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FABRICATION AND ANALYSIS OF BANANA WITH GLASS FIBRE COMPOSITE MATERIALS ON MECHANICAL PROPERTIES

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ABSTRACT

Natural fiber composites are emerging as realistic alternatives to glass-reinforced composites in many applications. Natural fiber composites such as banana fiber, hemp fiber-epoxy, flax fiber-polypropylene (PP), and china reed fiber-PP are particularly attractive in automotive applications because of lower cost and lower density. Natural fiber composites are also claimed to offer environmental advantages such as reduced dependence on non-renewable energy/material sources, lower pollutant emissions, lower greenhouse gas emissions, enhanced energy recovery, and end of life biodegradability of components. Since, such superior environmental performance is an important driver of increased future use of natural fiber composites. This paper deals with Banana and glass fiber composites. It is one of the fiber reinforced composites. Banana and glass fiber is used as reinforcement and the polymer based resin is used as a matrix. The mechanical properties like Tensile, Flexural and Impact strength are analyzed in detail.

KEY WORDS : Natural Fiber, Hand lay, Tensile strength, Flexural strength, Impact strength.

1. INTRODUCTION

In an advanced society like ours we all depend on composite materials in some aspects of our lives. Composite materials have a long history of usage. Their beginnings are unknown, but all recorded history contains references to some form of composite material. Fiber glass, developed in the late 1940s, was the first modern composite and is still the most common. Roger M. Rowell, et.al presented a paper on Utilization of natural fibers in plastic composites [1]. Results suggest that agro-based fibers are a viable alternative to inorganic/material based reinforcing fibers in commodity fiber-thermoplastic. These renewable fibers have low densities and high specific properties. Kenaf fibers, for example, have excellent specific properties and have potential to be outstanding reinforcing fillers in plastics. H.Y.Sastra, et.al analyzed the flexural properties of Agenta Pinnata fiber reinforced Epoxy composites [2]. Results from the flexural tests of Arenga pinnata fiber reinforced epoxy composite by Hand lay up method are that the 10% wt of woven roving Arenga pinnata fiber showed the highest value for maximum flexural properties.

From the literature reviewed it was identified the analyzes on banana and the glass fiber combination need to have attention. So the objectives of this work are,

1. To fabricate natural fiber reinforced composites with varying layers.
2. To analyze the properties like Tensile strength, flexural strength and impact strength.
3. Analyses of drilled holes, to assess the elastic re-bounce on stresses.

2.0 EXPERIMENTAL DETAILS

The methodology of the work is given in fig. 2.1. The fabrication process consists of fabricating different layers of composites by using hand-layup method.

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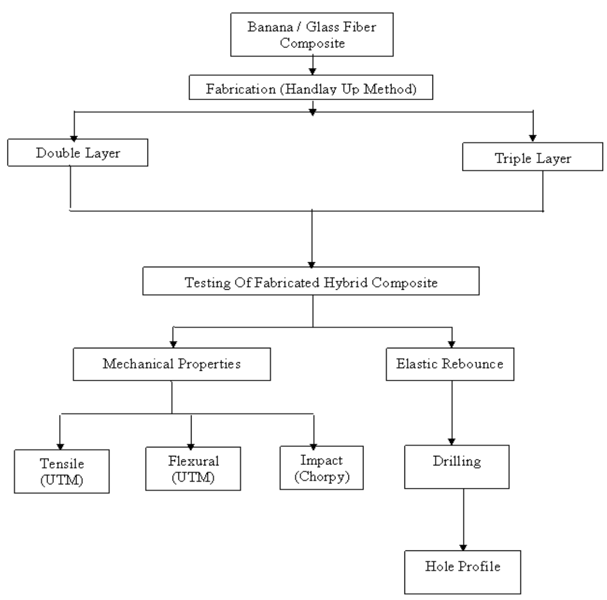

Figure 2.1 The methodology of the work

Using Universal Testing Machine (UTM), the Mechanical properties like Tensile and Flexural strength of the fabricated composites were tested and to be presented in this work. In addition to the stress-strain diagram, the important parameters like maximum deflection, ultimate stress, peak load, etc. are also analyzed separately. Flexural strength of fabricated composites are also tested using UTM with required attachment. In order to find out the toughness of the fabricated composites, Izod impact was conducted. In order to assess the elastic re-bounce on stresses, many holes were drilled in the material and the nature and profile of the holes is analyzed using profile projector.

