STUDY OF MECHANICAL BEHAVIOUR OF HYBRID NANO BAMBOO FIBER COMPOSITE

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ABSTRACT

In this paper, presented the tensile and flexural behaviour of nano particles of bamboo fiber embedded in to the 1:1 ratio of glass and epoxy resin reinforced matrix in an attempt for increasing the tensile and flexural strengths of composites. 6 % to 10 % of weight fraction of nano bamboo fiber is used. Hand lay up method is used for fabricating the composite. The combination of nano bamboo fiber in to glass fiber reinforced epoxy resin yielded the better results compared to nano jute embedded in to glass fiber reinforced epoxy resin composite.

KEYWORDS: Nano Bamboo fiber; Tensile strength; Flexural strength & Glass fiber

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INTRODUCTION

One of the abundantly available natural fibers is bamboo fiber. A typical cross section of a technical bamboo *G. angustifolia* fibre shows an irregular “beam” shape (Figure 1-c and d), having a size variation depending on their position across the surface culm section. Each fibre, irrespective of its position, contains several elementary fibres [2]. The cross-section of these primary fibres is either pentagonal or hexagonal and they are arranged in a honey comb pattern, separated by a thin wall of matrix (Figure 1) [1-2,4]. In the past, researchers worked on durability and mechanical properties of pure bamboo fiber in forced epoxy composites for replacing the wood [5-9]. The research in nano bamboo fiber embedded in parent natural fiber composites is lacking for improving the strength of composites, therefore, in this paper presented the tensile and flexural behaviour of nano bamboo fiber embedded in to the glass fiber in forced epoxy composite.

Figure 1: BambooG. Angustifoliamicrostructure [2]: (a) Bamboo Culm, (b) Cross-Section of the Culm Showing the Fibre Distribution Through the Wall thickness, (c) Vascular Bundle, the Main Anatomical Constituent of the Plant, Composed of Vessels, Floem II, Protoxylem, Parenchyma tissue, and Fibre Bundles, (d) Bamboo Technical Fibre Composed by Several Elementary Fibres, (e) Elementary Fibres with Pentagonal or Hexagonal Shape, and (f) Model of Polylamellae Structure of a Thick-Walled Elementary Fibre Proposed by Liese [3].

EXPERIMENTAL SETUP

The specimens are prepared based on ASTM standards for testing under universal testing machine. Each testing specimen is combination of percentage of nano bamboo fiber embedded in to the 50% glass fiber and 50% epoxy resin. A total of ten samples are used. The resin is used for the bamboo fibre composites and the resin which will be used for tensile testing is commercially available epoxy resin Epikote 828 LVEL and a DYTEK® DCH-99 Amine (1,2-diaminocyclohexane) hardener.

TENSILE TEST

Tensile test samples are prepared according to the standard ASTM D3039. An Instron 4467 machine is used for testing.

**Figure 2: Composite Tensile Test Specimens
(a) ASTM D 3039 for 0° and (b) ASTM D 3039 for 90°.**

FLEXURAL TEST

The flexural tests are conducted to determine the mechanical properties of resin and laminated fiber composite materials. Further, these tests are used to determine the interlaminar tear strength of a laminate, shear modulus, shear strength, tensile and compression moduli along with flexural and shear stiffness. These tests are not only used for

composites, but also for sandwich beams. These tests are simple one. Further, they need simple instrumentation and equipments. These tests are conducted on beams of uniform cross section. These beam specimens do not require the end tabs. There are two methods to carry out these tests. The beam is a flat rectangular specimen and is simply supported close to its ends. In the first method, the beam is centrally loaded. Thus, it gives three point bending. Since there are three important points (two end supports and one central loading point) along the span of the beam, this method is called as three-point bending test. In the second method, the beam is loaded by two load splaced symmetrically between the supports. In this method, there are four important points (two end supports and two loading points) along the span of the beam. Thus, it gives four-point bending. Hence, this method is called four point bending. Three point bend testing is used and specimen is prepared based on the standards of ASTM D7264, therefore, span to thickness ratio of the specimen is 16:1. The standard dimensions of specimen may be changed from three point bending to four point bending testing. The testing results are shown in figure in 4.

RESULTS AND DISCUSSIONS

Figure 3 shows the variation of tensile strength under the percentage of variation of nano bamboo fiber. Minimum tensile strength is observed as 168.5 Mpa at 6% of nano bamboo fiber embedding and maximum tensile strength is observed as 230.5 Mpa at 9 % of nano bamboo fiber. The percentage of increase from 6% to 9% is 36.79%. The reason for increasing may be increment in interfacial bonding strength.

Figure 3: Variation of Tensile Strength Under Variable % of Nano Bamboo Fiber

Figure 4 shows the variation of flexural strength under the percentage of variation of nano bamboo fiber. Minimum flexural strength is observed as 170.6 Mpa at 6% of nano bamboo fiber embedding and maximum tensile strength is observed as 224.8 Mpa at 9 % of nano bamboo fiber. The percentage of increase from 6% to 9% is 31.7%. The reason for increasing may also be increment in inter facial bonding strength .

Figure 4: Variation of Flexural Strength Under Variable % of Nano Bamboo Fiber

CONCLUSIONS

Tensile and flexural strengths of nano bamboo fiber embedded into the glass fiber composites are studied by preparing the specimens as per ASTM standards. The results are found better by embedding the nano bamboo fiber into the glass fiber reinforced epoxy composite. The percentage of increase in tensile strength is 36.79 % and flexural strength is 31.7 %, therefore, nano bamboo fiber embedding into glass fiber epoxy resin composites can be applicable where tensile and flexural strengths are prominent.

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