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Flexural & Tensile strength of E-Glass Fiber/Bamboo hybrid composite

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Abstract—When two or more material are arranged in the form of layer by using any binding element that combination is the composite material.in the bamboo glass fiber hybrid composite binding material is the epoxy resin and woven form of E-glass fibre is used. A layer of thin bamboo fibre matrix is taken into consideration in this experimental study. By using hand layup method prepare a bamboo/glass fibre composite sheet. In this sheet layer of glass fibre in woven form & layer of thin bamboo fibre is used. As per ASTM standard, specimen are prepared & followed by flexural test, tensile test & hardness test. It is observed that bamboo/glass fibre laminates have influenced mechanical properties.

***Index Terms*— Glass fibre, Tensile strength, bamboo fibre, Flexural strength, Hardness**

I. Introduction

Composite materials consist of many materials being used in refined applications [1]. A composite material made from two or more constituent materials like reinforcement (fibres, particles, flakes, and/ or fillers) and matrix (polymers, metals, or ceramics). One or more discontinuous phases are, therefore, embedded in a continuous phase to form a composite. The discontinuous phase is usually harder and stronger than the continuous phase and is called the reinforcement, whereas, the continuous phase is termed as the matrix[1]. The natural fibers are highly complex structures. Their three dimensional structure is found to consist of Cellulose, Hemicelluloses, Pectin and Lignin. They contain hydroxyl ions, and are distributed throughout the fiber wall. Interestingly, natural fibers may be considered as being tiny fiber reinforced composites on their own[2]. The main reason natural fibers are used is when they are added to plastic or polymer matrices, they significantly improve mechanical performance. An improvement in strength and stiffness is obtained without significant increase in density or the cost of the material. In the present work of study, an Epoxy based Bamboo-Glass Fiber Hybrid composite has been considered for study. Bamboo is a widely available Natural Fiber, which can grow abundantly in numerous climatic conditions.

The mechanical properties of bamboo such as stiffness, impact strength and flexibility are high and are comparable to the synthetic fibers such as glass fibre. The hardness of the column of bamboo depends on the number of fiber bundles and the manner of their scattering. Gupta et al. [3] studied the effect of different parameters on mechanical and erosion wear behaviour of bamboo fibre reinforced epoxy composites. It was found that the impact strength increases linearly with increase in fibre loading and then decreases the insignificant amount of energy. Tensile strength is maximum at 40 wt. % fibre loading amongst other composites. Biswas et al. [4] studied with the effect of length on mechanical behaviour of coir fibre reinforced epoxy composites. It was reported that the hardness is decreasing with the increase in fibre length up to 20 mm. The mechanical properties of a composite laminate based on natural flax fiber reinforced recycled high density polyethylene under conditions of tensile and impact loading were investigated by Singleton *et al* (2003) [5]. Thwe *et al* [6] compared the fatigue behavior under cyclic tensile load and the hygrothermal ageing of Bamboo fiber reinforced polypropylene (BFRP) and bamboo-Glass fiber reinforced polypropylene (BGRP). The results showed that with respect to stiffness and retention of tensile strength, the BGRP samples have better resistance to environmental ageing as compared to BFRP composites.

II. Materials

The composite material are made of two layers namely E-glass fibre & bamboo fibre which is binded by epoxy resin.the properties of material are as follows:

A. Bamboo fibre

The bamboo is also called natural glass fiber because of its strength. The remarkable properties of bamboo fibers such as low density and specific strength and stiffness can be compared with glass fibers.[7] The hybrid composites treated with alkali bamboo fibers were possess higher flexural properties

B. E-glass fibre

In E-glass fibre the term "E" stands for electric, which is made from alumino- borosilicate glass containing oxides of alkali less than 1% by weight. short E-glass fibre is used as reinforcing agent because of its good strength, light weight, chemical resistance and more importantly its low cost. Aluminium oxide (Al_2O_3) also called as alumina is used as a filler material. The addition of filler to the composites enhances the mechanical as well as physical properties [8]. Glass fibre in the form of woven roving consist of continuous roving, which is a fabric are woven in two mutually perpendicular directions.