3.0 FABRICATION OF COMPOSITES

The materials used in our fabrication process are

- General Purpose Resin (G.P.Resin chemically Polyester)
- Accelerator (Methyl Ethyl Ketone)
- Catalyst (Cobalt)
- Poly Vinyl
- Polythene Sheets & Glass Plates
- Banana Fibers & Glass Fibers

3.1 FABRICATION PROCEDURE

The steps followed during fabrication are

- Prepare the banana and glass fiber to the required size say 15cm X 15cm.
- Preparation of binding mixture resin in a proper proportion.

  For 60ml of GP Resin, 20 drops of Accelerator and 12 drops of Catalyst are mixed together.
- Apply Polyvinyl on the plain polythene sheet and allow it to dry.
- Apply the binding mixture over the dried sheet which acts as polymer resin matrix.
- Reinforce the required fibers over the polymer resin matrix.
- Again apply the binding mixture resin over the fiber reinforcement.
- Cover the reinforcement with polythene sheet coated with polyvinyl.
- Place the reinforcement in between two glass plates and allow it to dry for 3 to 5 hours.
- After drying we can obtain the required composite.

The various types of layers in the fabrication process are

- Double Layer
- Triple Layer
- Layer with Hard Particle dispersion.

3.1.1 DOUBLE LAYER

Double Layer consists of both banana as well as glass fiber acts as reinforcement and polymer based resin acts as matrix. In the fabrication of double layer, polythene sheet is placed in which resin mixture is poured. And above which banana fiber is placed and again resin mixture is applied, and over which the glass fiber is placed, then the mixture is poured and finally it is covered by a polythene sheet.

Fig 3.1 One Banana and a Glass Fiber Composite

3.1.2 Triple Layer

Triple Layer consists of two layers of banana and a layer of glass fiber in between the two layers or two layers of glass fiber and a layer of banana fiber act as reinforcement and polymer based resin act as matrix.

a) Two banana fibers and a glass fiber composite

This composite consists of two sisal fiber layer and a glass fiber layer. In the fabrication of two banana fiber and a glass fiber composite, first the resin mixture is applied over the polythene sheet. Then banana fiber is placed and again resin is applied over it. Then a layer of glass fiber is placed over it, and again the resin mixture is applied. Then another banana fiber is placed, then the resin mixture is applied, and it is finally covered by a polyvinyl applied polythene sheet.

b) Two Glass Fiber and a banana Fiber Composite

This composite consists of two glass fiber layer and a banana fiber layer. In the fabrication of two glass fiber and a banana fiber composite, first the resin mixture is applied over the polythene sheet. Then glass fiber is placed and again resin is applied over it. Then banana fiber is placed over it, and again the resin mixture is applied. Then another glass fiber is placed, then the resin mixture is applied, and it is finally covered by a polythene sheet.

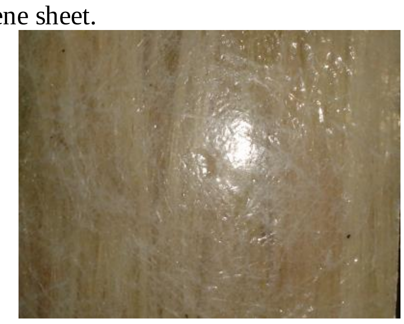

Fig. 3.2 Two Glass Fiber and a Banana Fiber Composite

4.0 RESULTS AND DISCUSSIONS ON MECHANICAL PROPERTIES

4.1. Tensile Test without Moisture

Tensile test is done on a dried specimen with a size of 15cm X 1.5 cm X .4cm.

