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Fabrication and Comparative Analysis of Mechanical Properties of Reinforced Sisal Fibre and Jute, Banana, Glass Fibre Composite

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ABSTRACT

The present work attends to make an improvement in the current existing sheet manufacturing methodology and materials used to have better mechanical properties as well as to enhance the compatibility between fiber and the matrix the bio composites are prepared with the unsaturated polyester matrix and fiber and comparative study has been made from eco friendly sisal fibre composite and jute, banana and glass fiber using hand layup method with appropriate proportion to result in sheet structure. The fabricated composites are planned to evaluate its mechanical properties such as tensile, impact, hardness and flexural strength and the results are compared in Ansys Software.

Keywords: Bio composite, Mechanical strengths, Eco friendly, Banana, Jute, Glass fibre, Sisal fibre.

1. INTRODUCTION

This work investigates the hybridization of glass fibers with natural fibers for the applications of structural, aerospace and automobile industry. Composites made of natural fibers are of low cost, light weight and user friendly but lower in strength when compared to synthetic fibers. Hence, the natural fiber and synthetic fiber composition need to be optimized for utilization as High Strength (HS) hybrid composite materials for many applications. In this research work two hybrid composites have been developed using Glass, Jute, Sisal and Banana fibers in the form of laminates, namely Jute-Sisal-Glass (JSG) and Jute- Banana-Glass (JBG) combinations. The fabricated test samples have been subjected to tensile, flexural and impact tests to evaluate their mechanical properties. The microstructures of the tested specimens have been performed through Scanning Electron Microscope (SEM) for fracture mode analysis. The comparison of the results shows that the high strength hybrid composite made of Jute-Banana-Glass (JBG) provides better mechanical properties and it could be used for a wide range of applications. Experimental Investigation on the Mechanical Properties of Jute/Sisal/Glass and Jute/Banana/Glass Hybrid Composite Materials

2. MATERIALS USED & PREPERATION OF SPECIMENS

Materials used

A . Epoxy resin (LY-556)

B. Hardener(HY-951)

C. Natural Fibers (banana,jute,glass fibre)

2.1 Features of Epoxy

a. Light weight

b. Resists most alkalis and acids

c. Resists stress cracking

d. Retains stiffness and flexibility

e. Low moisture absorption f Non-staining

g. Easily fabricated

2.2 Advantages of Natural Fibers

Comparing to conventional reinforcing fibers like glass, carbon and Kevlar, natural fibers have the following advantages:

1 Environmentally friendly

2 Fully biodegradable

3 Non toxic

4 Easy to handle

5 Non abrasive during processing and use

6 Low density/light weight

7 Source of income for rural/agricultural community

8 Renewable, abundant and continuous supply of raw materials

9 Low cost

2.3. Preparation of Specimen:

1. The mould is first selected in order to give shape and dimension to the product. The mould chosen for this project was G I Sheet of dimensions 150 X 150 mm is considered
2. The fiber cloths are cut into pieces which helps in fabrication process.

3. The mold is thoroughly coated with releasing agent. This releasing agent helps the component to get detached from the mould easily. Wax is used as a releasing agent for the manufacturing.

Fig 2.1. Applying Wax on the Mould

4. The mould which is coated with the wax is kept idle for almost 20 minutes.
5. Epoxy and hardener are mixed in the ratio of 2:1 and stirred it thoroughly.
6. First layer of epoxy resin is applied on the mould with the help of brush

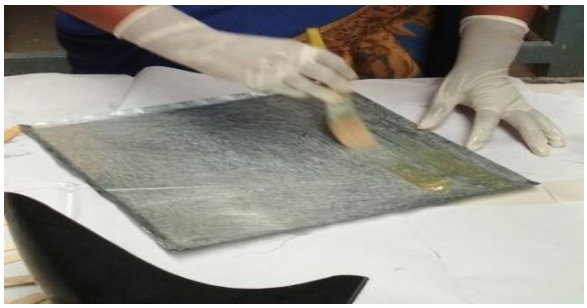

Fig 2.2. Applying the Resin On To the Mould

7. Then the fiber pieces are slowly placed on the mould

Fig 2.3 Adding Layers of Sisal fiber

8. It is then kept for drying. A drier is used to make the process faster.
9. Another layer of Epoxy hardener mixture onto the first layer.
10. This process is continued till four layers of fibers are added on the mould.
11. One more layer of Epoxy hardener is added on the fourth layer to give a smooth finish to the Samples.

