CHARPY IMPACT TEST RESULT

Table 4 CHARPY IMPACT TEST
Specimen 01

Test Temperature	Absorbed Energy – Joules	Notch Type	Speimen size (mm)
24°C	28	Un-notched	4x20x100

Table 5 CHARPY IMPACT TEST
Specimen 02

Test Temperature	Absorbed Energy - Joules	Notch Type	Speimen size (mm)
24°C	28	Un-notched	4x20x80

CONCLUSION

The effect of reinforcement fabric nature on the mechanical behavior of two types of composite laminates was examined. Generally, the mechanical properties of obtained synthesized composites are higher than those of Natural fabric reinforced one. According to the results obtained, The Hybrid Jute/glass reinforcement is sufficiently stiff and strong to be introduced in composite laminates with thermosetting matrix. Although the Jute fibers have a rough surface, their bonding strength with polymer matrix is weak requiring prior chemical treatments.

The Flexural of the Hybrid laminate were better than those of the synthetic reinforced one even thought tensile properties of this latter were better than those of the Hybrid laminate. The Incorporation of natural fibers with GFRP can improve the properties and used as an alternate material for glassfiber reinforced polymer composites.

ADVANTAGES OF COMPOSITE MATERIAL

1. Reduction in density of products.
2. Acceptable specific strength, toughness and stiffness in comparison with glass fibre reinforced composites.
3. Ease of shaping into complex shapes in a single manufacturing process.
4. Lower energy consumption from fibre growing to finished composites
5. The manufacturing processes are relatively safe when compared with glass based reinforced composites.

APPLICATIONS OF COMPOSITE MATERIAL

Automobile industries

1. door panels
2. seat backs
3. headliners,
4. dash boards
5. trunk liners

Building Component
1. Door
2. Window
3. Wall partition
4. Ceiling
5. Floor

Transport Sector (railway coach & vehicle)
1. Flooring
2. Ceiling
3. Seat & Backrest

Furniture
- Table
- Chair
- Kitchen cabinet etc