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Comparative Study of Mechanical Properties of Hybrid Composites using Carbon Fiber with Jute and Hemp

K.V. Manjunath
Department of Mechanical Engineering
K.S. Institute of Technology,
Bengaluru

Krishnamurthy. N
Department of Mechanical Engineering
Vijaya Vitala Institute of Technology,
Bengaluru

***Abstract*:- Materials play vital role for the development of human being living standards. Hybrid composites are multi-phase system consisting of matrix and reinforcing material. This paper deals with the comparative study of hybrid composite material made up of carbon fibre with jute and carbon fibre with hemp which are fabricated by hand layup technique using Lapox L12 epoxy and K6 hardener. The mechanical properties of the hybrid reinforced composites like tensile and flexural of the various specimens are determined using Universal Testing Machine as per ASTM standards. The results shows that hybrid composites prepared by hemp and carbon are having better tensile and flexural strength as compared with jute and carbon. The microstructure of the above said hybrid reinforced composite materials has been analyzed using SEM.**

Keywords : Carbon, Jute, Hemp, Hand layup, Epoxy, Lapox L12, SEM.

1. INTRODUCTION

Composites can be defined as materials that consist of two or more physically and chemically different phases separated by a distinct interface at the macro level. Composites have the advantages such as low weight, corrosion resistance, high fatigue strength and faster assembly. They are extensively used in aircraft industries, packaging of medical equipment, space vehicle and sports goods. Hybrid composites are the combination of materials differing in composition, fibre type and these separate constituents act together to give the essential mechanical properties like strength and stiffness to the composite parts.

The matrix and reinforcement are the two main components that are essential in developing reinforced composites. These two phases consists of organic polymers as matrix and fibre as the reinforcement. Usually the strength and stiffness of the fibre are much higher than the matrix material, thus the fibre is the major load carrying component in polymer composites. The primary purpose of the matrix is to hold the fibre firmly and efficient load transfer which improves the mechanical properties of the reinforced composites. Natural fibre material mechanical properties make them an attractive ecological alternative to glass, carbon and manmade fibres used for the manufacturing of composites. These natural fibres are eco-friendly, available in nature abundantly and are renewable and economical. Due to these advantages the natural fibre composite materials have found many applications worldwide.

2. HYBRID COMPOSITE MATERIAL FABRICATION

There are many techniques available in industries for manufacturing of composite material such as hand layup technique, compression technique, vacuum bagging, resin transfer molding etc., The hand lay-up process of manufacturing is one of the most simplest and easiest methods for manufacturing composites. The primary advantage of the hand layup technique is to fabricate very large and complex parts with reduced manufacturing time. It is shown in Fig. 1.

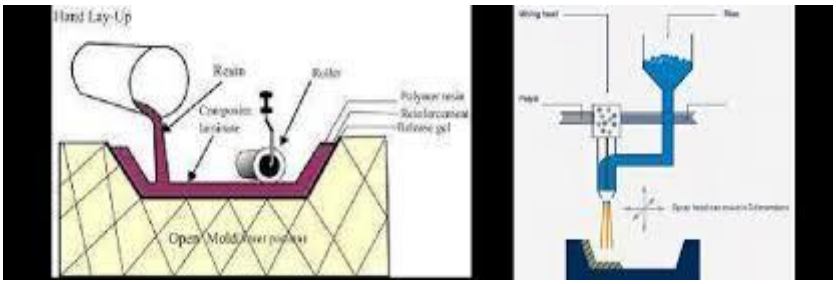

Fig. 1 Shows the hand layup technique for the fabrication of composite material

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2.1 Experimental work

All experimental tests are carried out at Composite Technology Park Bangalore. All experimental tests were repeated to generate the data.

2.2. Tensile Test

Tensile test is one of the fundamental tests in material science in which the sample is subjected to a controlled tensile failure. The results are used to predict how the material will react under tensile loading. Some of the mechanical properties that are directly measured by tensile test are tensile strength, Young's modulus, and yield strength. This test is commonly used for obtaining mechanical properties of isotropic materials. Fig.2 shows the UTM with tensile specimen.

