

Hybrid Glass and Jute Fibre Reinforced Epoxy Composites'

Tribological Characteristics

Bhawana Gupta

Lecturer

Department of Mechanical Engineering

Madhav Institute of Technology & Science

Corresponding Author's E-mail: bg675431@gmail.com

Abstract

Because of their unique qualities, composite materials are increasingly being used in fields ranging from aircraft engineering to the car industry and ships. Fiber reinforced polymer composites are becoming increasingly popular due to their better mechanical qualities such as tensile strength and flexural strength, as well as their cheap cost and density. It may be used more efficiently in the creation of composite materials for a wide range of industrial applications. Burmese silk orchid fibre offers superior mechanical characteristics, but it is difficult to get. The matrix (Epoxy) resin was reinforced with natural fibre (jute) and glass fibre in this study. Hand layup was used to create hybrid composites reinforced with chopped glass and jute fibres. Natural fibres (jute) and chopped glass fibres were discovered to increase the mechanical characteristics of hybrid composites. The ASTM standard is followed while cutting test specimens. The universal testing machine is used to assess tensile and flexural strength (UTM).

Keywords: *Natural fibres, ASTM standard, UTM, Fiber reinforced polymer composites, Epoxy resin*

INTRODUCTION

After merging two or more elements with diverse qualities, a composite is created that has new properties. It is made up of a

matrix and one or more reinforcement elements. The matrix is the foundation upon which two or more components are strengthened. There is no chemical

interaction between the components since the matrix material forms a physical link with the reinforced materials.

Because they are renewable, affordable, easily available, and biodegradable, interest in this subject is quickly expanding, both in terms of industrial applications and central research. Jute looks to be a competent material among all natural fibre reinforcing materials since it is relatively affordable and commercially available in the needed form. Glass Fiber Reinforced Polymers (GFRP) are fibre reinforced polymers made from a plastic matrix reinforced with glass fibre well fibres. Because of its bright qualities, fibre glass is a lightweight, robust, and strong material utilised in a variety of trades. These composites might be used as structural materials when demanding strength and cost considerations are crucial [1].

The addition of a tiny number of glass fibres to pineapple leaf fibre (PALF) and sisal reinforced polyester composites improves their tensile and flexural characteristics, demonstrating a beneficial hybrid effect [2]. An experimental investigation on natural woven jute fabric-supported polyester composites demonstrates the potential of this

sustainable source of normal fibre for use in a variety of consumer goods [3]. Because of the emergence of newer biodegradable polymers, the market outline for composite applications is shifting. Composite materials reinforced with natural fibres like flax and jute are gaining popularity in automotive, aerospace, packaging, and other industrial applications. The goal of this research is to combine natural fibres like as jute fibre, which is abundant in India, with synthetic fibres such as glass fibre to improve mechanical qualities. The impact of hybridization of jute/glass fibre reinforced epoxy composites is estimated in this study. The test findings aid in determining the possible applications of jute/glass fibre reinforced epoxy composites. The hand layup process is used to produce the composite, which is made of epoxy resin. On top of the jute is a layer of chopped glass fibre sheet. UTM is tested for tensile and compressive strength once it has been made. Load and displacement tensile strength and compressive strength are displayed on the graph.

EXPERIMENTAL PROCEDURES

Materials

The fibres are washed and dried at room temperature. Fibers are then trimmed to a length equal to the length of the mould. As

a matrix material, epoxy combined with hardener is employed. The epoxy and hardener are combined at a 20:1 ratio. It is simply prepared using the moulding process. This study makes use of chopped fibre glass sheets. Using a length of glass fibre ranging from 3 to 25 mm. Figure 1 depicts a sheet of chopped glass fibre. Glass fibres have a lesser strength on their own.



