IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

TENSILE BEHAVIOUR OF JUTE AND CARBON FIBER REINFORCED HYBRID COMPOSITE

[1] S Surappa, [2] Salla Uday Kiran Reddy, [3]Gopanagoni Sai Kiran, [4]B Sai teja
[14]Assistant Professor, [2]Student, [3]Student, [4]Student.
[1] Department of Mechanical Engineering,
Vignan Institute of Technology and Science, Deshmukhi, Yadadri, Telangana, India.

Abstract: Now a days hybrid composites materials becoming of key importance from an economic and ecological compatibility point of view using synthetic fibers such as carbon, glass, aramid, etc. is expensive because of higher cost of individual fibers. This requires alternative materials with less production cost and maximum strength. Naturally available jute and synthetic fiber carbon were used as reinforcement in this work. Natural fibers are inexpensive and synthetic fibers has greater strength which provides faster biodegradable rate compared to only synthetic composite materials such as glass, carbon and aramid, which are used as reinforcements and the cost become optimized. In this work, the objective was to develop, investigate and analyze the tensile behavior of a composite material using jute fiber and carbon fiber sandwich type composite. The results were studied. The experimental results shows that hybrid composites are having significantly greater value. The primary objective of the present work is to find the tensile properties of jute and carbon reinforced hybrid composite consists of 80% of jute and 8% of carbon fiber T-700 is used as a reinforcement and other 12% epoxy resin Ly556.

***Index Terms* – Hybrid, carbon, jute, fiber.**

I. Introduction

Composite materials are composed of two or more distinct components with different physical or chemical properties. These components, known as the matrix and the reinforcement, are combined to create a material that exhibits enhanced or tailored properties not typically found in individual components alone.

A natural composite material is a type of composite material where the constituents are derived from natural sources. Synthetic composite materials are made by combining two or more synthetic components to create a material with improved properties and performance. These composites are designed to meet specific requirements and can be tailored to have desired characteristics that individual components may not possess on their own.

Natural-synthetic hybrid composite materials are a class of materials that combine the advantages of both natural and synthetic components. These composites are engineered by integrating natural fibers or particles fibers with synthetic polymers or resins to create a material that exhibits enhanced mechanical, physical, and chemical properties.
The objective behind developing natural-synthetic hybrid composites is to harness the unique characteristics of natural materials, such as high strength, low density, biodegradability, and renewable sourcing, while also taking advantage of the versatility, durability, and customization capabilities offered by synthetic polymers. The use of natural fibers, such as jute, hemp, flax, bamboo, and sisal, in combination with synthetic fibers such as glass, carbon and aramid with matrices, such as thermoplastics or thermosetting polymers, leads to a composite material with improved performance in terms of strength, stiffness, impact resistance, and thermal stability. These composites can find applications in a wide range of industries, including automotive, aerospace, construction, packaging, and consumer goods.

The benefits of natural-synthetic hybrid composites include reduced weight, increased sustainability, lower energy consumption during production, and enhanced environmental friendliness compared to fully synthetic composites. Additionally, natural fibers can act as reinforcement within the synthetic fibers, improving load-bearing capabilities and reducing material costs.
However, challenges associated with natural-synthetic hybrid composites include the compatibility of natural fibers with synthetic fibers, moisture absorption, and the need for proper processing techniques to achieve good fiber-matrix adhesion.

II. EXPERIMENTAL PROCEDURE

Hand layup technique is used in the manufacturing of composite material. It involves the application of layers of reinforcement materials (jute fiber forwarded by carbon fiber) tool surface, along with the application of resin to impregnate the fibers. Here is a general overview of the hand layup procedure:

[1] **Preparation:** Start by preparing the tool surface. Clean it thoroughly and apply a release agent or mold release wax to facilitate easy removal of the finished part later.

[2] **Reinforcement Material:** Cut the reinforcement material into the desired shape and size. This can be done using scissors or a cutting tool. Ensure that the fibers are free from wrinkles or folds.

[3] **Layering:** Begin by applying a layer of resin (epoxy LY566) onto the mold surface, typically with a brush or roller. This acts as a bonding agent and helps to hold the first layer of reinforcement in place.

[4] **Placing the Reinforcement:** Carefully lay the first layer of reinforcement material onto the resin-coated mold surface. Ensure that the material is properly aligned and positioned without any wrinkles or gaps.

[5] **Impregnation:** Apply resin onto the first layer of reinforcement (carbon fiber) using a brush or roller. Ensure that the resin fully saturates the fibers, providing proper impregnation then place second reinforcement (jute fiber).

[6] **Repeating the Layers:** Repeat the process of layering the reinforcement materials and applying resin until the desired thickness (3 mm) and number of layers are achieved. Each layer should be applied in a consistent manner, ensuring proper impregnation and alignment.