12.The samples are allowed of 12 hours to become harder.

13.When the layers becomes hard in the shape of the composite detach from the mould by gently heating the mould.

14. Similarly three samples were prepared with combination of sisal, banana, jute and glass fibers.

Fig 2.4. Samples removed from the Mould

3. RESULTS AND DISCUSSIONS

3.1 Impact test Results:

Fig 3.1 Impact test specimen

Table 3.1: impact test results

Number of layers	Impact strength
Sample 1	0.35 J/mm^2
Sample 2	0.21 J/mm^2
Sample 3	0.21 J/mm^2

3.2 Hardness test Results

Fig 3.2 Hardness test Sample

Table 3.2: hardness test results

Number of layers	Hardness number
Sample 1	18.6
Sample 2	14.25
Sample 3	17.7

3.3 Flexural Test Results

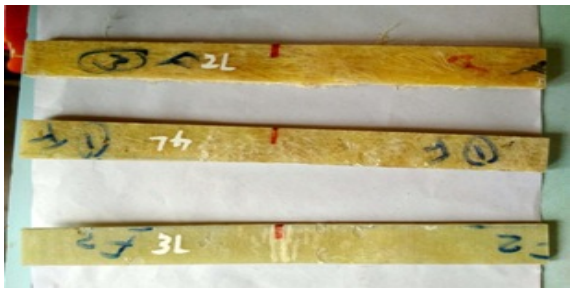

Fig 3.3 Flexural test specimen

Table 3.3: flexural stress result

Number of layers	Load (N)	Flexuial strength (N/mm^2)
Sample 1	180	37.64
Sample 2	120	35.87
Sample 3	60	11.7

3.4 Tensile Test Results

Fig 3.4 Tensile Test Specimens

Table 3.4.tensile test result

Number of layers	Width(mm* thick)	Ultimate tensile load (N)	Ultimate tensile strength (mpa)
Sample 1	13.42*5.87	1380	20.96
Sample 2	13.36*3.85	1080	17.51
Sample 3	13.66*6.01	1080	13.15

3.4 Analysis model comparison

The experimental results are compared with ansys results, here ansys model is created for the composite material which has greater strength so only the composite material made of glass, banana, jute and sisal fiber i.e sample 1of 4 layers is compared with ansys.

3.4.1 Analysis Models

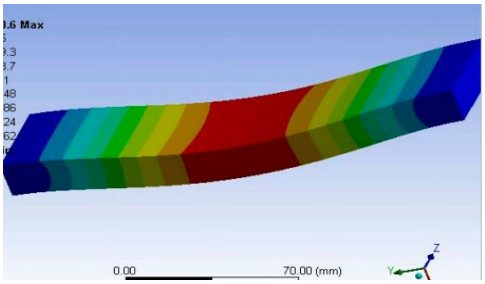

Fig 3.5 tensile stress.