The following figure illustrates a sample stress strain curves fabricated composites. The figure 4.1 depicts that when the load is applied above 13 KN, the composites begin to deform. As the load increases, the deformation begins to increase. The fluctuations in the figure are due to the breaking of fiber particles and the composite material breaks at the point of breaking load.

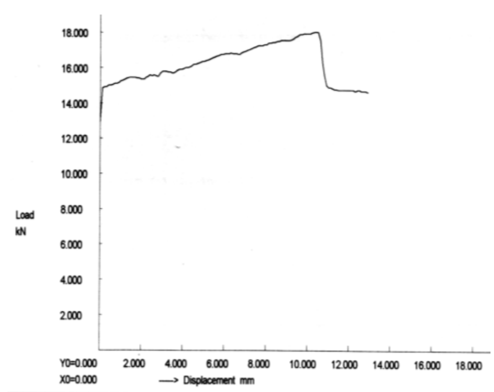

Fig. 4.1 Two Banana & A Glass Fiber Composites

The following figure shows the variations of various parameters with respect to layers.

The figure shows the effect of layer on peak load & displacement. The peak load is maximum for glass fibers as it is brittle in nature. Though the displacement remains almost same for all layers, the two glass fiber and a banana fiber layer exhibits better mechanical property.

1-	One Banana and A Glass Fiber Composite
2-	Two Banana and a Glass Fiber Composite
3-	Two Glass and a Banana Fiber Composite

The resin matrix distributes the load evenly to the glass and banana fiber composites and so it could withstand heavy loads and it could show better mechanical property. The displacement is maximum in glass fibers as it elongates while applying load.

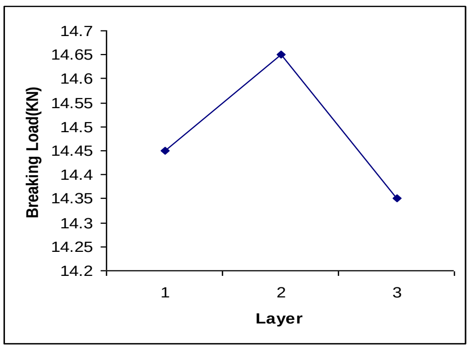

Fig 4.2 Effect of layer on Breaking Load (Without Moisture)

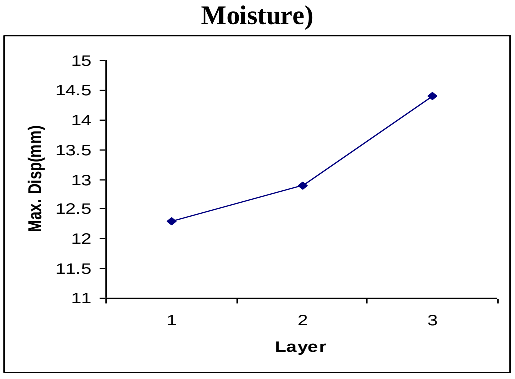

Fig 4.3 Effect of layer on Max Displacement (Without Moisture)

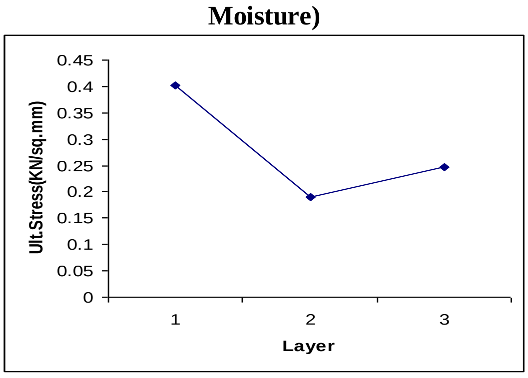

Fig 4.4 Effect of layer on Ultimate Stress (Without Moisture)

4.2 Flexure Test

Flexure test is done on a specimen of size 15cm X 2.5cm X .4 cm thick. It is done in UTE (100) Universal Testing Machine. The following figure 4.5 shows the failure of the specimen when a load is applied.

