EXPERIMENTAL INVESTIGATION OF REINFORCED JUTE AND EUCALYPTUS FIBER

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ABSTRACT

The main aim of our investigation study is to replaces conventional material like wood, metal ,etc.into composites. Most of these composites use synthetic fiber such as carbon, kevlar whose synthesis is rather complex, costly and requires specific processes .Natural fibers are generally low cost ,easily available and ecofriendly. In our project we are using jute mat as a major composite material. In order to increase its strength additionally , we are extracting the new fiber from the bark of the eucalyptus tree, due to its light weight ,high strength, which could be easily procured and also the extraction of the fiber, as opposed to the synthetic fibers is relatively simpler. To perform flexural, tensile, impact and compression test to find the strength of our reinforced composites. The flexural test, tensile test ,impact test ,compressive test involve measuring the maximum force the reinforced composites can withstand . These test will give the clear evidence of how the composites will prove to be advantageous under various circumstances .

Keyword - *Jute Mat, Eucalyptus fiber, Epoxy, Mechanical Properties.*

1. INTRODUCTION

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It is obvious, especially for composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

A composite material is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. Composites can be grouped into categories based on the nature of the matrix each type possesses and according to physical and chemical properties of the matrices and reinforcing fibers.

The various types of :

a)Metal Matrix Composites

b)Ceramic Matrix Composites

c) Polymer Matrix Composites

2. MATERIALS AND METHODS

2.1 Raw materials:

Raw materials used in the present investigation are jute fiber, Eucalyptus fiber, epoxy resin, Hardener HY-951.

2.2 Properties of Epoxy and Hardener:

Aspect (visual)	clear, pale yellow liquid
Epoxy content	5.30 - 5.45 eq/kg
Viscosity	10000 - 12000 MPa
Density	1.3 g/cm^3
Flash point	> 200 °C
Storage temperature	2 - 40 °C

TABLE 2.1 Properties of Epoxy LY 556

Appearance	Clear liquid
Viscosity at 25°C	10 - 20 mPa s
Specific Gravity at 20°C	0.98
Flash point	110°C
Density at 25 °C	0.95 g/cm^3
Storage temperature	Room Temperature

TABLE 2.2 Properties of Hardener HY 951

2.3 NaOH Solution

Sodium Hydroxide(NaOH) is a alkaline solution used to enhance the surface morphology of natural fibers

2.4 Jute Mat

Jute is a long, soft, shiny plant fiber that can be spun into coarse, strong threads. It is produced from plants in the genus Corchorus.Jute is one of the cheapest natural fibers, and is second only to cotton in amount produced and variety of uses.Jute fibers are composed primarily of the plant materials cellulose and lignin. Jute is a rainy season crop, growing best in warm, humid climates.It is 100% bio-degradable & recyclable and thus environment friendly.

FIG 2.1 Jute Mat

Properties	Values
Tensile Strength	393-723 MPa
Young's Modulus	13000-26500 MPa
Density	1.3 - 1.4 g/cm^3
Cellulose	61 - 71.5 wt.%
Hemicellulose	13.6 – 20.4 wt.%
Lignen	12 - 13 wt.%

TABLE 2.3 Properties of Jute Mat

2.5 Extraction of Eucalyptus Fiber

Methods of Fibers Most of the natural fibers are not readily available; they need to be extracted from their raw material. The process of extracting fiber from their raw material is discussed below. Various steps involved in extraction of Eucalyptus fiber from its bark is discussed below.

- Bark is taken and in the eucalyptus tree is made to soak in water for24 hours. Soaking is to makes the extraction of fiber easier
- After 24 hours, the bark is taken out and it is subjected to mechanical extraction. The mechanical extraction includes hammering the shell in order to loosen the bonding between the fibers
- After hammering, the fibers are peeled manually with a scissor. Then the fibers which are extracted are made to dry at room temperature for 24 hours

FIG Extracted Eucalyptus Fibers

3. FABRICATION OF COMPOSITES

3.1 Hand Lay Up Method:

Apply mold release agent(wax) to the top surface of the polyethylene sheet twice. There should be no wrinkles or raised regions in the peel ply, and its dimensions should be identical to those of the laminate .Cut the jute fiber mat and eucalyptus fiber .Number of layer is based on the required thickness. Weight the fabric using weighing machine. Now measure the epoxy LY556 resin whose weight is equivalent to 100% of the fiber weight. Add hardener (HY956) of weight 10% weight of resin weight of the resin and stir well .Prepare all the laminate with epoxy hardener mix .Lay one layer of fiber cloth over the plate then again apply the resin over the fiber cloth. This process is repeated until the desired thickness is achieved. Excess resins are removed using roller .Laminates are left to cure under standard atmospheric conditions for about 24 hours

FIG 3.1 Fabricated Specimen

4. TESTING OF SPECIMEN

4.1 Tensile Test

The tensile test is done by cutting the composite specimen as per ASTM: D638 standard (sample dimension is (216 × 19 × 3 mm). A universal testing machine (UTM) is used for testing with a maximum load rating of 100 KN. Composite specimens with different fiber combinations are tested. In each case, three samples are tested and the average is determined and noted. The specimen is held in the grip and load is applied and the corresponding deflections are noted. The load is applied until the specimen breaks and break load, ultimate tensile strengths are noted. Tensile stress and strain are recorded and load vs length graphs are generated.