III. Specimen preparations

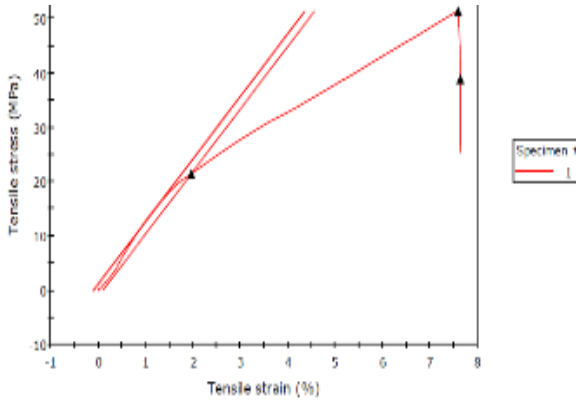
For small quantity production the specimen is prepare by hand lay out method .This method have four main steps first one is mould preparation second gel coating , layup & finishing. Mould can be made by wood ,acrylic sheet, metal or composite depending upon the no of parts cure temperature , pressure etc.in this experiment wooden frame is used as mould. Gel coating on the surface of mould is necessary part as to remove the composite from mould. By the help of roller we made a smooth surface of sheet. The ratio of weight of all elements in this sheet is 65% epoxy resin 23% woven E-Glass fiber & 12% bamboo fiber.property of composite increases as increasing thefiber loading[9][10]. The composite is completely cured in ambient condition and with the help of external load for minimum 24 hours duration. The test samples were taken as per required ASTM standards.Specimen for the testing is below

IV. Result & discussion

There are numbers of mechanical test to determine the suitability of composite material but following important mechanical tests have been performed in the present investigation such as tensile test, flexural test, hardness test.

A. Tensile Study

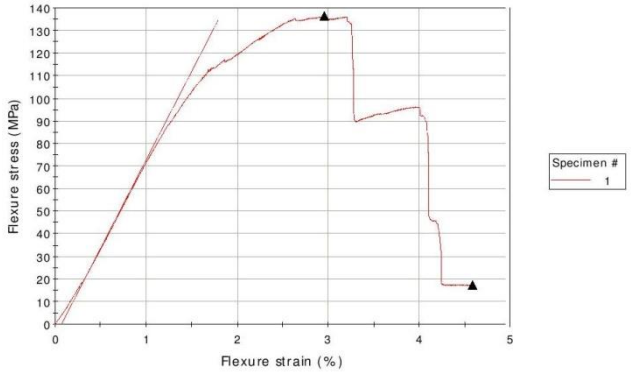
This is the test to study the tensile property of material test sample is prepared as per ASTM-D638 standards with the help of counter cutter. The prepared specimen is loaded in the digital universal testing machine & tensile load is observed during the test. During the test, the crosshead speed is taken as 2 mm/min as per ASTM standards. Following graph shows the tensile property of the specimen



Speed (mm/min)	Maximum load (N)	Tensile strength (MPa)	Elongation %@max load	Modulus (MPa)
2	4011.09	51.42	7.58	1321.34

B. Flexural study

Flexural test is also known as bending test.It is conducted in universal testing machine as per given standard of ASTM-D790. Before testing width and thickness of specimens measured at different point and mean value is taken. Samples were placed horizontally upon two points and midpoint is perpendicular to loading nose. The crosshead speed for test is maintained at 2 mm/min. Below graph shows the flexural property of the material where X axis shows flexure strain(%) & Y axis shows flexure stress(MPa)



Speed (mm/min)	Maximum flexural load (N)	Flexural strength (MPa)	Elongation %@max load	Modulus (MPa)
1.70	340.91	136.36	2.95	7705.53

C. Hardness study

Hardness is done by Shore-D hardness method. It is suitable for plastic , leather & composite materials.by testing we found the hardness no. for the given composite material is 82.

V. Conclusion

It is found that the tensile and flexural properties of bamboo/glass fibre hybrid composite is suitable for highly flexibility & it can be concluded by finding such a value of tensile & flexural strength that the mechanical properties significantaly influenced while using bamboo & glass fibre in such layer manner.

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