"EXPERIMENTAL INVESTIGATION OF NATURAL FIBER COMPOSITE MATERIAL USING JUTE AND SISAL WITH EPOXY RESIN"

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Abstract: Composite materials are helping the modern world in all acceptances as a replacement, through the use of alternative materials such as jute and sisal fibers. These alternative composite materials are more versatile than metals and can be adapted to meet complex performance and design requirements. Long life and excellent demands in terms of fatigue, impact, environmental resistance and reduced maintenance help replace conventional materials. The best mechanical properties against high tensile strength, high strength and weight ratio Natural fiber compounds, such as sisal and jute compounds, have shown good properties, such as high strength, lightness and biodegradability. Reinforced polymers of sisal and jute are showing enormous applications. In this study, sisal-jute-reinforced epoxy compounds are processed and their mechanical properties are calculated as flexural strength, impact resistance and tensile strength.

Keywords: Jute and Sisal Fiber, Epoxy Resin, Hardener, Composite material.

1. INTRODUCTION

The advantage of composite materials over conventional materials stem largely from their higher specific strength, stiffness and fatigue characteristics, which enables structural design to be more versatile. By definition, composite materials consist of two or more constituents with physically separable phases. However, only when the composite phase materials have notably different physical properties it is recognized as being a composite material. Composites are materials that comprise strong load carrying material imbedded in weaker material. Reinforcement provides strength and rigidity, helping to support structural load. The matrix or binder maintains the position and orientation of the reinforcement. Significantly, constituents of the composites retain their individual, physical and chemical properties; yet together they produce a combination of qualities which individual constituents would be incapable of producing alone.

The reinforcement may be platelets, particles or fibers and are usually added to improve mechanical properties such as stiffness, strength and toughness of the matrix material. Long fibers that are oriented in the direction of loading offer the most efficient load transfer. This is because the stress transfer zone extends only over a small part of the fiber-matrix interface and perturbation effects at fiber ends may be neglected. In other words, the ineffective fiber length is small. Popular fibers available as continuous filaments for use in high performance composites are glass, carbon and aramid fibers. The biggest advantage of modern composite materials is that they are light as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application.

2. EXPERIMENTAL DETAILS

2.1 Materials

Jute is a long, soft, shiny vegetable fiber that can be spun into coarse, strong threads. It is produced primarily from plants in the genus Corchorus. Jute is the name of the plant or fiber used to make burlap, hessian cloth. Jute is one of the most affordable natural fiber, and second only to cotton in the amount produced and variety of uses. Sisal Fiber is one of the most widely used natural fiber and is very easily cultivated. It is obtain from sisal plant. The plant, known formally as agave sisalana. These plants produce rosettes of sword-shaped leaves which start out toothed, and gradually lose their teeth with maturity. Each leaf contains a number of long, straight fibers which can be removed in a process known as decortication. During decortication, the leaves are beaten to remove the pulp and plant material, leaving the tough fibers behind. The epoxy resin (LY-556) is taken as matrix binder. Commonly epoxy resins have good mechanical and thermal properties. For getting the properties to be improved, the resin should undergo curing reaction in which the liner epoxy resin structure changes to form three-dimensional cross- linked thermo set structure. This curing reaction takes place by adding a curing agent called hardener in a ratio of 10:1 to Epoxy resin.

3. ALKALI TREATMENT

The fibers are well treated effectively with 5- 6% by wt NaOH solutions. The fibers were totally immersed in the NaOH solution for one day at 40 - 60^0 C and then washed with pure distilled water until the pH is neutral. The acetic acid is diluted and then washed again with plenty of water. Finally, the fibers were dried at 60-80° C for 12 h in the oven. The whole process is carried out in chemistry lab.

4. MAKING OF DYE

For making of dye the two wooden blocks are taken of dimensions 300mm length and 250mm width. After that the wooden strip of 6mm thick and 25mm width is taken for making of hollow rectangle of dimensions of 250mm length and 200mm width and thickness or height of that frame is 6mm. Then that frame is rigidly fixed on one of the wooden block of above mentioned dimensions and the other block is for applying pressure on material. The catia drawing of dye is as shown in below.

