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EVALUATION OF THE INFLUENCE OF THE BAMBOO FIBERS OF THE BASAL, INTERMEDIATE AND TOP REGION ON THE MECHANICAL AND FRACTOGRAPHIC PROPERTIES OF COMPOSITE MATERIALS OF POLYMERIC MATRIX

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Abstract. *In this research it was produced composites reinforced with bamboo fiber, with lengths ranging from 5 to 15 mm. Bamboo fibers extracted from basal, intermediate and top of the bamboo plant, and then the fibers were subjected to the equipment granulator mill, where we obtained the desired lengths. Were made 8 (eight) specimens defined by the following ratio of mass fraction; 5.41%; manufacturing was performed by hand molding using unsaturated polyester resin with the ratio of curing agent/resin 0.33%. The results of the tensile strength of the composite bamboo basal region was 14.20MPa, the result of the composite bamboo intermediate region was 16.03MPa and the result of bamboo composite top area was 16.93MPa. The tensile results showed that the top region of the bamboo plant showed better mechanical strength. Fractures of the composites were observed by scanning electron microscopy (SEM).*

Keywords: *Vegetable fibers; mechanical properties; composite.*

1. INTRODUCTION

Cellulose fibers such as bamboo, sisal, coconut, jute, curaua and mauve, among many others, open a new, inexhaustible and alternative source of use as a reinforcing element for polymer matrix composites. Technological development depends largely on advances in materials. (Lima, 2004)

According to the type of dispersed component, the composites can be classified into three groups: particular (reinforced with particles), fibrous (fiber reinforced) and structural composites (reinforced with structural elements). (Callister, 2002)

2. THEORETICAL REFERENCE

Bamboo plantations are found in sea-level regions, tropical and mountainous (altitudes of approximately 1,300 meters). Among the numerous advantages in the cultivation of bamboo, there is little demand with respect to the soil. It produces well in almost all soil types but has its greatest vegetative development in sandy and light soils with high organic matter content and good drainage, essential for the vegetative life cycle of tropical species. In marshy regions, with occurrence of sharp puddling, the bamboo does not develop. Bamboo of the species Bambusa vulgaris is being cultivated on a large scale in the States of Maranhão, Pernambuco and Paraíba, where soils are acidic and have low fertility (Beraldo and Azzini, 2004).

In hot climates, bamboo leaves in summer and thus reduces photosynthesis, saving energy. In warmer times, with full foliage, the opposite occurs, and the bamboo trees flood the air with oxygen. Studies have shown that bamboo trees oxygenate four times the atmosphere more than tropical forests (Lancher, 2000).

3. MATERIALS AND METHODS

The bamboo fibers were obtained manually and separated into three regions: basal region corresponding to the lower part of the bamboo plant, intermediate region and top region corresponding to the top of the plant. The lowest possible level of technological processing was used in the manufacturing steps of the composite.

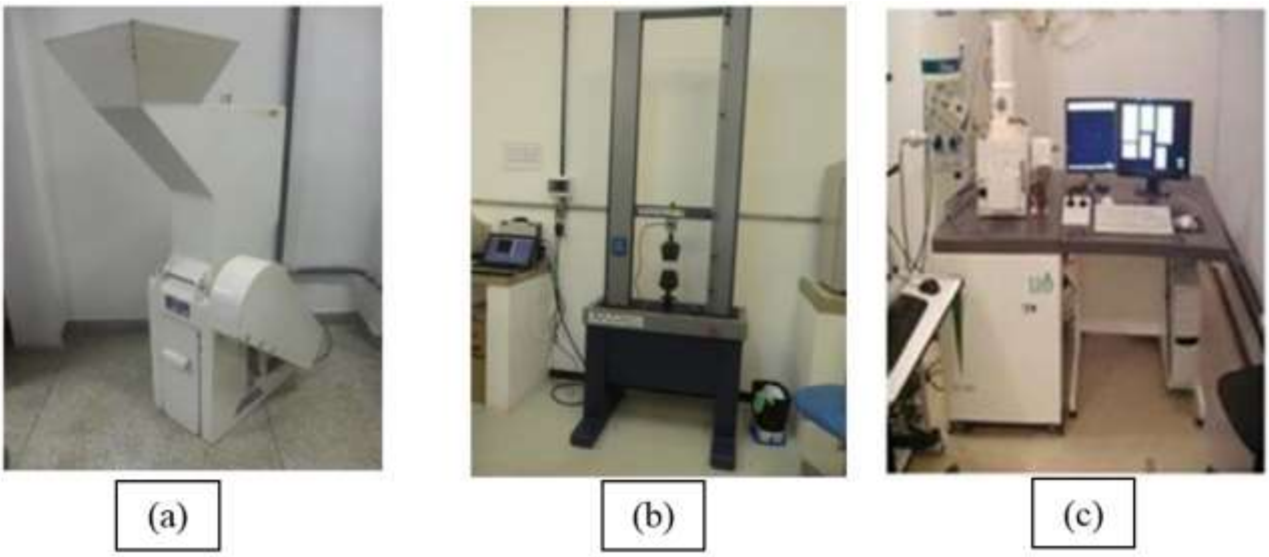

Figure 1. (a) Granulator mill; (b) universal tensile stress test; (c) scanning electron microscopy (SEM)

