TENSILE AND FLEXURAL PROPERTIES OF BURMESE SILK NATURAL FIBER REINFORCED EPOXY COMPOSITES

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ABSTRACT: Natural fibers are the other alternative in which the research is being carried out to overcome the problem of using metals due to its distinct characteristics like low cost, less weight, biodegradability etc. The mechanical properties namely, tensile strength (TS), flexural strength (FS) of untreated and treated alkali burmese silk fiber-reinforced epoxy composites were studied. In this paper an attempt is made to prepare two different composite materials using untreated and alkali treated burmese silk as reinforcement and Epoxy as the matrix material respectively. Composites were prepared by increasing the weight of fibers like 10,15,20 grams for reinforcement respectively by Hand Layup technique. The mechanical properties testing of the material was done by cutting the material into ASTM standards on Tester. It was found that as the weight of fiber increases there is improvement in the mechanical properties of the composite material.

KEYWORDS: Composite, Natural Fiber, Epoxy, Hand layup, Mechanical properties.

INTRODUCTION

SEVERAL STUDIES ON the composites made from epoxy matrix and natural fibers like jute, wood, banana, sisal, cotton, coir, and wheat straw were reported in the literature. The development of Burmese silk fiber-reinforced plastic composites using araldite (CIBA CY 230) resin as matrix. Though Burmese silk is extensively used as a valuable material from times immemorial (because of its high strength and low weight), the studies on this fiber-reinforced plastics are meagre. In the present work, the untreated and alkali treated Burmese silk fiber-reinforced high performance epoxy composites were developed and their tensile and flexural properties with fiber content (with varying ratio of untreated and alkali treated Burmese silk fibers) were studied. The effect of untreated and alkali treatment of the Burmese silk fibers on these properties was also studied.

MATERIALS

Burmese Silk Orchid (Bauhinia Racemosa) fibers were peeled off from the barks collected from their respective trees which are present in Nallamalla forest at Bailrooty area in Andhra Pradesh. High performance epoxy resin LY 556 and the curing agent hardner HY 951 system were used as the matrix. Some of these fibers were soaked in 5% NAOH solution for 30 min to remove any greasy material and hemi-cellulose, washed thoroughly in distilled water, and dried under the sun for 1 week. Fibers are cut to a length equal to the length of the mould. Epoxy mixed with hardener was used as matrix material. Epoxy and hardener were mixed at a ratio of 20:1 respectively. Glass mould with the dimensions 150mm x 150mm x 3mm (length x width x thickness) was used for the preparation of the composite. Other ingredients which were helpful in preparing the composite are releasing agent, OHP paper and a roller

Preparation of mould:

For making the composite, a moulding box was prepared with glass with 150mm x 150mm x 3mm mold cavity

Preparation of composite and test specimen:

In straight orientation method we take the fiber length as 150mm and thickness as 3mm. A glass mould of dimensions 150mm * 150mm * 3mm was taken in order to prepare composite. Epoxy plus hardener was taken as matrix and collected Burmese Silk Orchid as reinforcement. The first step is to cut fibers in such a way that the fibers fit in the length of glass mould and the amount of fibers taken were 10, 15 and 20 grams in weight.

The releasing agent used is hard wax which is applied over the glass mould such that the wax is equally spread and it is dried for about half an hour. Epoxy and hardener are thoroughly mixed in a separate beaker. Some amount of the mixture is poured over the glass mould and then the fibers are equally spread over the mixture in straight manner. Those fibers are pressed lightly so that they get immersed in the mixture and then remaining mixture is poured over the fibers and is spread equally. After that OHP paper is spread over the glass mould and the excess mixture of epoxy and hardener is removed by rolling over the OHP sheet by using a rod as a roller. This whole process is known as Hand Layup Technique. Weights were kept on the glass mould covered with OHP paper. While performing hand layup technique care should be taken to avoid formation of voids within the composite. After that mould was kept for about 24 hours to get hardened. After 24 hours the mould was kept in an oven for 20 minutes such that the releasing agent gets melted and it will be easy to remove the composite material from the glass mould. And then the composite material was kept in the oven for about one hour for curing purpose. After curing the material is kept under weights so that the material gets a uniform shape like the shape of the mould cavity

Tensile, flexural load measurement:

The tensile and flexural modulus were determined using by cutting specimens according to ASTM test standard D638-03 on a Universal Testing Machine (UTM). The cross-head speed for tensile, flexural and impact tests were maintained at 10 mm/min, at a temperature 25 degree centigrade. In each case two or three samples are taken and average value are reported.

RESULTS AND DISCUSSIONS

The variation of maximum stress and young's modulus with percentage untreated and alkali treated Burmese silk fber ratio is presented figures 1 and 2, respectively. For comparison, these values for the matrix are also presented in the same figures.