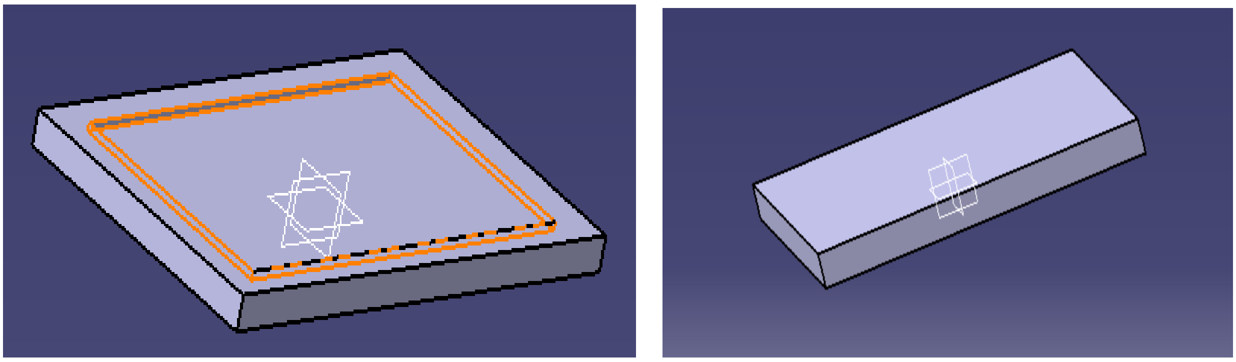

Figure 1: Design of dye in CATIA.

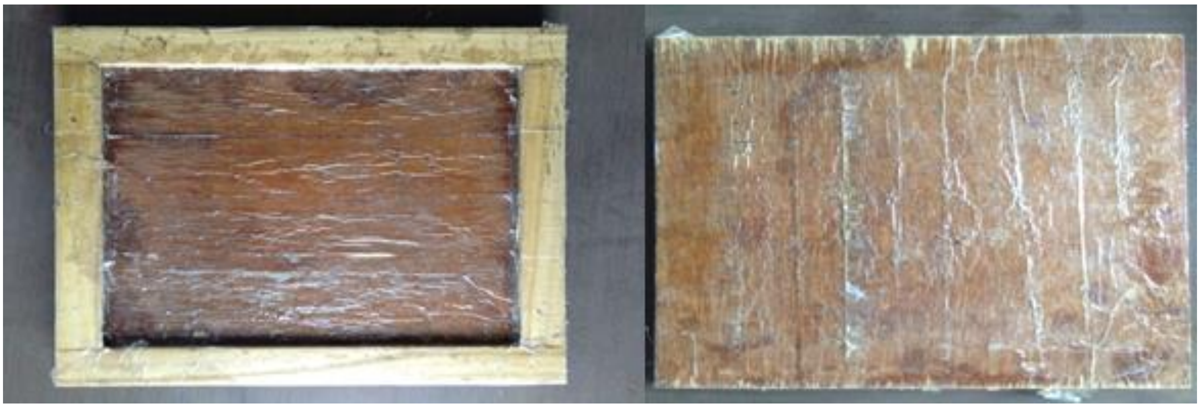

Figure 2: Actual Dye Design

5. MANUFACTURING OF PLATES

5.1 Method of Manufacturing

Fibers and resin premixed with curing agent are manually placed against the molding surface. The placement of fibers and resin can happen in two ways. These are while fabricating composite products with long fibers, reinforcing fibers are placed layer by layer over the surface, to ensure appropriate stacking sequence, as well as requisite thickness of the final product. Once a particular layer of fiber is placed, it is coated with a layer of resin either through a spray gun, or through a brush. Care is taken to ensure that resin is devoid of air bubbles, as it is applied to reinforcing fibers. For this, serrated rollers may be used, which help remove air bubbles, as well as ensure increased wetting of fibers. This manual method of layup may also be used for short fiber composites

