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Research Paper

Comparative Evalution on Mechanical Properties of Epoxy Composites With Jute Fiber (Cempec)

Engineering

KEYWORDS : natural fiber- epoxy composites; mechanical properties; Flexural properties; Scanning Electron Microscope

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ABSTRACT

The aim of this study is to evaluate mechanical properties such as tensile and weight properties of natural fiber-sisal/jute epoxy composites. Microscopic examinations are carried out to analyze the interfacial characteristics of materials, internal structure of the fractured surfaces and material failure morphology by using Scanning Electron Microscope (SEM).to scan the internal micro grain structure.The developed composites were characterized by tensile and three points bend tests and the experimental results thus Obtained were compared with that of the theoretical values. The results indicated that the incorporation of sisal fiber exhibited mechanical properties than the natural jute fiber with composites in tensile properties and jute fibercomposites performed better in flexural and natural jute fiber under mechanical properties.

1. INTRODUCTION

Jute as a natural fiber is eco-friendly, low cost, versatile in textile fields and has moderate mechanical properties, which replaced several synthetic fibers in development of many composite materialhacksawmodels.Over the past few decades there is a rapid increase in the demand of the fiber reinforced polymer (FRP) compositesbecause of the unique combination of high performance, great versatility and processing advantages at favorable costs by Permutation and combination of different fibers and polymers. Another important issue to note that the tensile strength of jute fiber is extremely defects and span sensitive. Environmental concerns are increasing day by day and the demand of replacing the existing synthetic fibers with theBiodegradable, renewable and low cost natural fibers for fabrication of composite materials increases.

2. EXPERIMENTAL DETAILS

2.1. Materials and Method:

Epoxy resin and the corresponding hardener Tri Ethylene Tetra Amine (TETA) are supplied by René India Ltd. jute fibers are collected in the form of residues from Kovilpatti, Tamil Nadu, India. The polymers composites are fabricated by hand lay-up technique. Turning pair also degree of freedom is one. When two links are connected such that one link revolves around another link it forms turning pair. Composite specimens with different fiber loading were prepared and subjected to posturing for 42 hours at room temperature.

2.2. Physical and Mechanical Characterization

Hardness measurement is done using a Rockwell-hardness tester equipped with a steel ball indenter.8

2.3. Mechanical properties

The edges of the specimen are finished by using file and emery paper for tensile testing. There are two different types ofspecimen are prepared, the first specimen consists of Sisal/GFRP fibers and the second is of Jute/GFRP fibers. Thespecimen preparation, dimensions, gauge length and speeds are according to the ASTM D638 standard. The test is Performed on the Universal Testing Machine (UTM) and the surrounding temperature is 35ºC. A tensile test specimenplacing in the testing machine and applying load until it fractures. Due to the application of load, the elongation of thespecimen is recorded. The experiments are repeated for three times and the average values are used for presentation.

2.4. Flexural test

Preparation of the flexural test specimens as per the ASTM D790 standards and 3-point flexure test is used for testing.The deflection of the specimen is measured and the tests are carried out at an average relative humidity of 50% and the Temperature about 35ºC. From the testing machine the flexural load as well as the displacements is recorded for the entire testsamples.

3. Tensile properties

The composite samples are tested in the universal testing machine (UTM) and the stress-strain curve is plotted. Thetypical graph generated directly from the machine for tensile test for sisal/GFRP is presented in Fig. 1. And for jute/GFRP isPresented in Fig. 2.