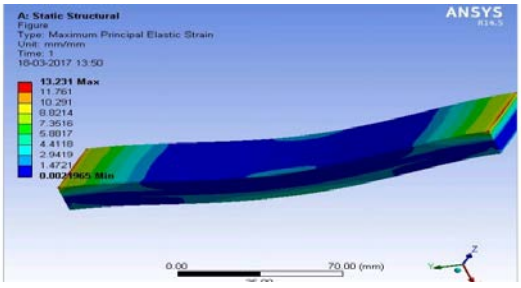

Fig 3. 6 :max principle elastic strain

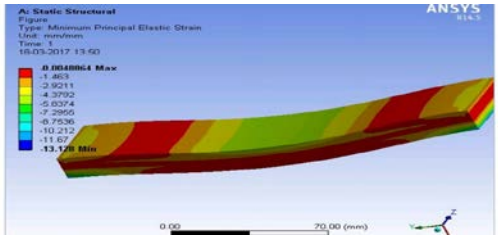

Fig 3.7 :min principle elastic strain

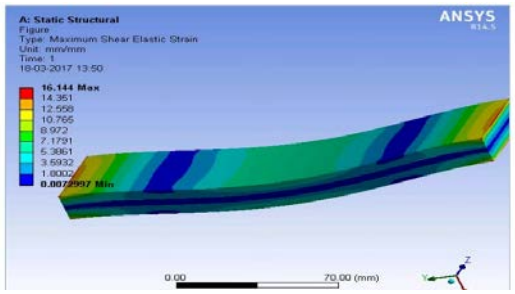

Fig 3.8 : max shear elastic strain

3.5 Ansys Results:

Tensile strength and flexural strength for sample 1, which is of 4 layers are shown in below table

Table 3.5 Ansys Results

Type	Tensile test	Flexural strength	Maximum Principal Stress
Maximum	3.6e-0.04mpa	35mpa	29mpa

From the above comparison values Hybrid composite has the greater advantage and the results of samples and ansys are relatively equal.

From the above all test results, the sample 1 is having higher values of flexural strength and tensile strength along with higher hardness values and impact values. Based on the test results in the combination of sample 1 materials a component is manufactured which could be usable in automobiles.

4. PREPARATION OF BIKE MUDGUARD

For preparing bike mudguard, plastic mudguard is taken as base and followed same procedure same as the specimen preparation. Initially a realizing agent was applied and then layers of epoxy and fibers were added and the final product is dried for 12 hours and the product is removed from the mould.

Fig 4.1 Applying Wax on the mould

Fig 4.2. Applying layers of fiber on mould

Fig 4.3 Final mudguard prepared with hybrid composite

The hybrid composite mudguard that has been produced is compared with the original plastic mudguard that has been used in bikes, the comparative values are shown in the table below.

Table 4.1: composite material and abs plastic results comparison

Test name	Hybrid composite Material	plastic material
Tensile strength	20.96 mpa	18.99mpa
Flexural strength	35.87mpa	29.68mpa
Impact strength	0.35 j/mm^2	0.35 j/mm^2
Hardness value	18.56 hb	18 hb
Weight	360 gms	450 gms

5. CONCLUSION

The Hybrid composite materials with different compositions had been manufactured and tested, based up on the results, sample 1 comprises of Glass, Sisal, Banana and jute fibers had greater strength when compared with other samples, after analyzing the results of sample 1, bike mudguard had been produced with hybrid composite and again compared with plastic mudguard that is currently used in bikes, the results had shown Hybrid composite has greater impact, hardness, Tensile and Flexural strength. With this results the Hybrid composite materials can be used in automobiles with greater reduction in weight thus generates less pollution and also Biodegradable.

6. REFERENCES

1. **Bledzki AK, Gassan J**. Composites reinforced with cellulose based fibres. Prog Polym Sci 1999;24:221–74.
2. **Jochen Gassan.** A study of fibre and interface parameters acting the fatigue behavior of natural fibre composites. Composites Part A: 2002;33(3):369–74.
3. Anon. The competitiveness of natural fibers based composites in the automotive sector the Sisal Agribusiness in Brazil.**Mater Res Soc Sym Proc** 2002;702:113–39.
4. **Van de Velde K, Kiekens P.** Thermoplastic pultrusion of natural fibre reinforced composites. Comp Struct 2001;54(2–3):355–60.

5. **Iannace S, Ali R, Nicolais L.**Effect of processing conditions on dimensions of sisal fibers in thermoplastic biodegradable composites. J Appl Polym Sci 2001;79(6):1084–91.
6. **Wang wei, Huang Gu,** Characterization and utilization of natural coconut fibers composites, journal of Materials and Design(2008).