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MECHANICAL PROPERTIES OF BAMBOO REINFORCED EPOXY COMPOSITES WITH DIFFERENT SIZES OF BAMBOO POWDER

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ABSTRACT

Uses of natural fibres as reinforcement have gained the importance in the recent years due to the eco-friendly nature. These natural fibres offer a number of advantages over traditional synthetic fibres. This paper deals with the evaluation of mechanical properties namely, Tensile strength (TS) and Compressive strength (CS) of different sizes of bamboo fibre reinforced with epoxy. Specimens were prepared by hand lay-up technique and are made as per ASTM standards to perform tests. The experimental results reveal that the mechanical properties of the composite material were highly influenced by the fibre volume fraction (fibre loading).

KEYWORDS: Bamboo fibre, Epoxy resin, Tensile strength, Compressive strength.

INTRODUCTION

Composite materials

In the past few decades, research & engineering interest has been shifting from monolithic materials to composite materials. The word composite in the term composite material signifies that two or more materials are combined on a macroscopic scale to form a useful third material. The key is the macroscopic examination of a material where in the components can be identified by the naked eye. Different materials can be combined on a microscopic scale, such as in alloying of metals, but the resulting material is for all practical purposes macroscopically homogeneous, i.e., the components cannot be distinguished by the naked eye and essentially act together.

The advantage of composite material is that, if well designed, they usually exhibit the best qualities of their components or constituents and often some qualities that neither constituent possesses. The advantage of composite materials over conventional materials are largely from their higher specific strength, stiffness and fatigue characteristics ,which enables structural design to be more versatile. By definition, composite materials consist of two or more constituents with physical separable phases.

Composite materials (also called composition materials or shortened to composites) are materials made from two or more constituent materials with significantly different physical and chemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons common examples include materials which are stronger, lighter or less expensive when compared to traditional materials.
Typical engineered composite materials include

- Composite building materials such as cements, concrete
- Reinforced plastics such as fibre reinforced polymer
- Metal Composites
- Ceramic Composites (composite ceramic and metal matrices)

Composites are made up of individual materials referred to as constituent materials. There are two main categories of constituent materials: matrix and reinforcement. At least one portion of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties. A synergism produces material properties unavailable from the individual constituent materials, while the wide variety of matrix and strengthening materials allows the designer of the product or structure to choose an optimum combination.

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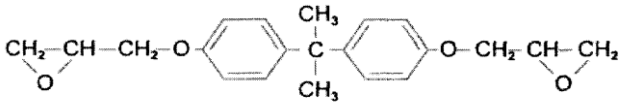
Bamboo

Bamboo belongs within the kingdom of Plantae, the division of Magnoliophyta and the family of Gramineae (Poaceae) (American Bamboo Society, 2011). Approximately 1200-1500 species have been found and the greatest varieties of species are to be found in South- and Southeast Asia. Other parts of the world where bamboo has great varieties are Polynesia, South America, Southeast USA and Africa. In these parts of the world bamboo is an important part in the vernacular building culture.

In Europe, bamboo is mostly used as an interior material, for example floor and furniture's. The purposes and techniques how bamboo is used vary a lot and depend on geographical location and application purpose. The different application aspects –depending on locations, seem to connect with the type of bamboo used, and available local resources. Also the mechanical properties of bamboo vary a lot, depending on its location and the type.
In several parts of the world, different types of grass have been used for thousands of years and are still used as a traditional building material. It is a natural and practical choice to build with grasses, such as bamboo. It is accessible in the nature and it possesses many qualities..

Epoxy Resin

The large family of epoxy resins represents some of the highest performance resins of those available at this time. Epoxies generally out-perform most other resins types in term of mechanical properties and resistance to environmental degradation , which leads there almost using air craft components. As laminating resin their increased adhesive properties and resistance to water degradation make these resins ideal for use. The simplest epoxy is a three-remember ring structure known by the term 'alpha-epoxy' or '1,2-epoxy'.



