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EXPERIMENTAL INVESTIGATION ON HYBRID COMPOSITE USING SILK AND ABACA FIBERS

[1]Sudhakar A, [2]Sudharsan M, [3]Thirunavukkarasu G, [4]Kavin S, [5]Sethubathi Jagadeesan

Department of Mechanical Engineering,
Erode Sengunthar Engineering College,

Abstract : Hybrid composites have better properties than single fiber composites. High-strength and high-modulus Abaca fiber is a kind of high-performance organic fiber rapidly developing in recent years. Taking advantage of its high strength and toughness being combined with silk fiber, it is expected to make a balance between stiffness and toughness, so as to afford a kind of structural composites with high strength and toughness. In this study, a series of hybrid fiber reinforced composites were prepared with high-strength and high-modulus Abaca fiber and silk fiber as reinforcements. Epoxy has high interaction with silk and Abaca fibers so epoxy resin is chosen as the matrix material. The effects of stacking sequence and hybrid ratio on the tensile, compressive and flexural properties and failure modes of the composites will be investigated. Experimental results that tensile, compressive and flexural properties of the hybrid composite will be compared with steel, while failure strain and failure energy were will be compared with the composite constituents.

***Index Terms* - Abaca and silk fibers, epoxy resin, stiffness, toughness reinforcement, matrix etc.,**

I. INTRODUCTION

Composite materials are something that is composed of a minimum of two materials. It combines to serve properties superior to the properties of the individual constituents. Two or more materials make up a composite material with significantly different chemical or physical properties when they combine.

As a result, it produces material different characteristics from the individual components. The individual components remain separate and distinct with the final structure, differentiating the composites from the mixtures and the solid solutions as well. It prefers new material for many reasons. Some usual examples consist of materials which are that are lighter, stronger or less expensive while comparing it with traditional materials.

Hybrid composites use more than one kind of reinforcement in the same matrix; hence, the idea is to get the synergistic effect of the properties of reinforcements on the overall properties of composites. With hybrid composites it may be possible to have greater control of the properties, achieving a more favorable balance between the advantages and disadvantages inherent in any composite material.

Earlier attempts at hybridization were made by combining stiffer fibers (carbon and boron) with more compliant fibers (glass and Kevlar) to increase the strain to failure of the composite and hence enhanced impact properties. Besides improving the impact performance, the incorporation of glass fibers reduces the cost and improves the fatigue resistance of the hybrid composites. This is attributed to the increased stiffness of the composite because of carbon fibers.

Works done on carbon–glass fiber hybrid composites showed that factors controlling monotonic tensile (and compression) failure do not necessarily continue to determine failure under cyclic loading conditions, and that for fatigue applications there appear to be positive benefits in using hybrids in place of single fiber composites.

Some of the specific advantages of hybrid composites over conventional composites include balanced strength and stiffness, balanced bending and membrane mechanical properties, balanced thermal distortion stability, reduced weight and/or cost, improved fatigue resistance, reduced notch sensitivity, improved fracture as hybrid composites present unique features that meet various design requirements more efficiently and more economically than conventional composites, offering advantages such as high strength and stiffness, increased fatigue and impact resistance, among others.

Ever-increasing demands for sustainability and eco-friendly products have considerably increased the academic and industrial interest in natural fibers in the last decades. Natural fiber-based composites also reduce the environmental impact.

II. Ease of Use

Fabrication Techniques

Casting: Some metal composites may be cast into specific shapes. The ease of use in casting depends on the melting points and properties of the metals involved.

Rolling and Extrusion: Metal composites can often be processed using traditional metalworking techniques like rolling or extrusion, making them suitable for a wide range of applications.

Machinability: The ease of machining metal composites depends on the hardness, abrasiveness, and other material properties. Some composites may require specialized tools or cutting techniques.

Application-specific Considerations: The ease of use can vary based on the intended application. For example, a metal composite used in aerospace applications may have different requirements compared to one used in architectural or automotive applications.

Cost and Availability: The cost of materials and the availability of processing technologies can influence the practicality and ease of use. Some advanced metal composites may require specialized facilities or equipment.

III. EXPERIMENTAL WORK

A. *Material Selection*

We choose the base material as metal waste (powder form) and copper burs. Here we used LY556 resin and HY951 hardener.

B. *Material Preparation*

The mould box has been prepared by acrylic sheet by the help of CNC laser cutting machine. Using the Glass jar for prepare the epoxy solution. Resin and hardener is the ratio of 10:1. We used EN8 Metal powder and copper burs as the mixing material to the epoxy.

C. *Mechanical Testing*

The mechanical property of the material has been calculated by the help of universal testing machine. Conduct tensile, compressive, and shear tests to evaluate the mechanical properties (strength, modulus, ductility, etc.) of the composite.

D. *Tensile Testing*

Tensile testing helps in understanding how a material responds to axial loading and provides important information about its strength, ductility, and other mechanical properties.

E. *Compression Testing*

This type of testing helps identify how well a system can handle and respond to various loads.

F. *Flextural Testing*

Flexural testing, also known as bending testing, is a material testing method used to determine the flexural or bending properties of a material. This test is particularly important for materials like ceramics, composites, metals, and polymers, where the ability to withstand bending loads is crucial in real-world applications.

G. *Impact Testing*

Assess the material's response to impact loading through impact tests (Charpy or Izod tests). This is crucial for applications where the material may experience sudden impacts.

