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FABRICATION AND TESTING OF POLYMER COMPOSITE MATRIX MATERIAL

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ABSTRACT
The natural composite have been emerged as potential reinforcement material for composites and that is why many researchers are been attracted towards natural fibers. Natural fiber offers many benefits such as low density, renewable in nature, biodegradable, low cost and harmless to environment when compared with the hybrid fibers, which are also emerging as a promising material due to their various applications like fire insulation, resistance to moisture, superior strength, electrical insulation. In this project Kenaf, Glass and Jute fibers are compounded with epoxy resin(LY 556) and hardner (HY 951). The fibers are soaked in sodium hydroxide with 5 wt% concentration for 24 hours at room temperature and fabricated by using hand lay-up process. According to the ASTM standards, the fabricated laminates are cut into different sections and various mechanical properties such as tensile test, compression test, and water absorption are discussed and analyzed

INDEX TERMS: Reinforcement material, Epoxy resin(LY 556), Hardner (HY 951)

INTRODUCTION

Natural fibers and artificial fibers are chosen for reinforcement. Natural fibers possess various characteristics such as low density, renewable in nature, biodegradable. Artificial fiber composites have superior strength, fire insulation, resistance to moisture, electrical insulation. In the present study the mechanical properties of jute, glass and kenaf reinforced composite materials is studied. The Jute, glass and kenaf composite materials are manufactured by hand lay up process and compressed by using CMM(compression molding machine). The properties such as compression, tensile and water absorption are been discussed and presented in detail. Hand lay-up is the simple molding method for composite fabrication. Kenaf and jute fibers are arranged in the form of woven mat, where as glass fiber is already available in the form of mat. These fibers are placed in a open mold and resin is poured, brushed over it. Air gaps are removed with the help of rollers. The laminates are allowed to dry for minimum 24 hours.

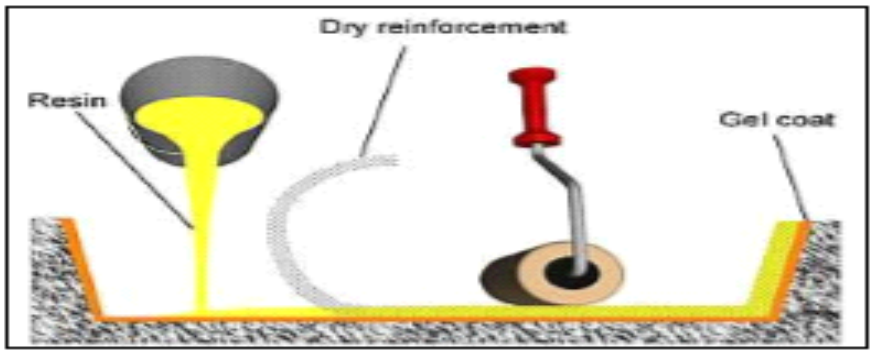

Figure 1 Hand Layup technique

MATERIALS USED

This chapter deals with the materials that are used and various methodologies that are adopted, during fabrication process.

The raw materials that are used in this study are:

Figure 2 Materials used with details

S. no	Materials	Details
1	Glass fiber	E -Glass
2	Jute fiber	Raw
3	Kenaf fiber	Raw
4	Epoxy resin	LY-556
5	Hardner	HY-951

GLASS FIBERS:

The one of the commonly used reinforcement for the polymer matrix composites is glass fiber. These fibers are generally of silica (sio2)

Figure 3: E-Glass

EPOXY RESIN

Epoxy resin (LY556) have excellent adhesiveness, Good dimensional stability, Free from internal stresses, Excellent electrical and mechanical properties, Nontoxic, Tasteless, Shrinkage is negligible.

Figure 4: Epoxy resin LY556

JUTE FIBER

Jute is a soft long shiny plant fiber that can be made into strong threads. Jute is produced from plants, it belong to the genus corchorus. Jute fibers are composed lignin and cellulose. They are bio-degradable and also recyclable.

Figure 5: Jute fiber

KENAF FIBER

Kenaf is a bast fiber, which have similar characteristics to that of jute fiber. Kenaf belongs to genus Hibiscus of Malvaceas family. This fiber is used in the production of low density panels, paper and pulp.

Figure 6: Kenaf fiber

HARDENER

Hardner is a substance that is been added to the resin for plastic composition, in promoting the curing action. It is a a substance used in controlling the degree of hardness and act as catalyst, curing agents.

