MULTISCALE STUDY OF BAMBOO PHYLLOSTACHYS EDULIS


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ABSTRACT

The mechanical properties of bamboo culms are affected by their anatomical characteristics. Bamboo culm can be considered as a composite material, reinforced axially by aligned cellulose fibers embedded in a lignin matrix. The distribution of the fibers in the cross section of a bamboo shell varies across the thickness of the culm, increasing from the inner surface to outer surface. According to the state of the stress distribution in its natural environment the bamboo culm presents a functionally gradient material. The non-uniform distribution of fibers avoids the direct application of equation used to model the behavior of composite materials, as the rule of mix equations for strength and modulus of elasticity.

This paper presents a non-conventional method for mesostructural characterization using an Astra Umax 1 2200 scanner and the NIH 2 Image J software. The variation of the volume fraction of the cellulose fibers in the transversal section of bamboo is established. The microstructure of bamboo was studied by Atomic Force Microscopy (AFM) to determine the various features associated with the fiber vascular bundles. Veeco 3 DI 3100 Nanoscope was used in tapping mode to characterize surface topography of the fiber bundles. The developed methodology is applied to study Phyllostachys Edulis (Moso) bamboo specie.

KEYWORDS

Bamboo, composite materials, functionally gradient material, mesostructure characterization, fiber bundles, rule of mix.

INTRODUCTION

The energy crisis has provoked an increase on the use of the non-polluting materials, which consume low energy for their production and utilization. The shortage of housing in the developing countries motivates the search for low cost and energy saving of materials that can be applied in the civil construction. To increase the amount of information concerning non conventional materials, many researchers have been studying the properties and the use of natural materials as building materials such as mud blocks, natural fibers reinforcing soil or cement matrices and bamboo culms.

The knowledge of the mechanical properties of bamboo has caught the attention of engineers, architects and researchers due to the bamboos potential to be used as construction material presenting high strength, light weight, and low cost. Furthermore, bamboo requires simple processing techniques and is obtained from renewable and ecological resources (Ghavami and Hombeeck 1981; Ghavami and Zielinski 1988; Ghavami and Culzoni 1987; Ghavami 1988; 1995a; Ghavami and Rodriguez 2000; Ghavami and Solorzano 1995, Ghavami et. al. 2001).

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