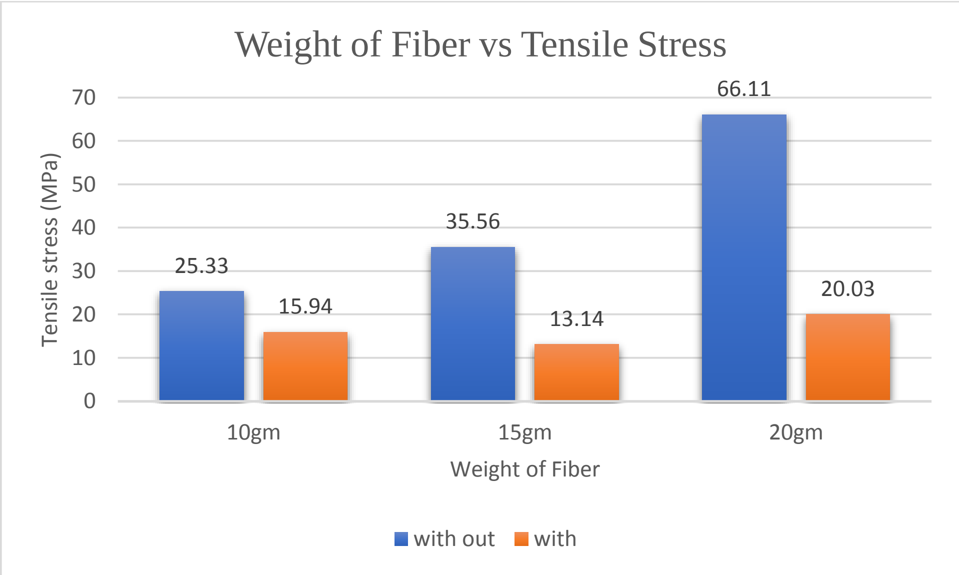

Figure 1. The variation of tensile stress for different weight ratios of untreated and alkali treated Burmese silk fiber-reinforced epoxy composites.

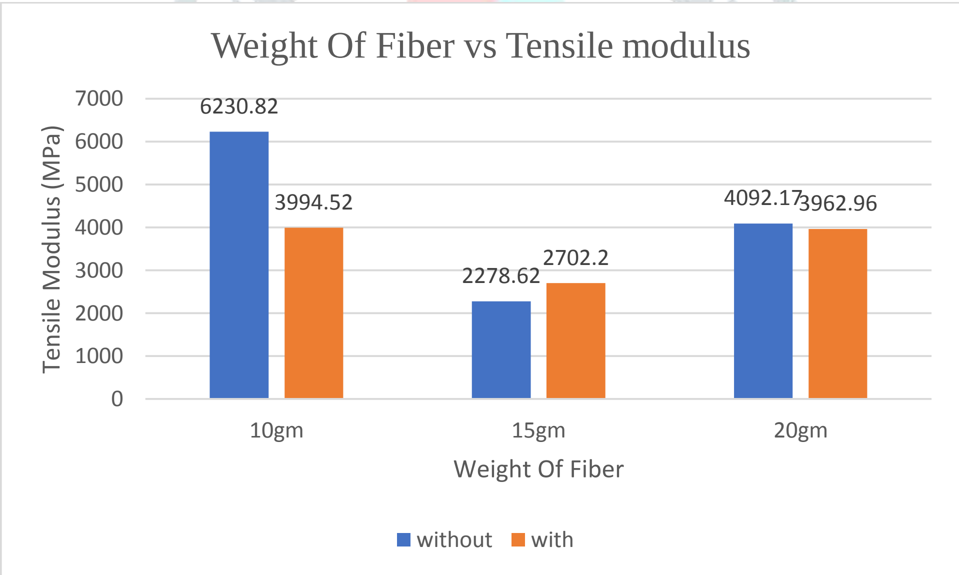

Figure 2. The variation of tensile modulus for different weight ratios of untreated and alkali treated Burmese silk fiber-reinforced epoxy composites.

From both the figures it is evident that the tensile properties are enhanced when the alkali-treated bamboo fibers were used in the epoxy composites. This is understandable as the hemi-cellulose and lignin contents decrease leading to higher percent of crystalline α-cellulose Burmese silk fibers on alkali treatment. The minimum and maximum values of tensile modulus for these composites are found to be 2278 and 6230 MPa, respectively. This observation clearly indicates that these composites have good load-bearing capacity. Similarly, the stress values vary in the range of 13–66 MPa. The variation of maximum flexural stress and flexural modulus with the ratio of percentage Burmese silk fiber in these composites is presented in Figures 3 and 4, respectively. In this case also the epoxy composites are found to have good flexural properties. In this case of flexural stress, the values very between 49 and 227 MPa. Similarly, the flexural modulus of these composites vary between 8106 and 28603 MPa. In this case of flexural properties, the flexural strength and modulus of these composites are also found to be enhanced when alkali-treated Burmese silk fibers were used in the epoxy composites. Similar observation was made by Varada Rajulu et al. [2–9] and Srinivasulu et al. [10] in the case of some Burmese silk composites and polymer-coated Burmese silk fibers.