Figure 1 shows the equipment used for the manufacture of the bamboo fiber particulate composites for the different regions of the tree. In Figure 1a, we have the granulator mill where the bamboo fibers were cut in sizes ranging from 5 to 15mm in length. The composite test specimen was manufactured according to ASTM D638, responsible for low performance composites, and then tested on the tensile testing machine, Figure 1b. Samples ruptured in the center of the useful length were analyzed in SEM.

4. RESULTS AND DISCUSSION

Table 1 shows the results of tensile test of the particulate composite for each section of the bamboo tree, for the fiber mass fraction of 5.41%.

Table 1. Results of the mechanical characterization for each part of bamboo tree

Localization from bamboo tree	Ultimate tensile stress (MPa)	Longitudinal modulus (GPa)
Basal part	14.20 (±1.30)	0.280
Middle part	16.20 (±2.52)	0.304
Top part	16.93 (±1.36)	0.344

Following the metallographic procedures, the samples were observed in the scanning electron microscope. Figure 2 shows the micrograph of the polyester matrix composites reinforced with bamboo fibers for basal region of fiber mass fraction of 5.41%.

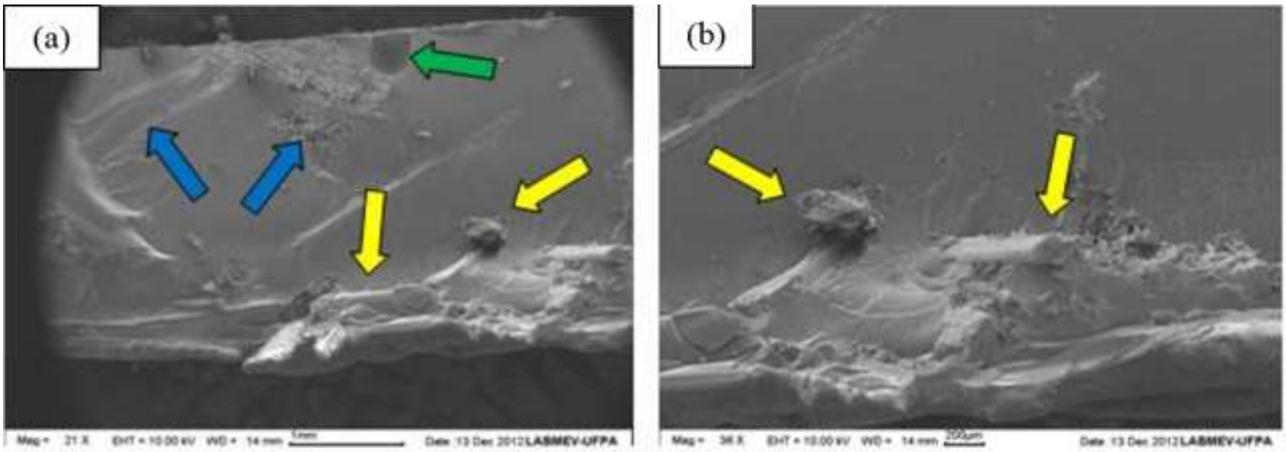

Figure 2. Scanning Electron Microscopy.

Figure 2 shows the scanning electron microscopy of the fracture surface of the composite of the polyester matrix reinforced with bamboo fibers, basal part of a mass fraction 5.41%. The blue arrow indicates the detachment of the fibers from the matrix; the yellow arrow indicates the fracture of a fiber in the matrix and the green arrow the presence of voids in the matrix.

5. RESULTS AND DISCUSSION

The methodology used in the manufacture of the composites was satisfactory, but the methodology used guarantees only a maximum amount of fibers in the composite, in the case was the value of 5.41%. The composites reinforced with bamboo fibers from both the basal, intermediate and top regions present a satisfactory mechanical performance in relation to the other plant fibers traditionally used as reinforcement of composites, for example, sisal fiber.

6. ACKNOWLEDGEMENTS

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8. RESPONSIBILITY NOTICE

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