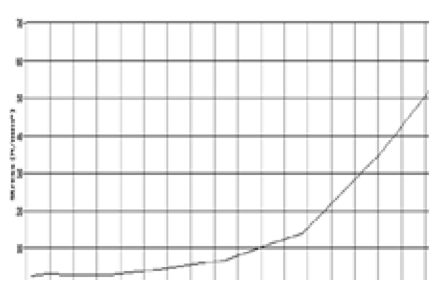

Fig. 1. Stress strain curve for tensile test in sisal/GFRP composite

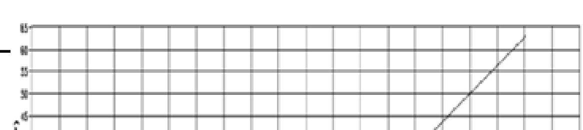

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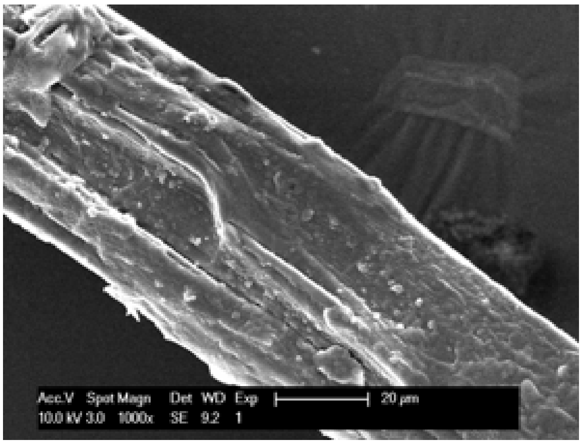
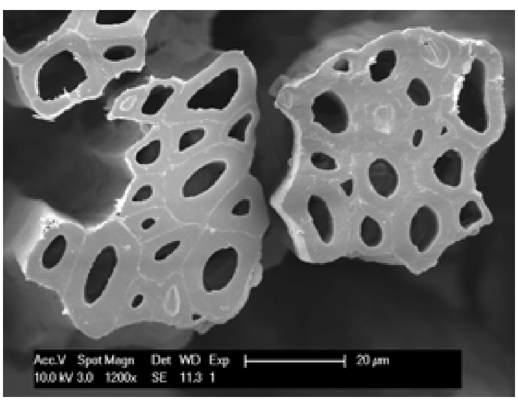
Fig. 2. Stress strain curve for tensile test in jute/GFRP composite

4. Results and discussion

The tensile strength of the jutefiber decreases with increase in the span length and scatter for each span is relatively higher for lower span length compared to that of the higher span length. The probability of finding a defect along the loading direction of fiber is very muchunpredictable for low span. But for higher span the probability of finding a single or a number of defects are greater and sothe tensile strength value is lower along with lower scatter band.



This is since the load bearing part of the fiber is the cellulose micro fibril and the lower the micro fibril angle (jute microfibril angle is less than 8°) the higher the mechanical properties [4]. Also cellulose micro fibril is the purest form of naturalCellulose, which could be in crystalline and amorphous forms that contribute as the fiber stiffness enhancer similar to that ofthe fiber reinforcement in composite.



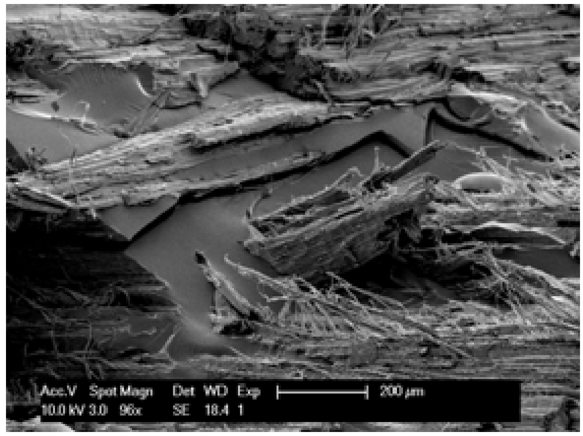
Tensile strength in the transverse direction is also lower than that of the theoretical values and significantly lower thanthat of the longitudinal direction. The probable reason could be mixed mode fiber-matrix interfaces. Along with thisinhomogeneous fiber content, irregular bonding between matrix/fiber interfaces, voids, inherent defects of the jute fiber, etc.seriously degrade the tensile strength of the composite [15]. As a consequence of the combined degrading effects, the

Experimental strength of the composites in the transverse direction becomes significantly lower than that of the longitudinaldirection. Ultimately, in any direction, the maximum fiber strength efficiency has not been achieved.

5. Fracture analysis of UD and composite

Jute fiber having relatively higher tensile strength was broken. The sequence of eventscould be; a) loading, b) matrix cracking and crazing, c) fiber/matrix interface or inter-phase deboning.

6. Fracture analysis of 0/+45/-45/0 composite



Indicates the typical fracture surface of 0/+45/-45/0 composite under longitudinal load. Failure is characterized bymatrix fiber matrix shearing, matrix and fiber shearing. Some fiber pullout in ±45° direction is also observed. Since, there isfiber matrix shearing, so fiber debris is also observed during 3 point bending. Large matrix crack owing to shearing effect isa characteristic failure criteria of jute epoxy 0/+45/-45/0 composite under the three point bend load as indicated rectangle.

7. Conclusion

- The hardness, tensile properties and impact strength of the jute-epoxy composites increases with the increase in fiber loading.
- Hybrid composite specimens are prepared and subjected to tensile and flexural loading.
- The failure morphology of the tested samples is examined by using Scanning Electron Microscope.
- This behavior of jute fiber is believed to be the main reason for the poor transverse mechanical properties of the developed composite.

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