4.2 Flexural Test

The flexural test is done in a three point flexural setup as per ASTM: D790 standard (sample dimension is 80 × 8 × 3 mm3). When a load is applied at the middle of the specimen, it becomes bends and fractures . This test is carried out in the UTM from which the breaking load is recorded and load vs length graphs are generated.

4.3 Impact Test

The impact test is done in a charpy impact setup as per ASTM: D256 standard (sample dimension is 65 × 12.5 × 3 mm3). The specimen must be loaded in the testing machine and allows the pendulum until it fractures or breaks. Using the impact test, the energy needed to break the material is noted and used to measure the toughness of the material and the yield strength. The effect of strain rate on fracture and ductility of the material is analyzed.

4.4 Compression Test

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. This method determines in-plane compressive properties by applying the compressive force into the specimen at wedge grip interfaces. ASTM D3410 is most appropriate for composites materials reinforced by high-modulus fibers including tape and textile, but other materials may be tested. The test fixture is designed to provide a compressive load to the unsupported center 12 to 25 mm (0.5 to 1 inch) gauge length of the specimen.

5. RESULTS

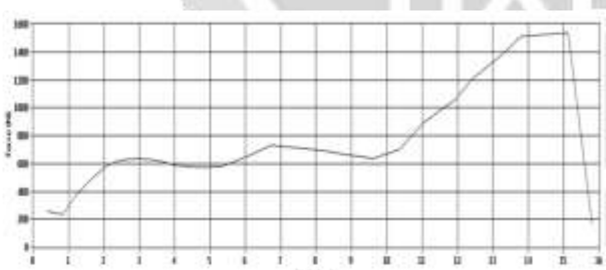

FIG 5.1 Tensile strength

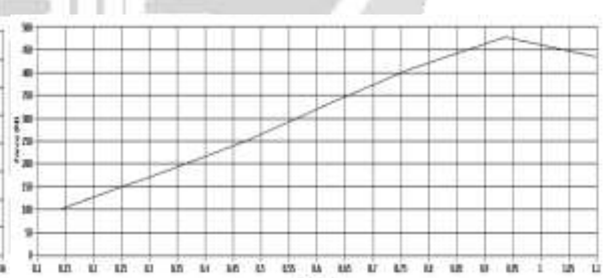

FIG 5.2 Flexural strength

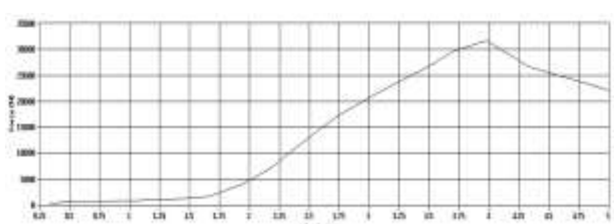

FIG 5.3 Compressive strength

PROPERTIES	VALUES
Tensile Strength	Maximum Force - 1.53 KN Ultimate Tensile Strength -14.08MPa
Flexural Strength	Maximum Force -0.48 KN
Impact Strength	2 J
Compression Strength	Maximum Force - 31.72 KN

TABLE 5.1 Properties Of Fabricated Specimen

6. CONCLUSION

The natural fibers have been successfully reinforced with the epoxy resin by simple wet hand lay-up technique. The aim of this project is to find the tensile, Bending, ILSS and impact strength of natural fiber reinforced bio-composites.The fibers like jute fibers, coconut coir, areca nut fibers, sisal fibers were successfully used to fabricate bio-composites with varying the fiber percentage.The new hybrid composite produced with natural fibers as reinforcements gives good mechanical properties as compared with pure matrix material. These hybrid-bio-composite can be used in Aerospace and automobile applications.In the present work, bio-composite with multiple natural fibers such as jute fibers,Coconut coir, areca fibers, sisal fibers, banana fibers have been successfully reinforced with the epoxy resin by simple and inexpensive hand lay-up technique. The mechanical testing results of fabricated bio composite helmet indicate that, concept of using multiple natural fibers is viable for helmet application. However, there is a scope to optimize the volume fraction of natural fibers as reinforcements to achieve enhanced mechanical properties of specmen.So, it is clearly indicates that reinforcement of natural fibers have good and comparable mechanical properties as conventional composite materials.

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