METHODOLOGY

Manufacturing Processes: The most commonly used manufacturing processes are introduced. Although many variants on these techniques exist, this overview gives a good indication of production possibilities by using hand lay-up techniques.

Hand lay-up is the simplest and oldest open molding method of the composite fabrication process. It is a low volume, labour intensive method suited especially for large components such as boat hulls, glass or other reinforcing, mat/woven fabric is positioned manually in the open mold and resin is poured, brushed or sprayed over into the glass plies. Entrapped air is removed manually with squeegees or rollers to complete the laminate structure. Room temperature curing resins such as polyesters and epoxies etc are most commonly used matrix resins. Curing is initiated by a catalyst in the resin system, which hardens the fibre reinforced resin composite with external heat .For a high quality part surface, a pigmented gel coat is applied to the mould surface.

Fig.2.1 Hand lay-up Technique

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TESTING OF SPECIMEN

Fig.2.1 Specimen before tensile test

Fig.2.2 specimen after tensile test

Fig.2.3 specimen during compression test

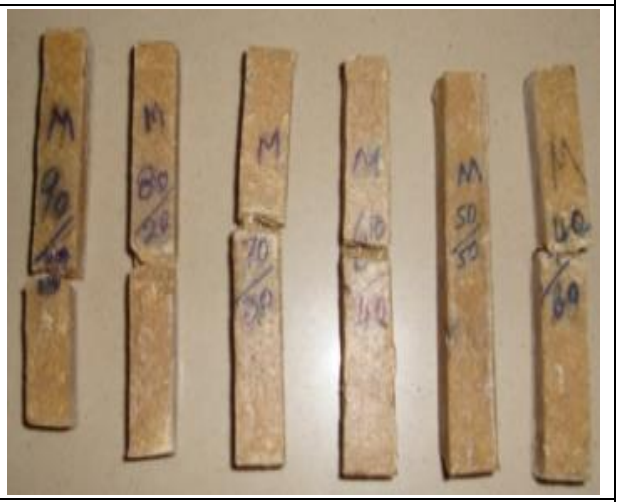

Fig.2.4 specimen after compression test

RESULTS AND DISCUSSIONS

The present research deals with the evaluation of mechanical properties namely, Tensile strength (TS) and Compressive strength (CS), of different sizes of bamboo fibre reinforced with epoxy by following proportions tabulated in the below.

Table 3.1 Percentage of composisitions with sample specimen

Samples	Compositions
EB-1	Epoxy(90%) + Bamboo Powder (10%)
EB-2	Epoxy(80%) + Bamboo Powder (20%)
EB-3	Epoxy(70%) + Bamboo Powder (30%)
EB-4	Epoxy(60%) + Bamboo Powder (40%)
EB-5	Epoxy(50%) + Bamboo Powder (50%)
EB-6	Epoxy(40%) + Bamboo Powder (60%)

