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Effect of Orientation of Bamboo Fiber in Epoxy Composites

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Abstract— **A composite is usually made up of at least two materials out of which one is binding material called as matrix and other is a reinforcement material known as fiber or whisker. The important characteristics of composites are their strength, hardness rigid light in weight. Composites can be produced by using natural fibers such as banana fiber, bamboo fiber, jute, coir and silk. Bamboo posses better properties than other natural fibers. In the present work composites are produced from epoxy resin with bamboo fibers. The bamboo fibers of 3mm in diameter (approximately) of fixed percentage (08% by weight fraction) are placed in different orientation i.e.30^0, 45^0, 60^0, and 90^0 . The mechanical properties such as tensile strength, flexural strength, and impact strength tests are conducted.**

Key words- **Matrix, bamboo fiber, epoxy resin, composite, flexural, tensile, orientation, impact strength, tensile strength,**

I. Introduction

Composite materials are produced by combining two dissimilar materials into a new material that may be better suited for a particular application than either of original material alone. The important characteristics of composites are their strength, hardness rigid light in weight environmental sustainability and low expense. They provide the required strength for all structures such as buildings, ships in combination with low weight. The tensile strength which is the capacity to bear stress is four to six ties greater than that of aluminum. Structures made of composites are 30 to 40% lighter than similar ones made of aluminum

Due to high stiffness the fiber composites have various structural applications. The composite materials are highly chemical resistant. And a lot of composites are manufactured at a lower cost as compared to other materials such as steel and concrete. Composites were used in cars because of desirable properties. Composites began to be used more and more in everyday commodities like bath tubs, railings electrical goods, sport equipment cars etc. variation in mechanical properties with addition of granite powder was carried out by Prof.A.varadarajulu and co authors [1]. Extensive work was carried by B.N.Dash on bio degradability of the jute felt composites [2]. The effect of temperature on epoxy composites was carried by A.V.Rajulu [3] Mechanical properties of bamboo fiber in polyurethane was studied by H. KUMAR [4].

II. Experimental Work

The matrix material, used for the fabrication of bamboo fiber reinforced composites consists of low temperature curing epoxy resin (Araldite LY556)and corresponding hardener(Primary amine HY951) supplied by Ecmas construction Pvt. Ltd., Resin and hardener are mixed in a ratio of 10:1 by weight[5] as recommended. Density of the epoxy resin is 1.2 gr/cc. The bamboo fiber collected from the local area, is cleaned with a NaCl and NaOH (10% concentration) [6] and then is dried. The fibers free from dirt and excess pigments are obtained. To prepare the composite slabs, these fibers in pre determined weight proportion (08%) are reinforced in different orientation into the epoxy resin. A block size (150mmX150mmX3mm) is thus cast, with Hand lay up technique in a glass mould.

A. Casting

Initially the glass mould is gently cleansed and is set free from moisture and dirt. Later a thin layer of wax is applied on inner walls of the mould along with its base plate, for easy removal of cast after curing.

B. Laminates

After wax is being applied initially the proportionate mixture of resin and hardener (10:1 by weight percentage) is taken and is poured into the mould to form a uniform layer and later fiber was taken and is placed in different orientation with uniform spacing. After the fiber gets wet on early layer of matrix, remaining matrix ix poured over it until desired thickness is obtained. In the present work because of thin slab thickness only a layer of fiber is considered.

First slab was prepared with complete epoxy resin, second was epoxy with bamboo fiber in 30^0 orientation', third one was prepared with bamboo fiber in 45^0 orientation , fourth one was prepared with bamboo fiber in 60^0 orientation and finally the fifth one was with bamboo fiber in 90^0 orientation

C. Curing

The casting is put under load for about 24 hours for proper curing at room temperature. After this moulds further at a constant temperature of up to 70° C in order to treat the cast and also to remove it from mould easily after wax is melt.

E. Tests Performed

Specimens of suitable dimensions are cut using a diamond cutter for physical characterization. On thus fabricated specimen the Tensile strength [7] test, flexural strength test, impact strength tests, were performed.

F. Tensile Test

The tensile test is performed on a flat specimens following ASTM test standard D 3039-76 in the universal testing machine Instron 3369. The test speed was maintained 5 cm/min. at a temperature of 22 ° C and humidity 50%. In ach case four samples are taken and values are reported.

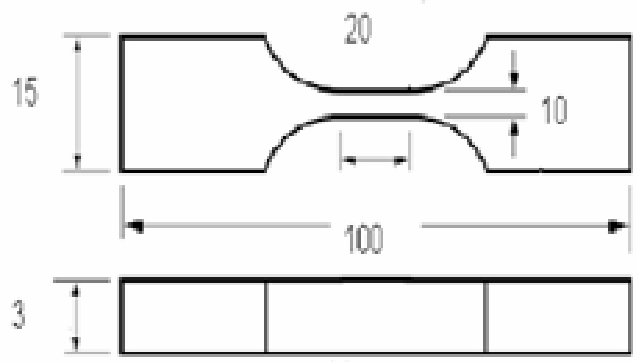

Fig: 1 Dog-bone shaped tensile test specimen (dimensions in mm)

G. Flexural strength test: Flexural strength was determined by the equipment as per ASTM D 792 procedure. The test speed was maintained 5 cm/min. at a temperature of 22 ° C and humidity 50%. In each case four samples are taken and values are reported.