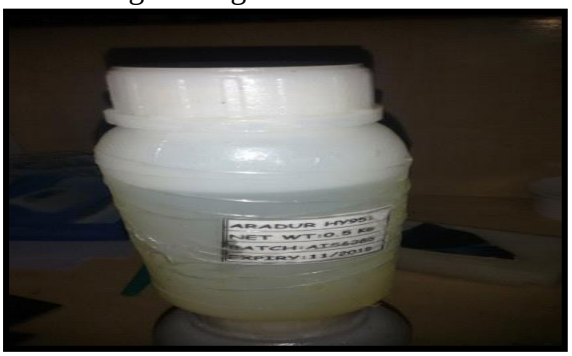

Figure 7: Hardener HY951

FIBER SURFACE TREATMENT

The natural fibers are treated with alkaline solution i.e, Fibers are immersed in the NaOH solution for 24 h at 50°C and then washed with distilled water till the pH becomes neutral. Then they are dried for 24 hours. They are cut in 30 mm length and made in the form of layers.

PREPARATION OF COMPOSITE

A rectangular board made of wood with dimensions 300 x300 mm is taken and thickness 4 mm is fixed on these wooden boards with the help of nails. After when moulds of required dimensions is prepared, wax polish is applied to the mould inner side for easy removal of the composite without getting stick. Then epoxy(LY 556) is mixed with hardner(HY 951). So matrix is prepared. Epoxy and hardener are maintained

at the ratio 10:1. The required quantity of fibers are placed in the mould, the resin mixture is spread over the fibers until the fiber layer gets filled by the resin hardner mixture after then the next layer is added the same process is repeated.

MECHANICAL ARRANGEMENT

Test specimens were cut from the composite plates as per the ASTM standard

ARRANGEMENT OF LAYERS

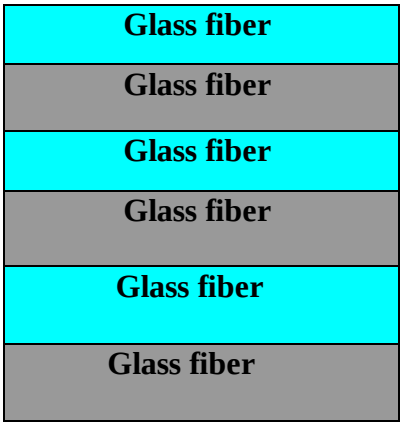

Figure 8: Glass fiber

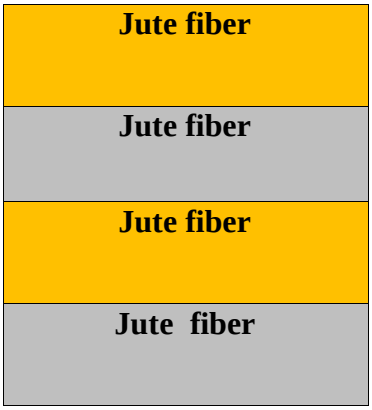

Figure 9: Jute fiber

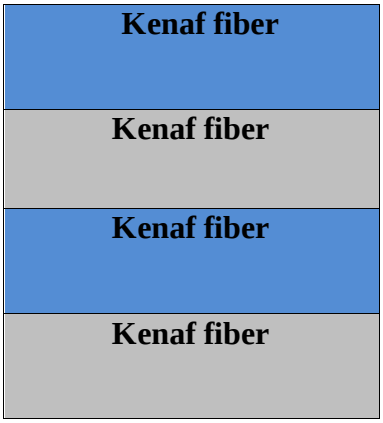

Figure 10: Kenaf fiber

TESTING OF FIBERS

TENSILE PROPERTIES : The specimen is held between the two grips attached to the universal testing machine. During the test, the grips move at a constant rate to stretch and pull the specimen. The force is applied on the specimen and displacement is monitored. The curve is plotted on a stress-strain to the point failure

1. TENSILE TEST – GLASS FIBER

Work piece is cut according to ASTM standards. Using universal testing machine load is applied on the specimen to the point of failure and readings are taken.

Specimen length	150 mm
Specimen breadth	30 mm
Specimen thickness	5 mm
Specimen shape	Flat
Specimen dimensions	50 mm^2
Load at peak	4.410 KN
Tensile strength	86.292 N/mm

Figure 11: Glass specimen

2. TENSILE TEST – KENAF FIBER

Work piece is cut according to ASTM standards. Using universal testing machine load is applied on the specimen to the point of failure and readings are taken.