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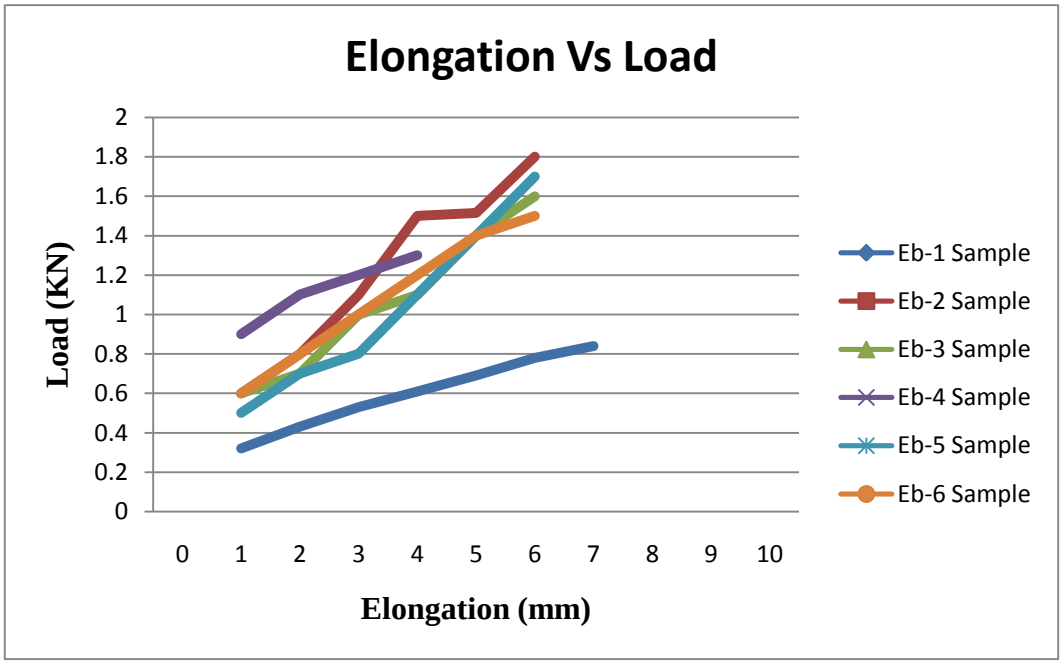
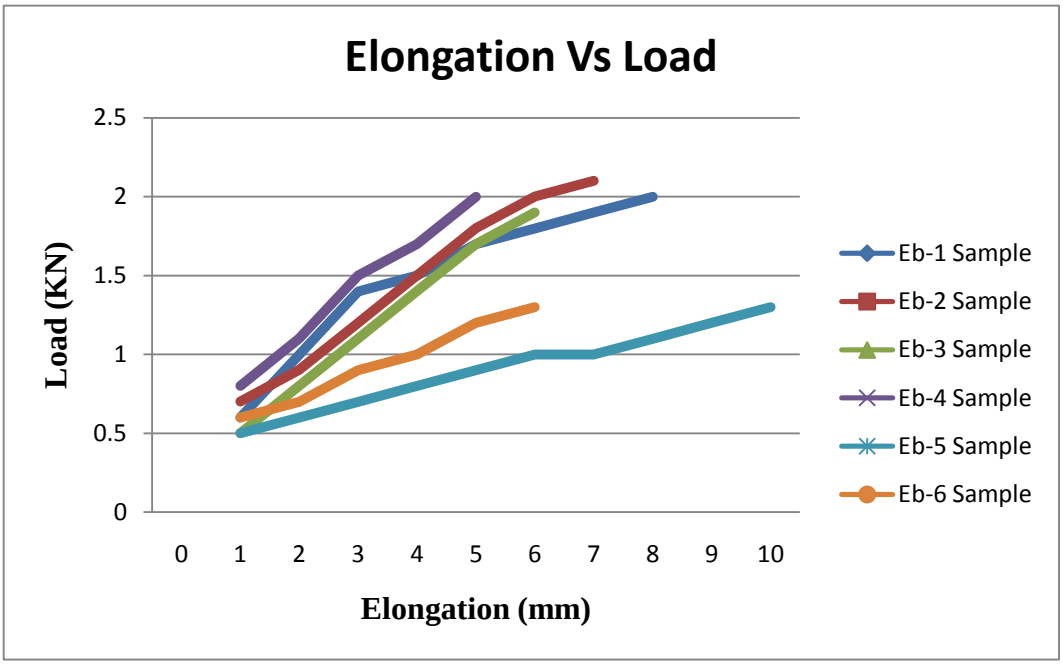
According to the values obtained in experimentation, We Plot the graphs for Epoxy & Bamboo in different sizes and proportions as shown following