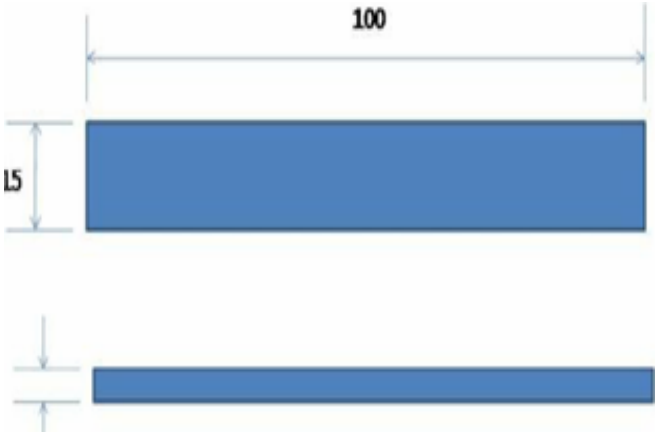

Fig. 2: Specimen for flexural test

H.*Impact strength test*:

Impact strength of un notched specimen was determined using an izod - impact tester according to ASTM D 256 strands. In each case four samples are taken and values are reported.

Fig. 3: Specimen for impact test

RESULTS

Incorporation of fibers into a polymer may change the mechanical properties of the composites [8]. The effect of fiber angle on Epoxy bamboo fiber[9] is shown in the table 1 and figure 4.The tensile strength (TS) for the bamboo fiber epoxy composites is increasing when fiber angle is reduced from 90 degrees to 60 degrees, then lowers for 45 degrees and increases for 30 degrees. Showing the maximum tensile strength at 60 degrees of fiber orientation and minimum at 90 degrees.

Table 1

Average strength	
Fiber Angle in Degrees	Average Tensile strength in MPa
90	4.524
60	8.168
45	6.235
30	9.59

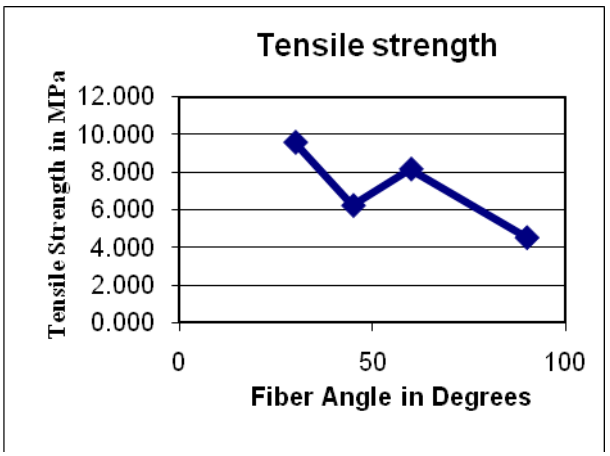

Figure 4 tensile strength Vs Fiber angle

Table 2

Fiber Angle in degrees	Average Flexural strength in MPa
90	22.725
60	33.521

45	25.309
30	32.112

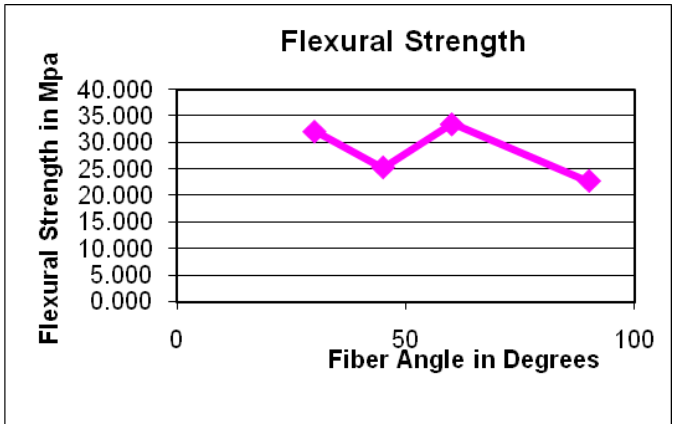

Fig: 5 Flexural strength Vs Fiber angle

The behavior of the flexural strength is similar to the behavior of tensile strength. From the table 2 and figure 5 it is clear that at 60 degree of fiber inclination the bamboo fiber epoxy composites have maximum flexural strength and for 90 degree of fiber orientation the composites have minimum strength.

Table 3

Fiber Angle in degrees	Impact strength J/m
90	67.818
60	83.040
45	32.633
30	34.933

The impact strength values for the composites under study for different forms of fiber are given in the above table no.3

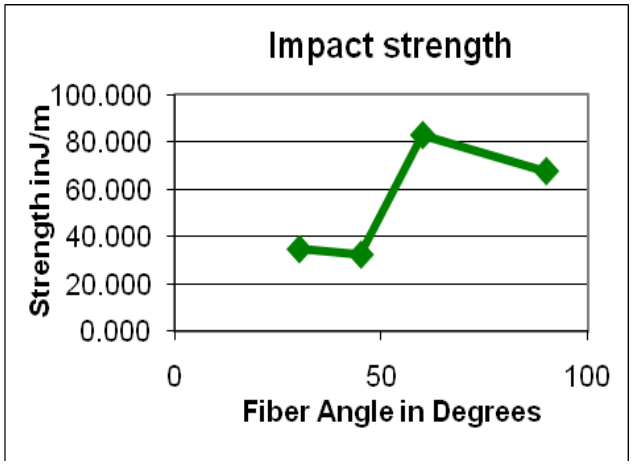

Figure 6 Impact strength Vs Fiber angle

The impact strength is low at low fiber angles and it is maximum at 60 degree of fiber orientation and slightly drops when fiber angle reaches to 90 degrees.

Conclusion: From the above results the following conclusions can be made for bamboo fiber epoxy composites.

At 60 degree of fiber orientation the composites have maximum flexural and impact strengths and its values are 33.521MPa and 83.040 J/m. the tensile strength is maximum at 30 degrees of fiber inclination.

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