Fig.1 Sheet of chopped glass fiber

Jute is the second substance utilised. On this sheet, the jute is oriented lengthwise. Jute, for example, is a long, soft, lustrous vegetable fibre that can be spun into coarse, strong threads. Jute is being studied because of its low cost, 100% biodegradability, and high strength-to-weight ratio. Burmese silk orchid was used instead of jute in previous studies. In the

preparation of the hybrid composite, epoxy resin is employed. Epoxy is a colloidal term for the epoxide functional group as well as the dry end product of epoxy resins. Epoxy resins (polyepoxides) are a type of reactive pre polymer and polymer with epoxide groups.

Fabrication of composite

Hand Lay-up is a method of combining layers of reinforced fibre with resin. The technique entails arranging reinforcing material into layers. These layers are then soaked with a resin system, either by brush or roller, to ensure that the reinforcing material is thoroughly saturated. After 24 hours, the mould is placed in an oven for 20 minutes to melt the releasing agent and make removal of the composite material from the glass mould simpler. This procedure places both the chopped glass fibre sheet layer and the jute layer. Table 1 shows the percentage volume of glass fibre and plywood.

Table 1: Composition of hybrid FRP material

Sr. No	Types of layer	Percentage in hybrid
1.	glass fiber	36.21%
2.	jute	63.79%

The wet epoxy glue is then poured over the fibre layers to saturate them. The fibre layers and wet epoxy glue are allowed to cool at room temperature. We can store the material at various temperatures to find the ideal temperature for great mechanical qualities. After curing, a test specimen of the required size is cut from the composite. Figures 2 and 3 depict the preparation of composite material.



Fig 2. Application of epoxy on chopped Glass fiber sheet



Fig. 3 Jute placed on glass fiber sheet

TENSILE STRENGTH TEST

Tensile test is act on composites by cutting specimens according to ASTM test standard on a Universal Testing Machine (UTM). The cross head speed is maintained at 10 mm/min, at a temperature 25 degree centigrade. The specimen used in this study is cut from the rectangular sheet of thickness 5.8 mm prepared by hand layup process. For the test purpose, the specimen is cut in dumbbell shape. The dimensions of the specimen are taken as per the Table 2. Fig. 5 shows the original specimen and Fig. 6 shows the machine on which the experiment is performed.

Table 2: Dimensions of the specimen for tensile test (in mm)

Total length	Gauge Length	Width	Thick	Length of pipe
90	50	12.8	5.8	20

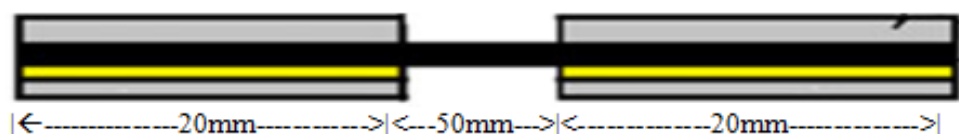


Fig.4 Specimen design



Fig.5 Specimen for tensile test

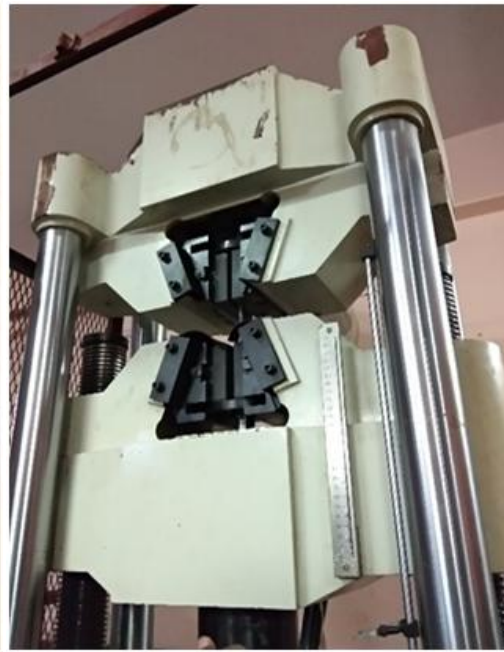


Fig.6 UTM on which test is performed

Testing machine with a capacity of 600 KN is used for the test. The final results are shown in graph 1.

