Experimental Investigation on Mechanical Properties of Natural Fiber Reinforced Epoxy Composite

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ABSTRACT in the arena of composites numerous types of manmade and natural fibers used as reinforcement purpose, but the manmade fiber are non-biodegradable and non-recyclable materials. In current days as per ecological worry, recyclable and renewable material used in industrial applications as in the bio composites. Strength of different accepted fiber composites material is focus on categorization as per their use in different applications as per requirement. Variability of bio fibers are obtainable in market, but as per cost alarm, banana fiber is low cost material as related to other natural fiber material. In this study woven mat, banana fiber material is in use for study. The sample is set in layers or as the fiber orientation is the angle wise orientation, which is the two types multi directional and parallel layers, prepared as per ASTM standard methods. Mechanical characterization such as tensile, flexural and impact strength at different ply orientations is studied.

Keywords: banana fiber, epoxy resin and epoxy hardener, hand lay-up method, mechanical properties.

I. INTRODUCTION

Composite material is composed of fiber and matrix constituents to manufacture easily. Matrix will be strengthen the properties and assist in transferring load between the strong and stiff reinforcements. It has combination of material that are one constituent known as reinforcing and other known as the matrix at a macroscopic level. The fiber material is in the form of particles or flake etc. This material is significant in mechanical, physical, thermal, corrosion resistance and dimensionally stable properties. However, many factors like those lightweight, cost and failure nature lead the polymer epoxy resin used in composite because it gives well balance in a chemical properties and mechanical properties.

The awareness on health and environment concern the natural fiber provides opportunities to work on them for replacing the unhealthy material like synthetic fiber it is affecting the environment due to toxic, non-degradability and non-recyclability resulting waste products were increasing in the environment. By the classification of natural fiber, banana is coming into non-wood fiber it is produced from skin or bast of Corchorus capsularis plant. It used from centuries as a packaging material. In recent time this fibres found to be valuable material property, and that's why aid to composites material. Banana is eco-friendly, low cost, etc Banana is available in many forms like raw non-woven, woven and breaded in course threads by the use in different application. These fibre materials used in door panels, automobile headliners, in helmet, automobile dashboards, furniture materials, etc.

II. MATERIALS AND EXPERIMENTAL PROCEDURE

2.1. Materials

For fabricating the composite laminates, the banana fiber is used as the reinforcing material with combination of epoxy resin and hardener and is being fabricated by using common user friendly hand lay up method.

2.1.1 Banana Fiber

The banana is natural fiber, and it is extracted from the banana plant, this fiber shows the good material properties, inexpensiveness and commercially available in

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the required form. Banana fabric mat is used in the current research work, as it possess the predominant properties.

2.1.2. Matrix Material

Epoxy resin is used as a matrix material with the use of hardener. It is purchased from the Electro coating & Insulation Technology Pvt. Ltd Pune, Maharashtra, India.

2.2. Hand lay-up Procedure

Tensile test specimen is fabricated with overall dimensions L- 246 mm, W- 29 mm, and T-10 mm. Flexural test with 165 mm length, 19 mm width and 3.2 mm thick. Impact strength having the dimensions of 80X10X4 in length width and thickness in mm respectively. These dimensions are considered according to the testing standard and the it is fabricated.

2.3. Volume fraction of the Banana fiber Epoxy composite laminate

$$Vf = (Wf/\rho f)/ (Wm/\rho m+Wf/\rho f)$$

Where, Wf = weight of banana fiber

ρf = density of fiber

Wm = weight of matrix

ρm = density of matrix

This study is carried out through literature survey and studied that for this fractions, the overall properties are more predominant and finally the volume fraction is of 40% fibre and 60% matrix.

Table.1 Chemical and mechanical properties of banana fiber

Material Characteristics	Banana
Cellulose (%)	60-65
Hemicellulose (%)	6-19
Lignin (%)	5-10
Pectin	3-5
Extractives (%)	3-6
Ash (%)	1-3
Moisture content (%)	1.1
Tensile strength (MPa)	529-914
Specific Tensile Strength (Mpa)	392-677
Youngs Modulus (GPa)	27-32
Specific Young's Modulus (Gpa)	20-24
Diameter of fiber(mm)	5-25
Fiber length(mm)	0.8-6
Density(kg/m^3)	1460
Elongation (%)	1.8

Table.2 Banana fiber and Epoxy resin

Weight of banana fiber (kg)	Weight of epoxy resin (kg)	Weight of composites (kg)
1.32	3.1533	4.4733

III. MECHANICAL CHARACTERIZATION OF BANANA FIBER AND EPOXY COMPOSITES

3.1. Tensile Test

The testing is done with the help of standard UTM. Loaded in longitudinal direction as per ASTM D 638.

Fig.1 Tensile Test

3.2. Flexural Test

Flexural tests were performed on an UTM. Using the three-point bending fixture and according to the testing standards

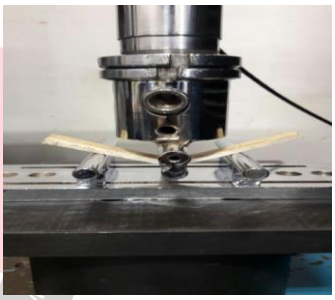

Fig.2 Flexural Test

3.3 Impact Test

It is carried out as per requirement, which determines amount of energy required to break under the force, which is related to toughness of material.

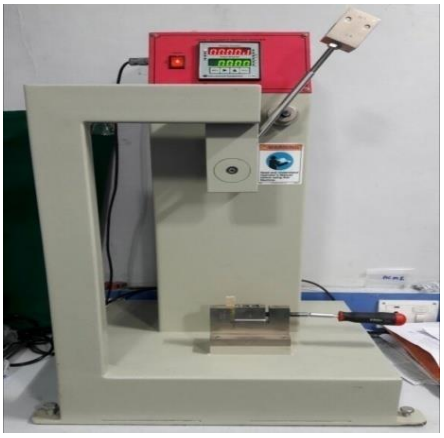

Fig.3 Izod Impact Test

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IV. RESULTS AND DISCUSSION

Table No. 3 Results

Sr. no.	Sample Identification	Tensile strength (MPa)	Flexural strength (MPa)	Izod Impact test (J/M)
1	Layer in Multidirectional	18	21	64
2	Layer in Parallel	36	50	113

V. CONCLUSION

- .It is concluded the tensile strength for parallel layer for multidirectional is s 36 and 18 MPa respectively which is found larger in parallel i.e. 50.61% than bidirectional.
- The flexural strength for multidirectional layer is 21 and for unidirectional is 50 MPa respectively.
- The Izod impact strength for parallel layer is 113 and for multi-layer is 64 MPa respectively
- The largest impact and tensile strength is found in case of parallel layer.

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