[7] **Consolidation:** After applying each layer, use a roller or a squeegee to remove any air bubbles or excess resin, ensuring good consolidation and adhesion between the layers.

[8] **Curing:** Allow the composite part to cure and harden under 10 bar pressure with 140 ºC for 4 to 5 hours.

[9] **Demolding:** Once the curing process is complete, carefully remove the composite part from the mold. Use caution to avoid any damage or distortion to the part.

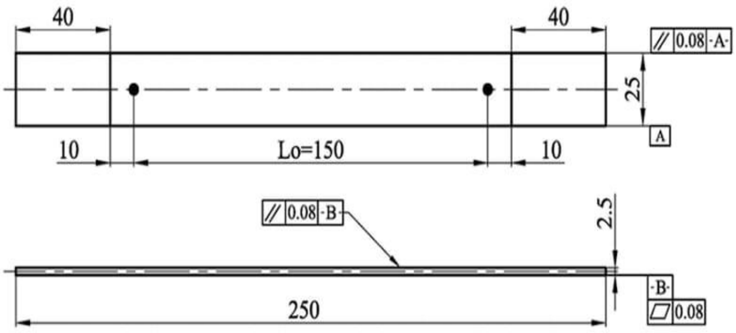
[10] **Trimming and Finishing:** Trim any excess material and clean up the edges of the cured composite part using appropriate tools. Additional finishing processes, such as sanding, polishing, or painting, may be performed depending on the desired final appearance and requirements.

(Applying resin on jute fiber, below the jute consists of carbon fiber)

Figure 1: Hand layup process

III. SPECIMEN STANDARDS

ASTM D3039 tensile testing is used to measure the force required to break a composite specimen and the extent to which the specimen stretches or elongates to that breaking point. The most common specimen for ASTM D3039 is a constant rectangular cross section, 25 mm (1 in) wide and 250 mm (10 mm) long. Optional tabs can be bonded to the ends of the specimen to prevent gripping damage.



All Dimensions are in mm
According to ASTM D 3039-17 Coupon without Tabs

IV. TEST PROCEDURE

Specimens are placed in the grips of a Universal Test Machine at a specified grip separation and pulled until failure. For ASTM D3039 the test speed can be determined by the material specification or time to failure (1 to 10 minutes). A typical test speed for standard test specimens is 5 mm/min (0.05 in/min) for this project standard test speed is used. The test is carried out at Ambient temperature an extensometer or strain gauge is used to determine elongation and tensile modulus.
Tensile tests produce a stress-strain diagram, which is used to determine tensile modulus. The data is often used to specify a material, to design parts to withstand application force and as a quality control check of materials.

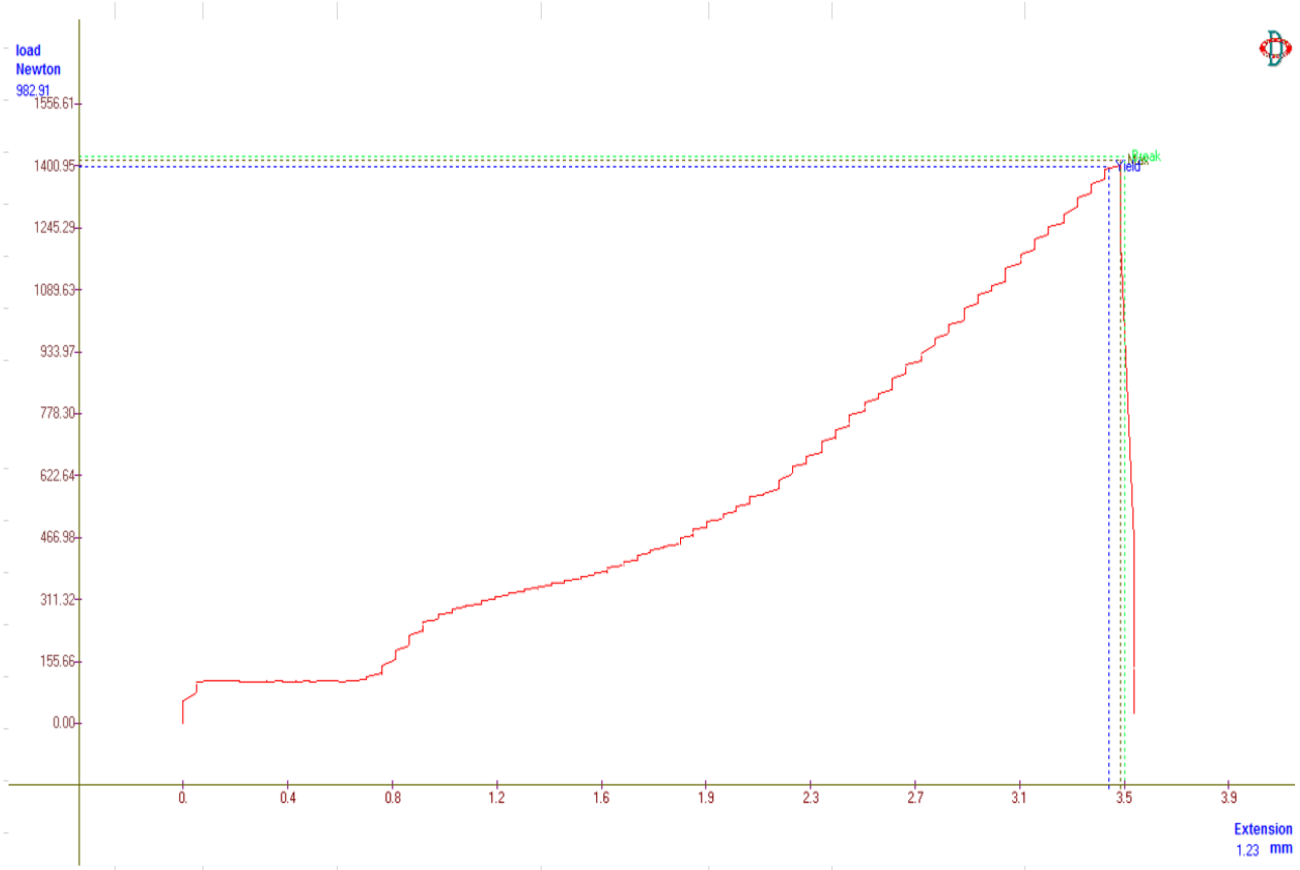
V. RESULTS AND DISCUSSION:

All the five specimens were observed to failure at a load of 1424 N(Approximately) and it is also observed that major fiber bundle failure also occurs at this magnitude of load. Load Vs displacement data is shown in figure 5. From the calculation the tensile strength value is found to be 14 MPa. After the yield point it is observed that load bearing capacity of the composites is slightly increased. This may be due to the stress produced in the surrounding fibers. This is attributed to the significant contribution of jute and carbon fibers reinforcements in hybrid composites. Hence the jute and carbon fiber dual reinforced hybrid composites can be used for higher load structural applications. The percentage of elongation in the hybrid composites is 3.51 magnitudes greater as compared only jute reinforced or only carbon reinforced composites, this result clearly reveals that hybrid composites is tough as compared to monolithic composites.

Material can be susceptible to various types of defects during preparation. These defects can compromise the integrity, strength, and performance of the material. Some common defects expected in material include:Voids, Delamination, Fiber Misalignment, Matrix Cracks, Resin-rich or Resin-starved Areas, Surface Imperfections.

Table 1: Tensile properties of material

Sr. No.	Results	Value	Unit
1	Area	100.6104	mm^2
2	Yield Force	1398.85	N
3	Yield Elongation	3.45	mm
4	Break Force	1424.1	N
5	Break Elongation	3.51	mm
6	Tensile Strength at Yield	13.90	N/mm^2
7	Tensile Strength at Break	14.15	N/mm^2
8	Tensile Strength at Max	14.07	N/mm^2
9	% Elongation	3.51	%
10	Max Force	1415.10	N
11	Max Elongation	3.51	mm



load Vs displacement data of hybrid composite

VI. Conclusion

The tensile strength of material is typically higher that of 14 Mpa owing to the synergistic effects of the fiber-matrix interaction. while jute fiber may not possess exceptionally high tensile strength compared to synthetic fibers or certain other natural fibers, it still offers favorable mechanical properties, including good strength-to-weight ratio and biodegradability. Where the tensile strength of jute can be increased by adding other reinforcement (carbon) can provides optimum strength has shown in this project. The percentage of elongation is also higher for this hybrid composite which clearly reveals that hybrid composites absorbs more energy before fracture as compared to individual reinforced composite.

Note: In this project bi-directional jute fabric is used where the carbon fibers are in unidirectional and perpendicular to the load applied.

VII. Reference

1.Chaudhary, Anisha; Gupta, Vinay; Teotia, Satish; Nimanpure, Subhash; Rajak, Dipen K. (2021-01- 01), "Electromagnetic Shielding Capabilities of Metal Matrix Composites", in Brabazon, Dermot (ed.), Encyclopedia of Materials: Composites, Oxford: Elsevier, pp. 428–441, ISBN 978-0-12-819731-8, *retrieved 2022-02-14*

2.Bhatt, Pooja (2017). Carbon Fibers: Production, Properties and Potential Use (Thesis). Archived from the original on 2021-04-30. Retrieved 2021-07-25.

3."Plants for a Future", Pfaf.org, retrieved 21 May 2015

4."Welcome to the world of Jute and Kenaf - IJSG". 26 May 2008. Archived from the original on 26 May 2008. Retrieved 27 April 2019.