Graph 3.1 Elongation Vs Load for coarse EB Samples



Graph 3.2 Elongation Vs Load for Medium EB Samples

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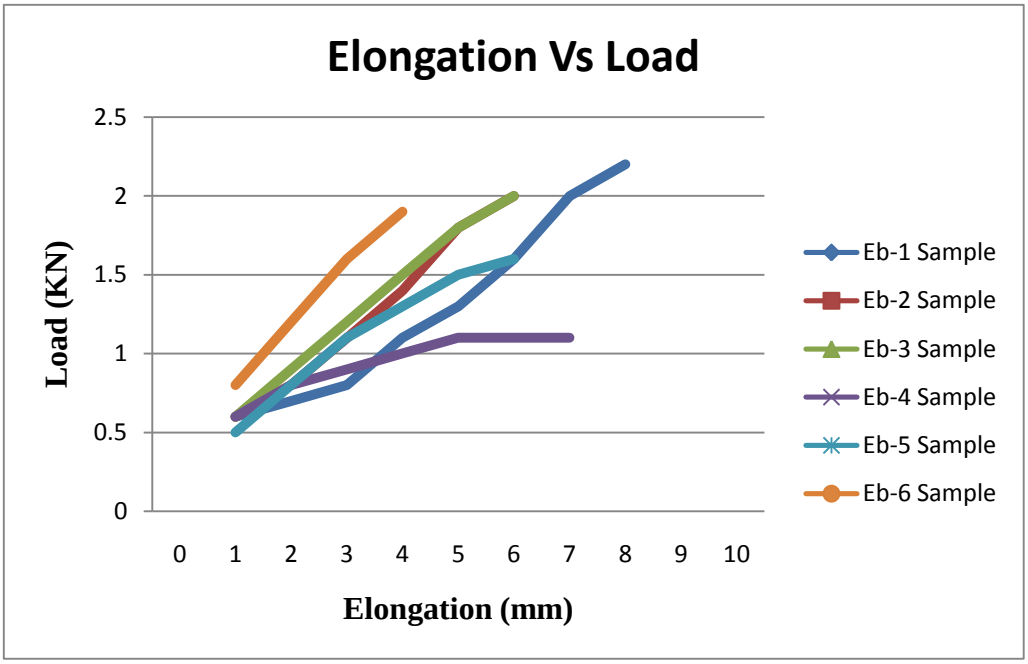
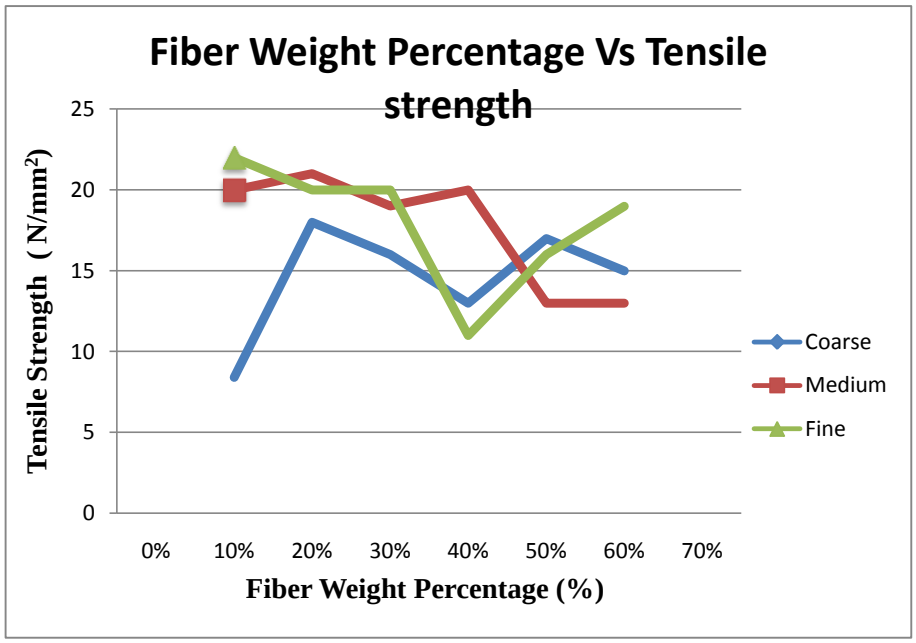
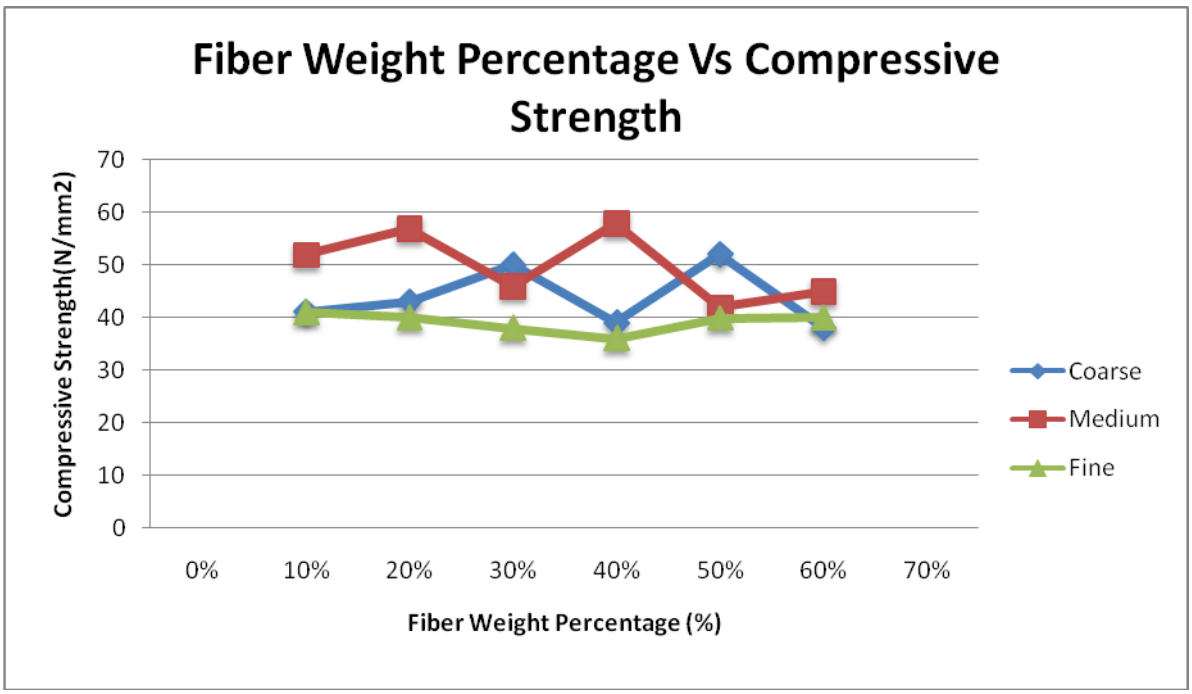