IV. CONCLUSION

The conclusion for a discussion on hybrid composite materials would depend on the specific points and arguments presented in the context of your discussion. However, here is a general conclusion that can be drawn for hybrid composite materials:

In conclusion, metal composite materials represent a promising and innovative class of materials that offer a wide range of benefits in various industries.

Their unique combination of different materials provides enhanced properties, including superior strength, lightweight characteristics, corrosion resistance, and improved mechanical performance. As technology continues to advance, the development and application of composites are likely to expand, opening new possibilities for manufacturing, aerospace, automotive, and other sectors.

While challenges such as cost and production processes exist, ongoing research and engineering efforts are addressing these concerns. The versatility and performance of hybrid composites make them a valuable asset in the pursuit of more efficient, durable, and sustainable materials for the future.

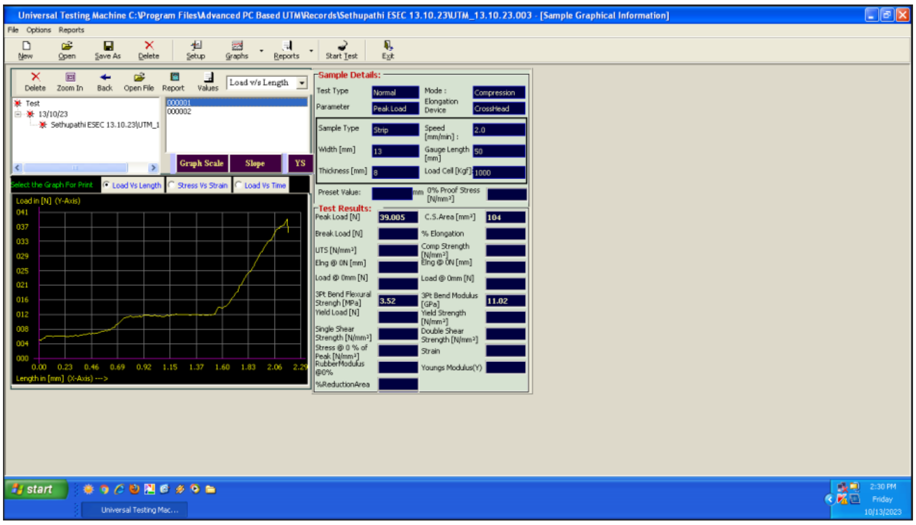

Fig. 1. Flextural Load

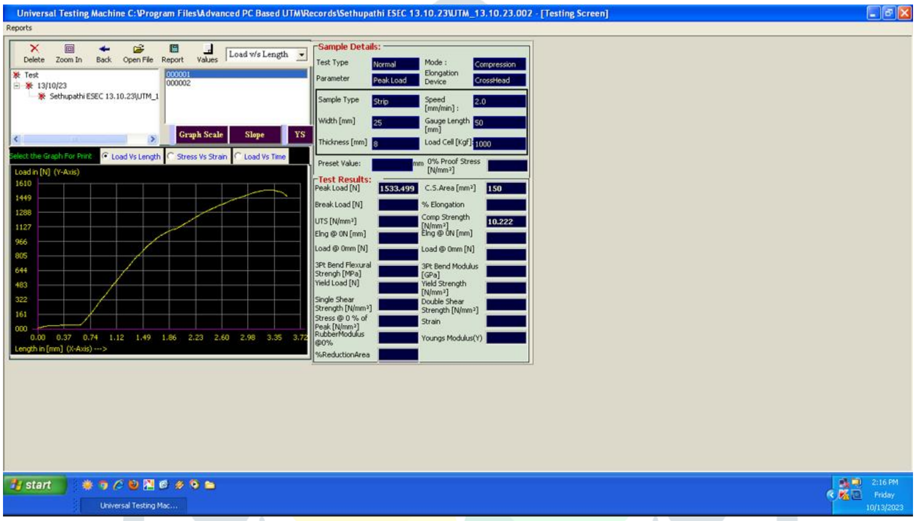

Fig. 2. Compression Load

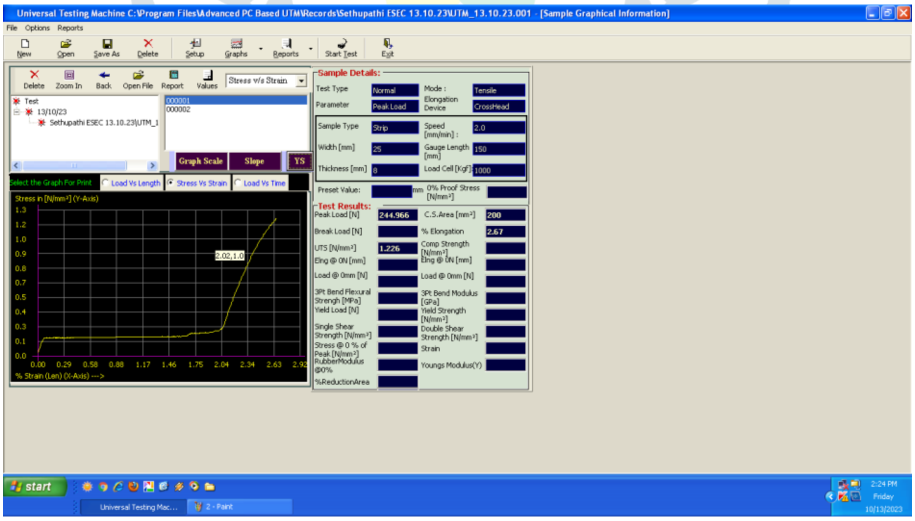

Fig. 3. Tensile Stress

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