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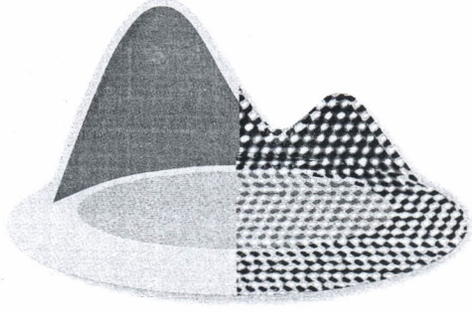

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Obtaining nanofibers from sugarcane bagasse to reinforce nanocomposites biodegradable matrice

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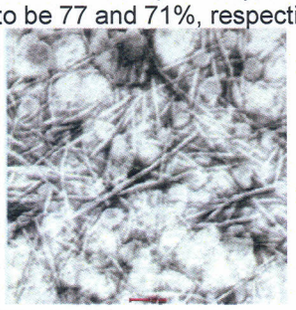
Abstract – Sugarcane alcohol production is important economical activity in São Paulo State, thus large quantities sugarcane bagasse waste. Some of them are potential resource of natural fibers, which can be used as source of nanofibers cellulose extraction. Cellulose nanofibers have been extracted by acid hydrolysis from sugarcane bagasse fibers. They are seen a good source material due to availability and low cost. The nanofibers was evaluated by thermal degradation behavior using thermogravimetry (TG), crystallinity by X-ray diffraction and morphological structure was investigated by transmission electronic microscopy (TEM) experiments. The resulting nanofibers were shown high cristallinity and rodlike cellulose elements with lateral dimensions approximately 7 nm and length approximately 250 nm. The nanofibers will be incorporated as reinforcement in a biodegradable matrice and evaluated.

Over the last year, increasing interest regarding environmental preservation, rational use of agricultural residues is growing. This fact is being mainly motivated by the increasing consumption of polymers products and reinforced composites with natural fibers. Cellulose nanofibers could be a viable alternative for news materials in which high performance, evaluated in terms of life cycle analysis, has to be taken into account for the final disposal [Ganãn et al. 2008]. However, fibers agricultural residues of annual plants such as sugarcane bagasse can be an important resource of natural nanofibers, especially in Brazil.

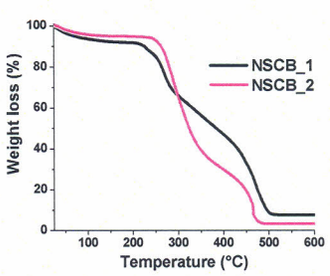
Sugarcane bagasse fibers were triturated and, subsequently, the cellulose was extracted using a pre-treatment with hydrogen peroxide solution to remove lignin. Nanofibers were prepared by the acid hydrolysis from previously obtained cellulose. The acid hydrolysis was carried out with sulphuric acid (H_2SO_4) solution 60 v/v at 45ºC/30 min (NSBC_1) and 45ºC/75 min (NSBC_2) under continuous agitation. Samples for transmission electron microscopy (TEM) were observed with a TECNAI F20G2 transmission electron microscope using an acceleration voltage of 120 kV. A drop of diluted suspension of nanofibers was deposited on a carbon-coated grid. The samples were stained with a 2 wt % solution of uranyl acetate. Dynamic thermogravimetric measurements were performed by using a TA Q500 instrument. Temperature programs for dynamic tests were run from 25 ºC to 600ºC at a heating rate of 10 ºC/min. These tests were carried out under air atmosphere (60 ml/min). X-ray difraction was measured for nanofibers with a Rigaku X-ray diffractometer using Cu Kα radiation at 40 kV and 30 mA. The scattered radiation was detected in the Bragg angle range 2θ (5–40°), at a speed of 2°/min. Crystallinity Index (*Cr*) was estimated by means of Eq. $Cr = [(I_{max}-I_{min})/I_{max}]x100$ using : I_{max}, 2θ = 22.6° and the minimum I_{min}, 2θ = 18°.

TEM micrographs in Figure 1 show the homogeneity and nanometric dimensions of sugarcane bagasse nanofibers. The length and diameter of them were determined by using digital image analysis (ImagePlus). The geometric average length and diameter were around 250 nm and 7 nm, respectively. The thermal stability of nanofibers was shown (Figure 2) an initial loss weight between 25 and 150 ºC which corresponds to a mass loss of absorbed moisture. The initial decomposition temperature NSBC_1 and NSBC_2 was 300 and 250ºC respectively, and it is due to cristallinity. According to X- ray diffraction analysis result it was found to be 77 and 71%, respectively.



A

Figure 1: TEM image of sugarcane bagasse nanofibers



B

Figure 2: TG curves of sugarcane bagasse nanofibers. Atmosphere air at 60mL/min, rate 10ºC/min.

P. Gañán, R. Zualuaga, A. Restrepo, J. Labidi and I. Mondragon, Bioresour. Technol. (2008) 99, 486.