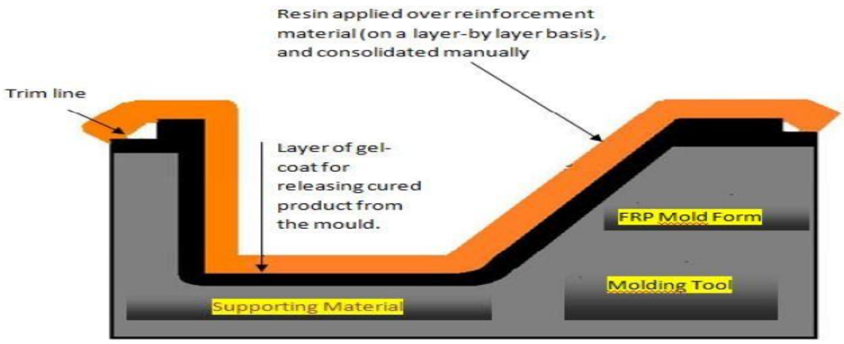

Figure. 3: Hand lay-up process

The dye is placed on flat surface. The mixture of epoxy and hardener is prepared with the 10:1 ratio. The wax is applied to the internal side of the dye for easy removal of plates after manufacturing. After that the layer of epoxy resin is applied in the dye and then the layers of alternate materials are placed, after placing every layer the epoxy resin is applied and in the last the upper pressure plate is placed on the layers and the dye is kept under Compression Testing Machine (CTM) for removing excessive epoxy resin and kept under compression for 10 to 12 hours. After that the pressure is released and plates are removed from the dye and done the finishing on the plates finally. The two plates are manufactured, in which the composition of jute sisal and epoxy resin is 20, 30, 50 by the volume fraction of the dye respectively and the other plate is 30, 20, 50 as per above mentioned sequences of the material respectively.

Figure 4: 20% jute 30% sisal and
50% epoxy resin composition

Figure 5: 30% jute 20% sisal and
50% epoxy resin composition

6. TESTINGS

6.1 Tensile Test

Tensile testing was carried out in a universal testing machine UTM with a 500 kN capacity with a gauge length of 160 mm and a cross head speed of 10 mm/min, at 25^0 C as per The tensile testing is carried out by applying longitudinal or axial load at a specific extension rate to a standard tensile specimen with known dimensions (gauge length and cross sectional area perpendicular to the load direction) till failure. The applied tensile load and extension are recorded during the test for the calculation of stress and strain.

6.2 Flexural Testing

Preparation of the samples for the bending test according to ASTM. The standards and folding of the 3-point test are used for the tests.Measure the removal and sample testsaverage relative humidity of 50 % etemperature around 25 ° C. From the testing machine Flexible loads and movements have been recorded all test samples. As per ASTM D-790.

7. Result and Disscussion

Table no. 1 Tabulated results of tests

Composition (%)	Name of Test	Specimen No	Maximum Load (N)	Max. Strength (MPa)
Jute30,Sisal 20,Epoxy resin 50	Tensile Test	1	11750	65.27
Jute20,Sisal 30,Epoxy resin 50		2	12050	66.94
Jute30,Sisal 20,Epoxy resin 50	Flexural Test	1	9050	50.27
Jute20,Sisal 20,Epoxy resin 50		2	9450	52.50

8. CONCLUSION

With the help of this work we found out composite material with optimum strength for practical use. We also come to know that increase in fiber content increases mechanical properties but increases brittleness and start delaminating. The material with 20, 30, 50 compositions of jute, sisal, and epoxy resin respectively is good for application as it has optimum properties with less brittleness

- The tensile test shown better result for composition of 20% jute, 30% Sisal, 50% Epoxy resin.
- The flexural test shown better results for composition of 20% jute, 30% Sisal, 50% Epoxy resin.

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