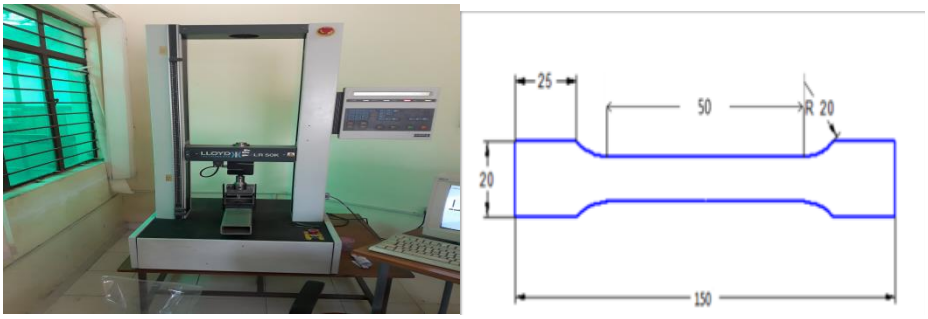

Fig. 2. Shows the UTM with tensile specimen

2.3 Flexural test

The three-point bending flexural test provides values for the modulus of elasticity in bending, flexural stress, flexural strain and the flexural stress–strain response of the material. The main advantage of the three-point flexural test is the ease of the specimen preparation and testing. However, this method has also some disadvantages. The results of the testing method are sensitive to specimen, loading geometry and strain rate. Fig.3. shows the UTM with flexural specimen.

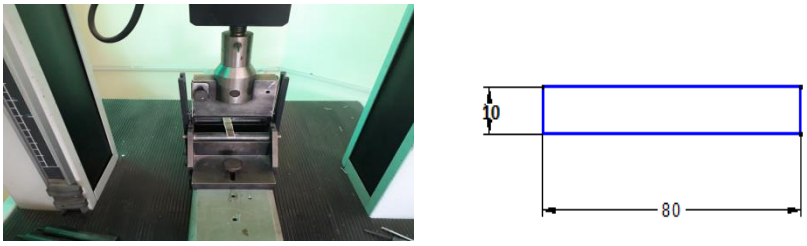

Fig.3. Shows the UTM with flexural specimen

2.4 SEM analysis

A scanning electron microscope is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample thus producing various signals that contain information about the surface topography and composition of the sample. SEM can achieve resolution better than 1 nanometre. SEM samples are prepared to withstand the vacuum conditions and the high energy beam of electrons and have to be small enough to fit on the specimen stage. Samples are generally mounted rigidly to the specimen holder using a conductive adhesive. Fig.4 shows the SEM analysis equipment.

Fig.4. Shows the SEM analysis equipment

3. RESULTS AND DISCUSSIONS

Experiments were conducted to determine the tensile strength, fleural strength and hardness of the above said material. All experimental tests were repeated three times to generate the data. The SEM analysis has been carried out to understand the internal structure of the hybrid composite material.

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3.1 Tensile test results for Carbon and Jute Hybrid composite.

The mechanical behaviour of natural and synthetic fibres was investigated. Fig. 5 shows the tensile strength and Young's modulus of the hybrid composites prepared using carbon and jute. It was found that the average tensile strength to be 90.63MPa and the corresponding average Young's modulus to be 6422 MPa.

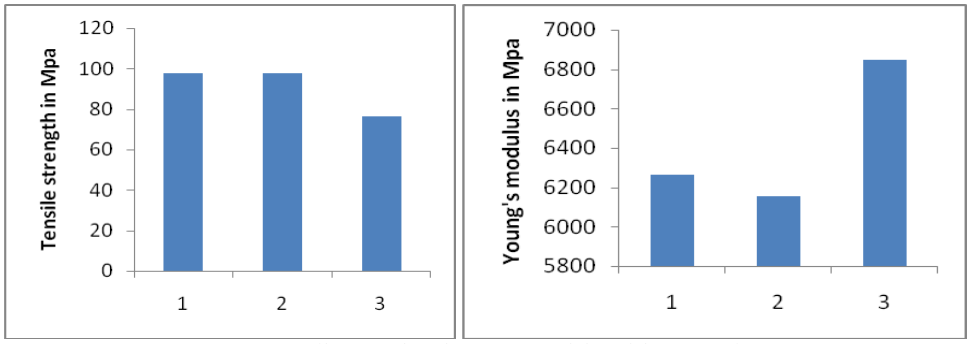

Fig.5 Shows the tensile strength and Young's Modulus of the composite material

3.2 Flexural test results for Carbon and Jute Hybrid composite.

Fig. 6 shows the flexural strength and its corresponding Young's modulus of the hybrid composite prepared by carbon and jute. It was found that the average flexural strength to be 322.93MPa and the corresponding average Young's modulus to be 1850.33MPa.

