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Cellulose nanofibers extracted from different biomass

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Abstract – In this work, cellulose nanofibers were obtained from sisal fibers and sugarcane bagasse by acid hydrolysis. The nanofibers were characterized in respect to morphology by transmission electron microscopy (TEM), crystallinity by X-ray diffraction (XRD) and thermal stability by thermogravimetry analysis (TG). Both nanofibers had a rod-like aspect. Sisal nanofibers had length and diameter around 210±60 nm and 5±2 nm respectively while sugarcane bagasse nanofiber its values were around 255±55 nm and 4±2 nm, respectively. The main differences between them were the major crystallinity and thermal stability for sugarcane bagasse nanofibers.

The interest in materials biodegradable was increased motivated for the use with plastic materials on composition of composites and nanocomposites. Cellulose nanofibers are alternative technological application such as a reinforcing agent in polymers materials which result in environmental benefits due to your biodegradability, renewability, low cost and high efficiency. Thus it is an alternative to maintain the environmental balance and aggregate value of products in the agriculture sector [1].

In this study, originals fibers of sisal and sugarcane bagasse were pre-treated with alkaline peroxide solution to remove other non-cellulosic components (bleaching). After the bleaching, nanofibers were obtained from acid hydrolysis with 60 wt% sulphuric acid (H_2SO_4) solution under continuous agitation. For sisal nanofibers (**NS**), the temperature and time of extraction were 60ºC and 30 min respectively, while for sugarcane bagasse pith nanofibers (**NSCB**), they were at 45ºC and 30 min.

The nanofibers morphology was characterized using a scanning transmission electron microscopy (STEM). They are observed with a TECNAI F20 G^2 transmission electron microscope using an acceleration voltage of 120 kV. The crystallinity index was measured by X-ray diffraction (XRD) a Rigaku Xray diffractometer using Cu Kα radiation at 40 kV and 30 mA. The scattered radiation was detected in the Bragg angle range 2θ (5 - 40^o), at a speed of 2^o/min. Crystallinity index ($Cr_{\%}$) was estimated by means of Eq. $Cr_{\%} =[(I_{max}-I_{min})/I_{max}]x100$ using: I_{max}, 2θ = 22.6^o and the minimum I_{min}, 2θ = 18^o. Thermogravimetric analyses (TG) were performed by using a TA Q500 instrument. Temperature program for dynamic tests were run from 25ºC to 600ºC at a heating rate of 10 ºC/min and air atmosphere (60 ml min^{-1}).

TEM micrographs in Figure 1 show the rod-like aspect and nanometric dimensions of NS and NSBC. The length and diameter of them were determined by using digital image analysis (ImagePlus). The length and diameter for NS were around 210±60 nm and 5±2 nm respectively while to NSBC were around 255 ± 55 nm e 4 ± 2 nm, respectively. The thermal stability of nanofibers was shown (Figure 2) an initial weight loss between 25°C and 150 ºC which corresponds to a mass loss of absorbed moisture. The initial decomposition temperature "onset" NS and NSBC was 230°C and 252ºC respectively, and it can be due to higher crystallinity of NSBC sample. According to XDR analysis the values for crystallinity were 51 and 71% for NS and NSBC respectively.

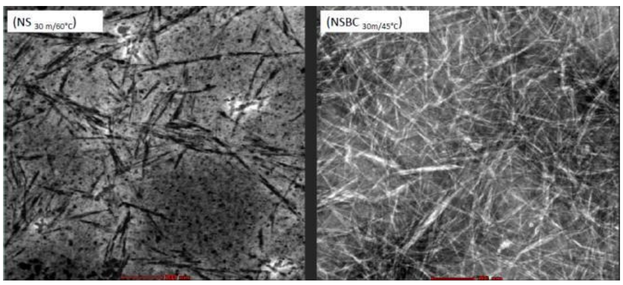

Figure 1: TEM images of $NS_{60°C/30min}$ and $NBSC_{45°C/30min}$. Scale bar: 200 nm

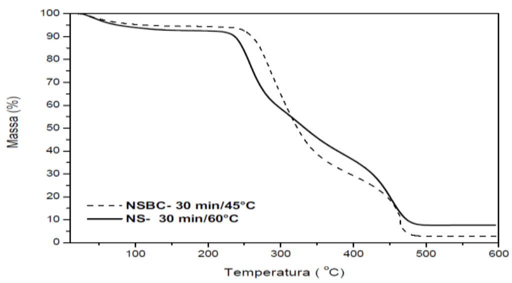

Figure 2: TG curves of NS and NBSC nanofibers in air atmosphere.

[1] BHATTACHARYA, D., GERMINARIO, L. T., WINTER, W. T., **Carbohydrate Polymers**, v.73, p.371, 2008.