Specimen length	150 mm
Specimen breadth	30 mm
Specimen thickness	5 mm
Specimen shape	Flat
Specimen dimensions	50 mm^2
Load at peak	3.410 KN
Tensile strength	66.801 N/mm^2

Figure12: Kenaf Specimen

3. TENSILE TEST – JUTE FIBER

Work piece is cut according to ASTM standards. Using universal testing machine load is applied on the specimen to the point of failure and readings are taken.

Specimen length 150 mm
Specimen breadth 30 mm
Specimen thickness 5 mm
Specimen shape Flat
Specimen dimensions 50 mm^2
Load at peak 3.208 KN
Tensile strength 62.386 N/mm^2

Figure 13: Jute Specimen

COMPERSION PROPERTIES

Compressive test is used to determine the ultimate compressive strength of a material. The specimen is cut flat and made perfect plane. The specimen is locked between the two heads upper and lower cross head and gradually load is applied. The work piece undergoes compression. At a particular point of load the control unit rotates anti clock wise, which is taken as ultimate crushing load.

1. COMPRESSION TEST – GLASS FIBER

Work piece is cut according to ASTM standards. Using universal testing machine load is applied on the specimen to the point of failure and readings are taken..

Specimen length 100 mm
Specimen breadth 10 mm
Specimen thickness 5 mm
Specimen shape Flat
Specimen dimensions 100 mm^2
Load at peak 2.270 KN
CHK at Peak 0.950 mm
Compression strength 23.951 N/mm^2

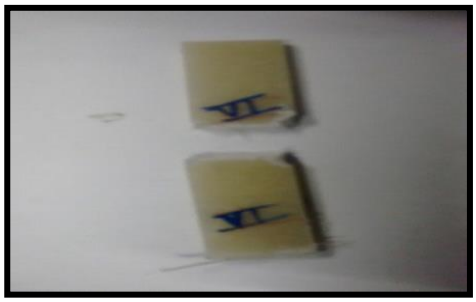

Figure 14: Glass Specimen

2. COMPRESSION TEST –KENAF FIBER

Work piece is cut according to ASTM standards. Using universal testing machine load is applied on the specimen to the point of failure and readings are taken.

Specimen length 100 mm
Specimen breadth 10 mm
Specimen thickness 5 mm
Specimen shape Flat
Specimen dimensions 100 mm^2
Load at peak 2.30 KN
CHK at Peak 10.80 mm
Compression strength 24.972 N/mm^2

Figure15: Kenaf Specimen

3. COMPRESSION TEST –JUTE FIBER

Work piece is cut according to ASTM standards. Using universal testing machine load is applied on the specimen to the point of failure and readings are taken.

Specimen length 100 mm
Specimen breadth 10 mm
Specimen thickness 5 mm
Specimen shape Flat
Specimen dimensions 100 mm^2
Load at peak 2.00 KN
CHK at Peak 12.060 mm
20.294 N/mm^2

Figure 16: Jute Specimen Compression strength

3. WATER ABSORBTION TEST*:*

Firstly, the weight of specimen is taken, then it is placed in the water and reading are taken at regular time intervals. The specimen which absorbs less water regarded as the finest.

Material	0 hr	1hrs	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs	7 hrs	8 hrs
Glass fiber/gms	**3.5**	**3.56**	**3.63**	**3.70**	**3.78**	**3.89**	**3.97**	**3.98**	**4.00**
Kenaf fiber/gms	**3.00**	**3.19**	**3.36**	**3.49**	**3.64**	**3.81**	**3.97**	**4.01**	**4.02**
Jute fiber/gms	**3.00**	**3.16**	**3.38**	**3.47**	**3.62**	**3.83**	**3.99**	**4.02**	**4.03**

CONCLUSION

- The Mechanical behavior of glass fiber, jute fiber and kenaf fiber reinforced epoxy resin composites was studied.
- From the results it was observed that Glass fiber shown better mechanical properties when compared compare to other fibers. Due to high strength, stiffness and Inter laminar shear strength.
- Glass fiber has best tensile properties compared to natural fibers, i.e 86.264 N/mm^2
- Kenaf and glass fiber have good compression strength compare to other fibers, i,e 23.951N/mm^2 , 24.972N/mm^2.
- Glass fiber absorbs less water and becomes stable quickly.

Natural fibers also have exceptional mechanical properties next to glass fiber.

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