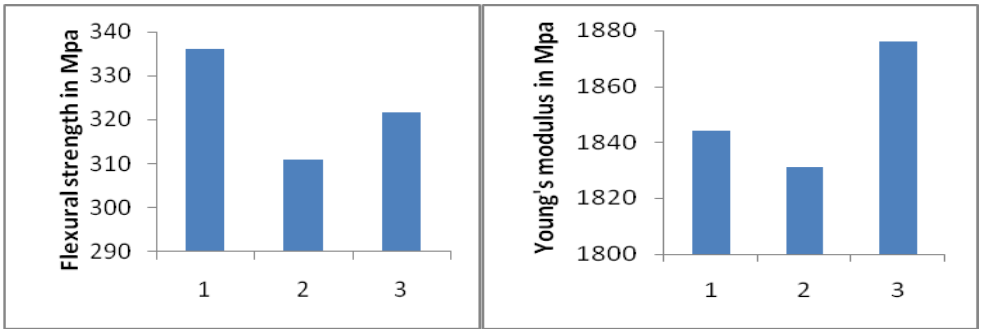

Fig.6 Shows the Flexural strength and Young's Modulus of the composite material

3.3 Tensile test results for Carbon and Hemp Hybrid composite.

The mechanical behaviour of natural and synthetic fibres was investigated. Fig. 7 shows the tensile strength and Young's modulus of the hybrid composite prepared using carbon and hemp. It was found that the average tensile strength to be 103 MPa and the corresponding average Young's modulus to be 8916MPa.

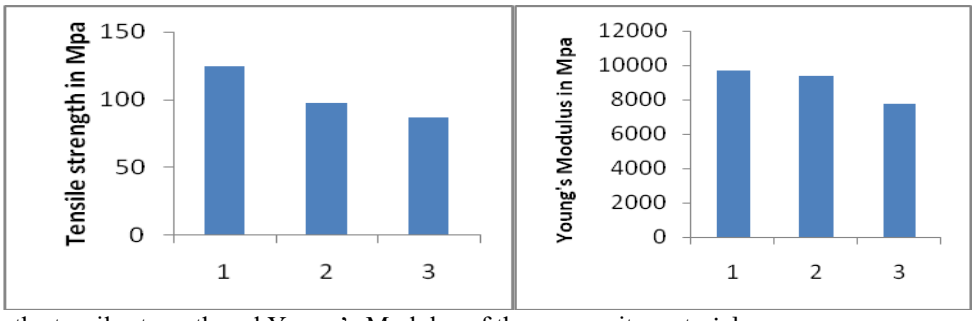

Fig.7 Shows the tensile strength and Young's Modulus of the composite material

3.4 Flexural test results for Carbon and Hemp Hybrid composite.

Fig.8 shows the flexural strength and its corresponding Young's modulus of the hybrid composites prepared by carbon and hemp. It was found that the average flexural strength to be 335.33 MPa and the corresponding average Young's modulus to be 2653.66MPa.

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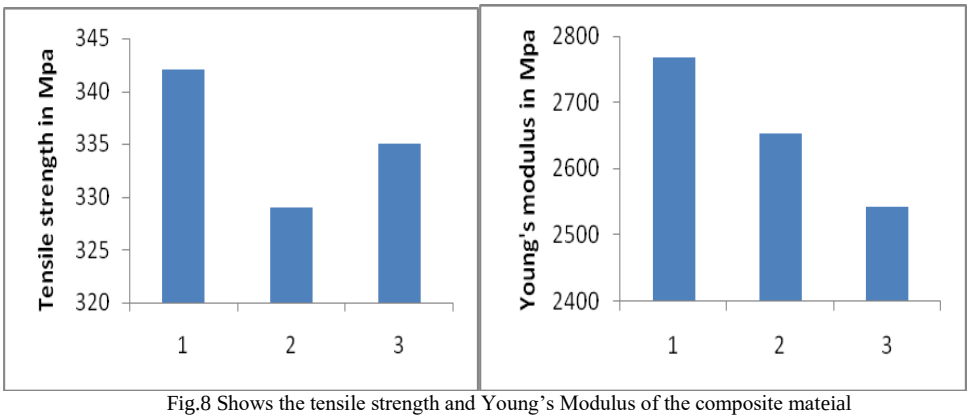

Fig.8 Shows the tensile strength and Young's Modulus of the composite mateial

3.5 SEM Analysis of hybrid composite materials

The microstructure of the fractured surfaces of carbon and jute, carbon and hemp are presented in Fig 9 with a magnification of 100X. It is evident from the microstructure that there is a fibre pull out, indicating the poor bonding between fibres and epoxy. This poor interfacial bonding reduces the mechanical properties of the composite materials.

