STUDY ON MECHANICAL BEHAVIOUR OF BHIMAL FIBER REINFORCED EPOXY COMPOSITE

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ABSTRACT:

In the present work, the fiber reinforced epoxy composite is fabricated and tested for evaluation of various mechanical properties such as tensile, flexural and impact strength. In this project, composite is made by reinforcing bhimal fiber with epoxy resin. Bhimal fibers are quite a newer novel kind of bio-degradable fibers. For using them as reinforcing fibers in bio-degradable composite fabrication, their strength and absorption properties under different condition are essential to evaluate. For this purpose the absorption properties of Bhimal fibers have been determined in this paper using UTM. The results are shown in tables and graphs. From the results obtained, it is concluded that the Bhimal fibers have a high mechanical strength, and hence, can be used in applications where high strength are desired.

INTRODUCTION:

Overview of fiber and composites

The attraction in utilizing natural fiber, for example, distinctive wood fiber and plant fiber as support in plastics has expanded drastically throughout last few years. Concerning the ecological viewpoints if natural fibers might be utilized rather than glass fibers as fortification in some structural provisions it might be extremely intriguing. Natural fibers have numerous points of interest contrasted with glass fiber, for instance they have low thickness, and they are biodegradable and recyclable. Also they are renewable crude materials and have generally great strength and stiffness.

Natural fibers are classified on the basis of the origin of source, into three types.

a) Plant Fiber
b) Mineral Fiber
c) Animal Fiber

Composite Materials

The composite materials could be termed as those materials which are synthesized by two or more materials having diverse properties. The primary constituent of composites have a nonstop stage which is the significant a piece of the composite is called matrix. Matrix are by and large more ductile and less hard and these are generally either inorganic or natural. Optional constituent of composites have ductile called reinforcement and they are implanted in the matrix. The constituents of composite materials have their property however when they are consolidated together, they give a blend of properties that a singular can't have the capacity to give. Most of the composite materials developed are fabricated to improve mechanical properties such as strength, stiffness, toughness, and high temperature performance. The strengthening mechanism strongly depends on the geometry of the reinforcement. Therefore, it is quite convenient to classify composite materials on the basis of the geometry of a representative unit of reinforcement. Composites are broadly classified as two types:

a) Fiber reinforced composite

b) Particulate reinforced composite

a) Fibrous Composites: Fibrous Composites can be broadly classified as single layer and multilayer. Single Layer Composites may actually be made from several distinct layers with each layer having the same orientation and properties and thus the entire laminate may be considered as a single layer composite. Multi-Layer Composite consists of several layers of fibrous composites. Each layer or lamina is a single layer composite and its orientation is varied according to design. Laminates are called when the constituent materials in each layer are the same.

b) Particulate Composite: In the particulate composite reinforcement used is a particle in nature. The particle may be spherical, cubical, tetragonal, or platelet in shape. Particles are not very effective in improving mechanical strength but they enhance the stiffness of the composite to a limited extent. Particle fillers are widely used to improve the properties of matrix materials such as to modify the thermal and electrical conductivities, improve performance at elevated temperatures, reduce friction, increase wear and abrasion resistance, improve machinability, increase surface properties such as hardness and reduce shrinkage. Also, in case of particulate reinforced composites the particle can be either randomly oriented or can be in preferred orientation.

Bhimal fibre (Fig. 1) is also known as Grewia Optiva (Biological name), dhaman, biung, biul, Bihul, bhimal, bhengal, bewal (local names: Hindi), shyalphusro, phusre, ghotli, Bhimal (in Nepali) and dhaman, biul (Trade name). Grewia optiva is a small to medium-sized deciduous tree, 9-12 m in height; crown spreading and about 1m in diameter. Its branches are smooth, pale silvery-brown in colour; bark is dark brown, thick and roughish.

Fig. 1 Bhimal Fibers

Objectives of the current research work

The main objectives of current research work are outlined as follows:

1) Fabrication of Bhimal fiber based epoxy composites.
2) Evaluate the mechanical properties such as impact strength, tensile strength, flexural strength and hardness of fabricated composites.
3) To compare this composite with neat epoxy and other materials in daily practice.

Material used

The materials used are Bhimal fiber, Epoxy resin, Hardener, Acetone, Wax.

TESTING:

Tensile Testing

A tensile test, also known as tension test, is probably the most fundamental type of mechanical test you can perform on material. Tensile tests are simple, relatively inexpensive, and fully standardized. By pulling on something, you will very quickly determine how the material will react to forces being applied in tension. As the material is being pulled, you will find its strength along with how much it will elongate.

Standard: ASTM-D638-03

Specimen Dimension: 250*25*3 mm

Flexural Testing

The flexure test method measures behavior of materials subjected to simple beam loading. It is also called a transverse beam test with some materials. Maximum fiber stress and maximum strain are calculated for increments of load. Results are plotted in a stress-strain diagram. Flexural strength is defined as the maximum stress in the outermost fiber. This is calculated at the surface of the specimen on the convex or tension side. Flexural modulus is calculated from the slope of the stress vs. deflection curve. If the curve has no linear region, a secant line is fitted to the curve to determine slope.