Graph 3.3 Elongation Vs Load for Fine EB Samples



Graph 3.4 Fiber Weight Percentage Vs Tensile strength Comparison



Graph 3.5 Fiber Weight Percentage Vs Compressive strength Comparison

CONCLUSIONS

The experimental investigation on the effect of fibre loading and filler content on mechanical behaviour of different sizes of bamboo fibre reinforced epoxy composites leads to the following conclusions obtained from this study are as follows:

1. The successful fabrications of a new class of epoxy based composites reinforced with fine, medium, coarse sized bamboo powder have been done.
2. It has been observed that the Mechanical properties of the composite such as Tensile strength (TS) and compressive strength (CS) are greatly influenced by the fibre volume fraction.
3. The present investigation reveals that 20% fibre loading(EB-2) at coarse sized bamboo powder shows the superior tensile strength and better compressive strength was noticed at 50% of fibre loading (EB-5).
4. It also reveals that 20% of fibre loading(EB-2) at medium sized bamboo powder shows the superior tensile strength and better compressive strength was noticed at 40% of fibre loading(EB-4) .
5. It also reveals that 10% of fibre loading(EB-1) at fine sized bamboo powder shows the superior tensile strength and better compressive strength was noticed at 10% of fibre loading(EB-1).
6. Maximum tensile strength among all three different sizes of bamboo powder is 22 Mpa is found for 10% of fine sized bamboo fibre reinforced epoxy composites (EB-1).
7. Maximum compressive strength among all three different sizes of bamboo powder is 58 Mpa is found for 40% of medium sized bamboo fibre reinforced epoxy composites (EB-4).

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