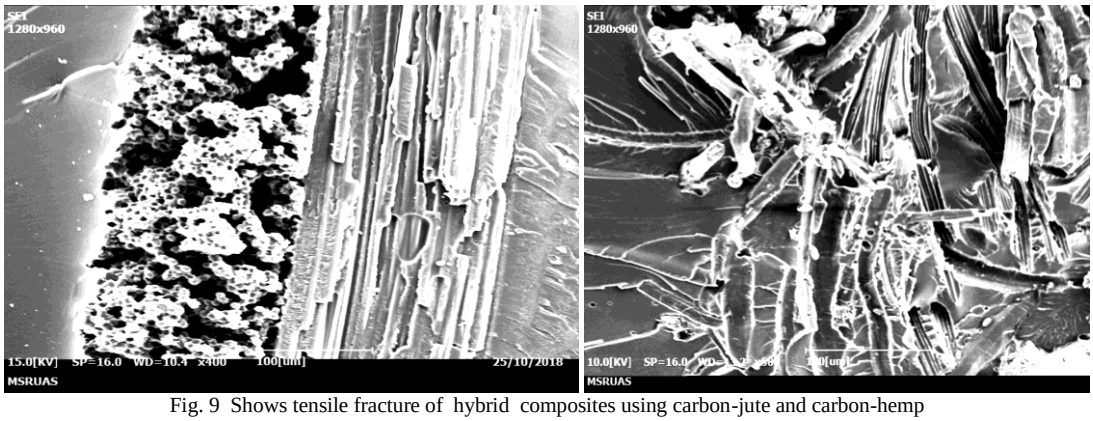

Fig. 9 Shows tensile fracture of hybrid composites using carbon-jute and carbon-hemp

CONCLUSIONS

- Fabrication of multi layered reinforced hybrid composites using Carbon-Jute, Carbon-Hemp with epoxy has been successfully carried out using hand layup technique.
- It was observed that mechanical properties of the hybrid composites depend on the type of fibre and orientation.
- It was observed that carbon with hemp has yielded better results as compared to carbon and jute since hemp has better tensile strength than jute.
- Micro structure of the above said composite is observed using SEM. The fractured surface has shown the presence of voids and debris in case of hand layup technique.

REFERENCES

[1] M R Sanjay "Studies on Mechanical Properties of Jute/E-Glass Fiber Reinforced Epoxy Hybrid Composites Journal of Minerals and Materials Characterization and Engineering", Vol. 4, Pages 15-25 published Online January 2016 in Scientific Research.

[2] M. Muthuvel , G. Ranganath , K. Janarthanan K. Srinivasan "Characterization Study Of Jute And Glass Fiber Reinforced Hybrid Composite Material International Journal of Engineering Research & Technology" (IJERT), Vol. 2, Issue 4, April – 2013.

[3] Navjot Pal Singh, Lakshay Aggarwal, V.K.Gupta (2015) study on 'Tensile Behaviour of Sisal/Hemp Reinforced High Density Polyethylene Hybrid Composite' Materials Today: Proceedings 2 (2015) 3140 – 3148

[4] R. Bhoopathi, M. Ramesh,*, C. Deepa (2014) study on 'Fabrication and Property Evaluation of Banana-HempGlass Fiber Reinforced Composites' Procedia Engineering 9(2014)2032–2041

[5] Asim Shahzad Hindawi Publishing Corporation Advances in Materials Science and Engineering Volume 2013, Article ID 325085, 9 pages

[6] Subhash Kumar Gupta (2014) study on mechanical behavior of bamboo fiber based polymer composites Thesis, NIT Rourkela

[7] Avtar Singh Saroya and Vishvendra Meena (2011) Study on 'study of mechanical properties of hybrid natural fiber composite' thesis, National Institute of Technology Rourkela.

[8] Supriya Kunwar, Dr. K. K. S. Mer, Amit Joshi (2015) study on 'Mechanical Characterization of Graphene based Hybrid Polymer' international Journal of Scientific & Engineering Research, Volume 6.

[9] V. Manikandan, P. Amuthakkannan, V. Arumuga Prabu (2015) study on 'Banana/Hemp Fiber and Its Hybrid Composites' Report number: Vol. 1: Issue 2, Affiliation: International Journal of Composite Material and Matrices

[10] Gangadhar M Kanaginahal, Anjan Kumar Muniraju, Mr. Madhav Murthy (2014) study on 'Testing of Polymer matrix Hybrid Composites' Materials Today: Proceedings 00 (2014)

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