Standard: ASTM-D790

Specimen Dimension: 154*13*3 mm

RESULTS and DISCUSSION

Density of bhimal fiber =4.585 X 10^{-2}

Tensile Strength

Tensile strength is a measurement of the force required to pull something such as rope, wire, or structural beam to the point where it breaks. The tensile strength of a material is the maximum amount of tensile stress that it can take before failure, for example breaking.

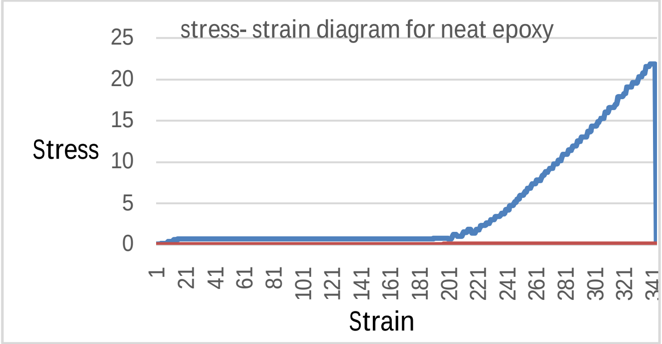

Fig. 2 Stress-strain diagram for neat epoxy

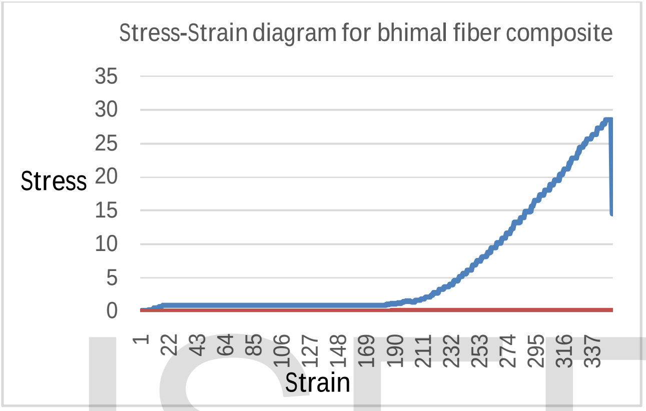

Fig. 7.2 Stress-strain diagram for Grewia Optiva fiber composite

Table 1 Tensile strength comparison of different epoxy based composite

S.No.	Composite	Tensile strength (MPa)	Modulus of Elasticity (GPa)
1	Neat Epoxy	23	6.8
2	Grewia optiva fiber composite	28	7.6

Flexural Strength

Flexural strength also known as modulus of rupture, bend strength, or fracture strength is a material property, defined as the stress in a material just before it yields in a flexural test. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress.

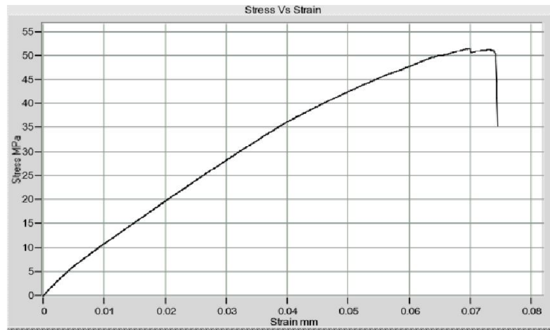

Fig. 7.3 Flexural stress-strain diagram for neat epoxy

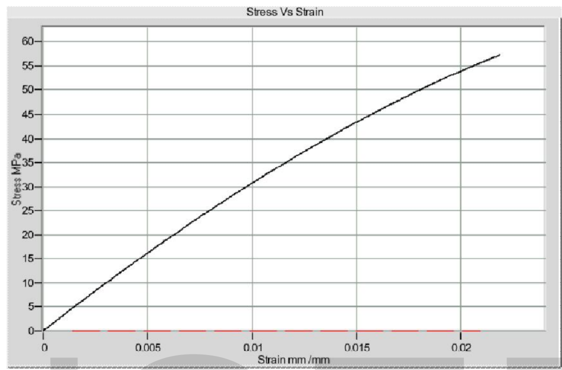

Fig. 7.4 Flexure stress-strain diagram for Grewia Optiva fiber composite

Table 2 Flexural strength comparison of different epoxy based composite

S.No.	Composite	Flexural strength (MPa)	Flexural Modulus (GPa)
1	Neat Epoxy	51	0.93
2	Grewia Optiva fiber composite	54	2.30

CONCLUSION:

From the above studies, the following conclusions have been drawn.

(1) The percentage weight gain varies from 175.69% to 195.93% for different bundles of fibers.

(2) Grewia Optiva composite bears high tensile and flexure strength as compared to neat epoxy

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