Fig. 4.5 Flexure Failure of the Specimen

The following figures explain the stress-strain curves of the various layers of composites. The fig. 4.5 shows that the load almost remains constant. The deformation increases at constant load due to the presence of resin matrix and the presence of glass fiber composites.

Flexure test is done on specimen without moisture in a dried condition. The following figure explains the effect of layer on various parameters. The banana fiber and glass fiber composites can withstand high loads since it exhibits brittleness. The fracture mechanism of composite is brittle fracture. Under this condition, the double layer composite shows enhanced mechanical properties.

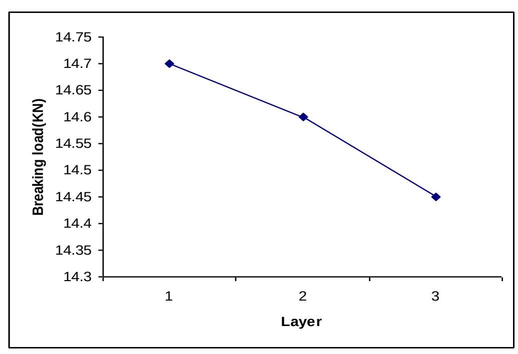

Fig. 4.6 Effect of layer on Breaking Load

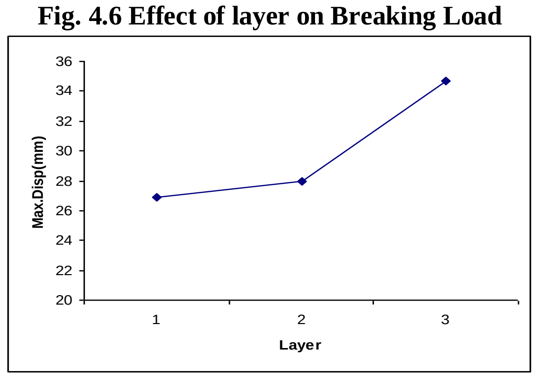

Fig. 4.7 Effect of layer on Maximum Displacement

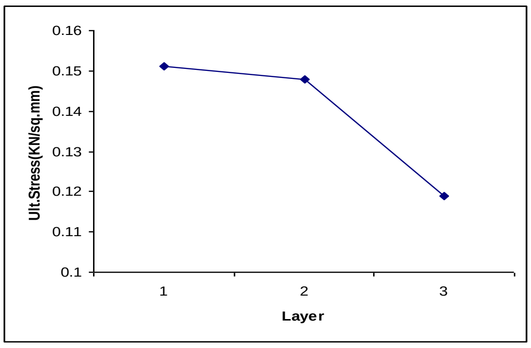

Fig 4.8 Effect of layer on Ultimate Stress

4.3. IMPACT TEST

Impact test is done in Chorpy Impact test bed. The specimen for impact test is 9cm X 1.5cm. The specimen is placed horizontally in the test bed. The pendulum is lifted and is made to hit the specimen from height. Each particle absorbs energy when it is hit under some height. The fig. 4.9 depicts the failure of the specimen under impact load.

Fig.4.9 Impact Failure of the Specimen

The impact test results show that the impact strength is increased with increase in layer. The glass fibers resist more to the impact loading and so the impact strength is high for glass fibers. Therefore glass and banana fiber composites have high impact strength. The impact strength increases with moisture. Also the resin matrix distributes the impact load evenly and it increases the impact strength of the composites.

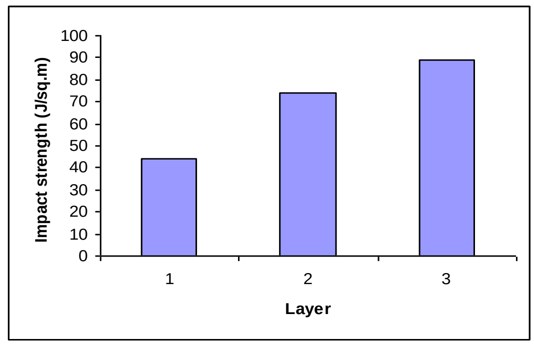

Fig 4.10 Effect of layer on Impact Strength

The impact strength of the two glass and a banana fiber composite is found to be high due to the presence of glass fibers. The glass fiber is brittle in nature and hence it exhibits better impact strength.