FLEXURAL STRENGTH TEST



Fig.7 specimen for compressive test

Specimen with dimension $90 \times 56.5 \times 5.80$ (L×W×T) are used in this test. The sample is placed in the machine such that the glass

fiber is on the compressive side i.e., it is placed upward. The load touches its surface and the jute is below bearing

tensile load. Fig. 7 shows the specimen on which the test is performed. Final result is shown in the Graph 2.

RESULTS AND DISCUSSIONS

As we all know, composites are constructed in such a way that some beneficial characteristics may be accomplished with the assistance of two distinct materials by forming a physical

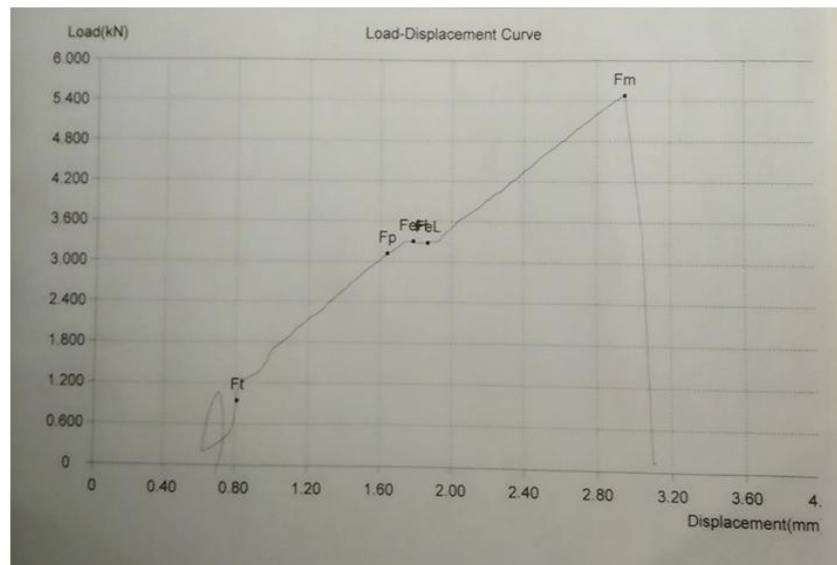
compound between them. Tensile and compressive tests are performed on a glass fibre composite reinforced with jute in this study. The following data is obtained as a consequence of these two experiments. As seen in Tables 3, 4, Graph 1, and Graph 2. Figures 8 and 9 show the specimens following tensile and compressive testing. Figure 10 shows a picture of the specimen following the compressive test.

Table 3: Tensile Test

Sr. No.	Parameter	Observation
1.	Cross-section Area (mm ²)	74.24
2.	Gauge Length (mm)	50
3.	Elongated Length (mm)	51.0
4.	Elongation (%)	2.0
5.	Ultimate Load (KN)	5.48
6.	Ultimate Tensile strength (MPa)	74
7.	Young's modulus (N/mm ²)	3690.5N/mm ²

Table 4: Compressive Test

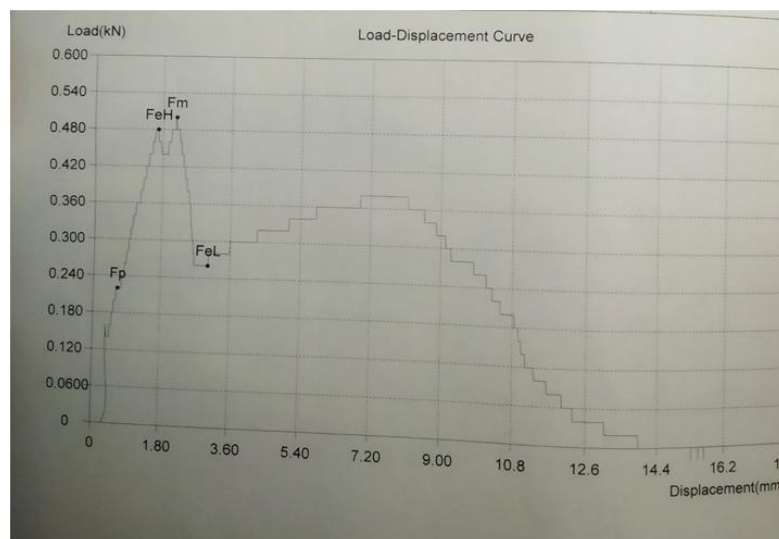
Sr.No.	Parameter	Observation
1.	Width (mm)	56.5
2.	Thickness (mm)	5.80
3.	Length (mm)	90.0
4.	Ultimate Load (N)	500
5.	Flexural Strength (N/mm ²)	35.5