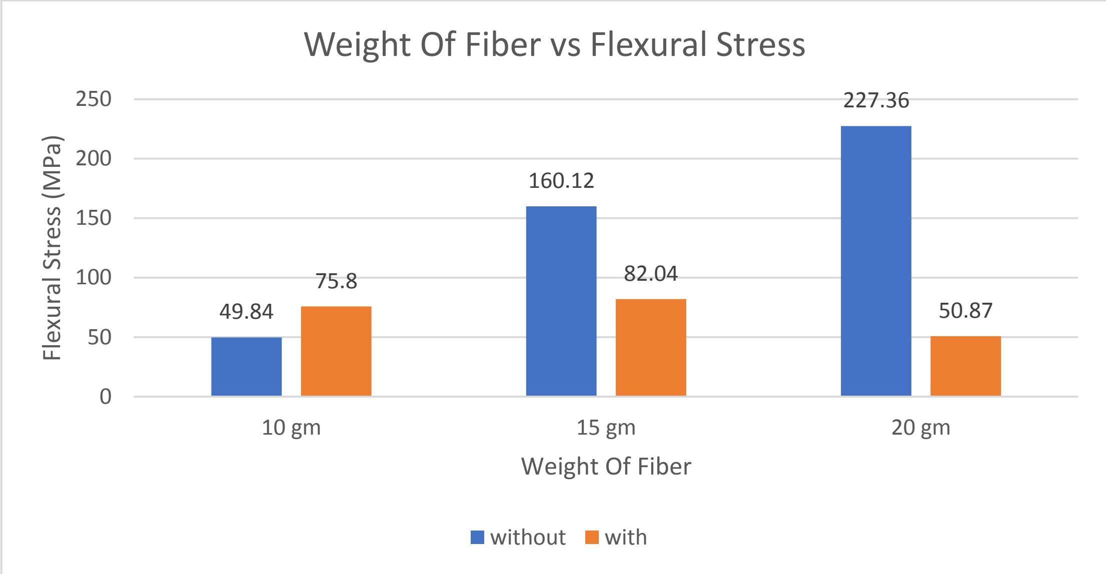

Figure 3. The variation of flexural stress for different weight ratios of untreated and alkali treated Burmese silk fiber-reinforced epoxy composites.

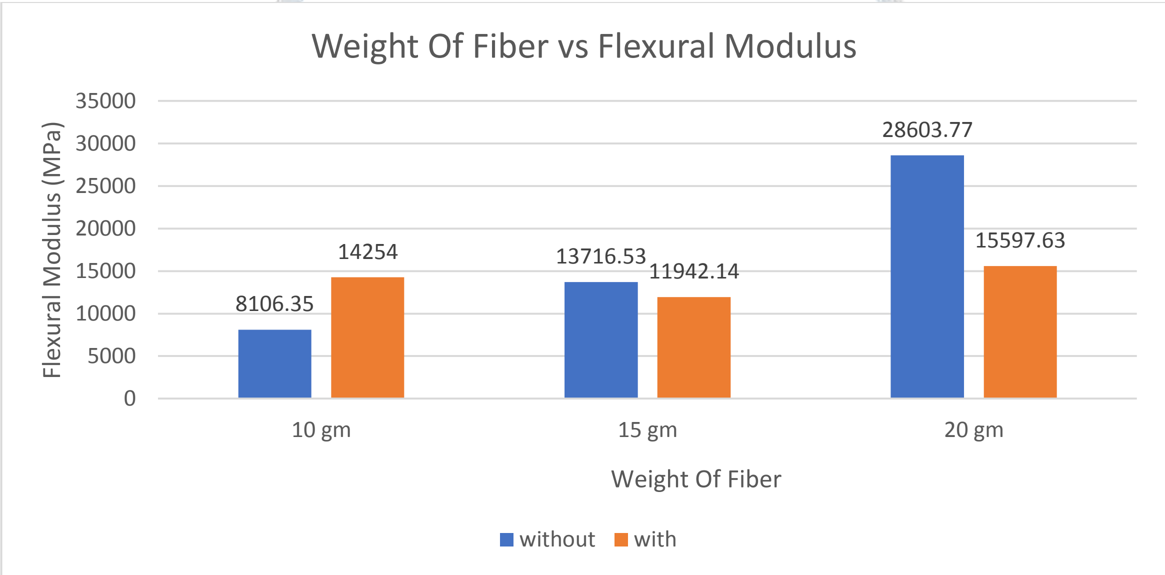

Figure 4. The variation of flexural modulus for different weight ratios of untreated and alkali treated Burmese silk fiber-reinforced epoxy composites.

CONCLUSION

The epoxy composites of untreated and alkali treated Burmese silk fiber-reinforced epoxy were made and their tensile and flexural properties studied. The effect of alkali treatment of the bamboo fibers on these properties was studied. These epoxy composites were found to exhibit good tensile and flexural properties. The epoxy composites with alkali-treated Burmese silk fibers were found to possess higher tensile and flexural properties. The elimination of amorphous weak hemi-cellulose components from the Burmese silk fibers on alkali treatment may be responsible for this behavior.

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