5.0 DRILL PROFILE ANALYSIS

The drill hole is made in the fiber composite material by using 2mm HSS drill bit. 30 holes are drilled on composite. The hole profile is analyzed by using profile projector with 20x magnification. The magnified hole is measured for its diameter in different areas. The holes are selected randomly and studied and their average diameter is analyzed for various layers.

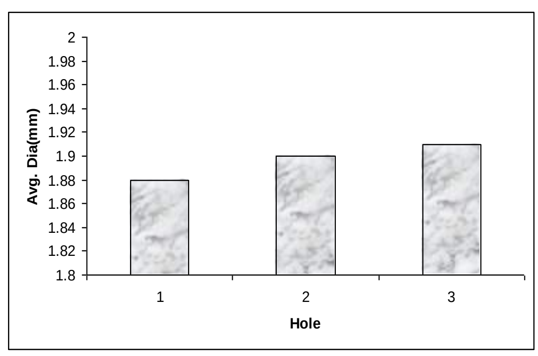

Fig. 5.1 Two Banana & one Glass Fiber Composite

The figures shows that the hole profile of the glass fiber composites vary drastically due to the tensile nature of glass fibers. The fiber particles contract after the removal of force. The glass fiber re-bounce and the drilled hole contract and the hole size gets reduced. The two banana and a glass fiber composites show more elastic re-bounce than other composites. Thus it confirms elastic re-bounce of the banana fiber composites.

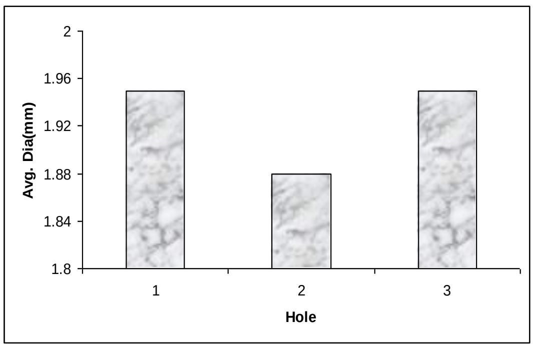

Fig. 5.2 Two Glass and One Banana Fiber Composites

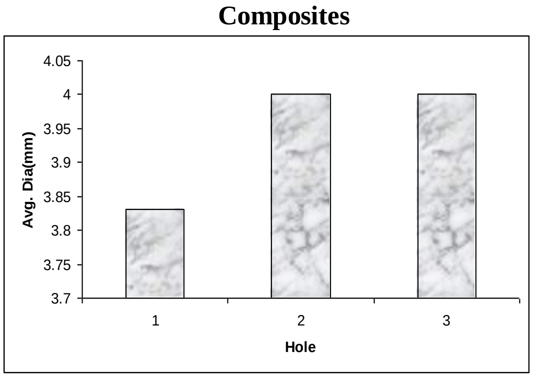

Fig. 5.3 One Banana and One Glass Fiber Composite.

One banana and a glass fiber composite show better dimensional accuracy than other fiber composites. The dimensions of the hole are similar to the actual diameter of the drill bit and the elastic re-bounce is less in one glass and a banana fiber composite.

6.0 CONCLUSION

- The tensile testing of fiber composites proves that the two glass and a banana fiber composites shows better tensile strength.
- The flexure testing of fiber composites proves that the one glass and two banana fiber composite show better flexural strength.
- The Impact testing results of fiber composites show that the two glass and a banana fiber composites produces high impact strength.
- The drill hole profile analysis shows the certainty of elastic re-bounce of fiber composites.

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