Graph 1. Tensile test



Fig. 8 Specimen after the test



Graph 2. Compressive test



Fig. 9 Specimen after test from jute side



Fig.10 Specimen after test from glass fiber side

CONCLUSION

The hand layup process was used to create a hybrid composite out of jute and glass fibre reinforced epoxy composite. The technology produced exact results in both the tensile and compressive tests. The failure occurred on the gaugelength of the specimen during the tensile test, indicating that the holding specimen functioned well. The ultimate tensile strength and flexural strength were computed in both tensile and compressive tests. The stress and strain

graph was used to derive Young's modulus. The final value of Young's modulus is 3690.5 N/mm^2 . Previous study found that the highest improvement in tensile stress and young's modulus was around 48.74 MPa and 1949.6 MPa, respectively [5]. The mechanical characteristics of hybrid composites were good. The addition of glass fibre to jute fibre composites improves mechanical qualities, leading to increased usage of natural fibres in a variety of applications. More samples are

recommended for clear findings. The combination of jute and glass fibre will boost the material's strength while decreasing its cost when compared to glass fibre alone and glass fibre composite reinforced with carbon, respectively. Because of its high strength, this structure may be employed in furniture and a Jute composite boat with an outside covering.

REFERENCES

1. Sreekala M.S., George, J., Kumaran, M.G. and Thomas, S. (2002) The Mechanical Performance of Hybrid Phenol Formaldehyde-Based Composites Reinforced with Glass and Oil Palm Fibers. *Composites Science and Technology*, 62,339-353. [http://dx.doi.org/10.1016/S0266-3538\(01\)00219-6](http://dx.doi.org/10.1016/S0266-3538(01)00219-6)
2. Mishra, S., Mohanty, A.K., Drzal, L.T., Misra, M., Parija, S., Nayak, S.K. and Tripathy, S.S. (2003) Studies on Mechanical Performance of Biofiber/Glass Reinforced Polyester Hybrid Composites. *Composites Science and Technology*, 63, 1377-1385. [http://dx.doi.org/10.1016/S0266-3538\(03\)00084-8](http://dx.doi.org/10.1016/S0266-3538(03)00084-8)
3. Gowda, T.M., Naidu, A.C.B. and Chhaya, R. (1999) Some Mechanical Properties of Untreated Jute Fabric-Reinforced Polyester Composites. *Composites: Part A*, 30, 277-284. [http://dx.doi.org/10.1016/S1359-835X\(98\)00157-2](http://dx.doi.org/10.1016/S1359-835X(98)00157-2)
4. Kin-tak Lau, ab Pui-yan Hung, a Min-Hao Zhu, c David Hui, d <https://doi.org/10.1016/j.compositesb.2017.10.038>
5. B. Madhusudhan Reddy, a Y. Venkata Mohan Reddy, a B. Chandra Mohan Reddy, b <https://doi.org/10.1016/j.matpr.2017.02.195> Get
6. https://www.google.co.in/search?ei=c42NWtGVFYKd0gSWmoHgCg&q=young%27s+modulus++of+glass+fiber&oq=young%27s+modulus++of+glass+fiber&gs_l=psy-ab..3..0.17050.23948.0.24999.33.21.0.0.0.0.391.2862.0j1j5j4.10.0..2..0...1.1.64.psy-ab..25.8.2186...35i39k1j0i7i10i30k1j0i7i30k1.0.a4ZdTcmFkFU