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ID-1-P-3476 Confocal and electron microscopy for evaluation of delignification kinetics of Agave fibers by using green technology

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The use of organosolv pulping represents an alternative to traditional methods to obtain cellulose pulp from agro-wastes. It has been studied the use of different kinds of Agave species such as A. sisalana and A. tequilana to produce paper, but not Agave atrovirens, that is used in the “mescal” production. The wastes of this process can be a good source of cellulose and lignin. The aim of this work was study microstructural changes during kinetic of Acetosolv and Milox (green chemical methods), to produce cellulose derivatives from agave wastes. Fibers were obtained from leaves of A. atrovirens through pre-treatments that included drying at 60 °C and 3 m/s air, milling and fiber separation through mesh. A previous experimental design provide the delignification process conditions for Milox kinetics of fibers were time of 180 min, a formic acid concentration of 80% and a H2O2 concentration of 2%. Acetosolv kinetics were time of 30 min, acetic acid concentration of 80% and 0.3% of HCl. Pulps were studied by SEM (XL 30, Philips, USA) to observe overall microstructural changes during kinetic delignification of the fibers. Also it was possible to monitor the changes on lignin and cellulose in the fibers during the organosolv process by CLSM (LSM 710, Carl Zeiss, Germany). Figure 1 shows SEM and confocal images of the Acetosolv process, there, it can be observed the ordered arrangement of the bundle of the fibers with lower time treatment (Figure 1A and B). In all CLSM images, blue color is the fluorescence of stained cellulose (MR2 with calcoflour white), while green is the autofluorescence of lignin. Higher time treatment shows a collapsing of arrangement of the fibers (Figure 1C, D and E). In the case of Milox kinetic these images shown in Figure 2, it is possible to see that the fibers are separating mostly with the increasing reaction time. At the beginning of the kinetic the bundle of fibers are complete but in function of the reaction time the separation of the fibers increased until complete liberation of microfibrils at the end of the Milox kinetic (figure 2A-E). Agave fibers show a low content of lignin, even so, can be solubilized by this acidic organosolv processes. Both pulps were achieved with very high purity of cellulose and CLSM images showed that Milox was the better process for delignification of agave fibers, but at the expense of oxidizing conditions that compromise the length of the cellulose chain. Therefore, the applied microscopy techniques in this work were useful to monitor the microstructural changes occurring during the pulping processing and they were efficient for select the better process conditions for delignification of Agave fibers.

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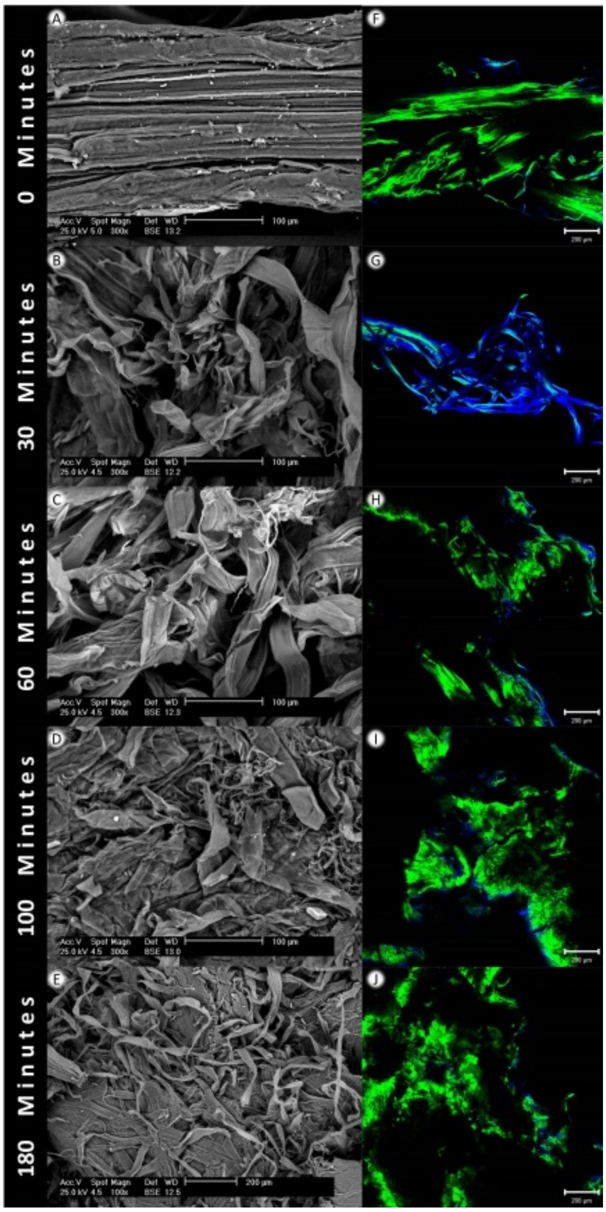

Fig. 1: SEM and confocal images of Acetosolv pulping at different process time.

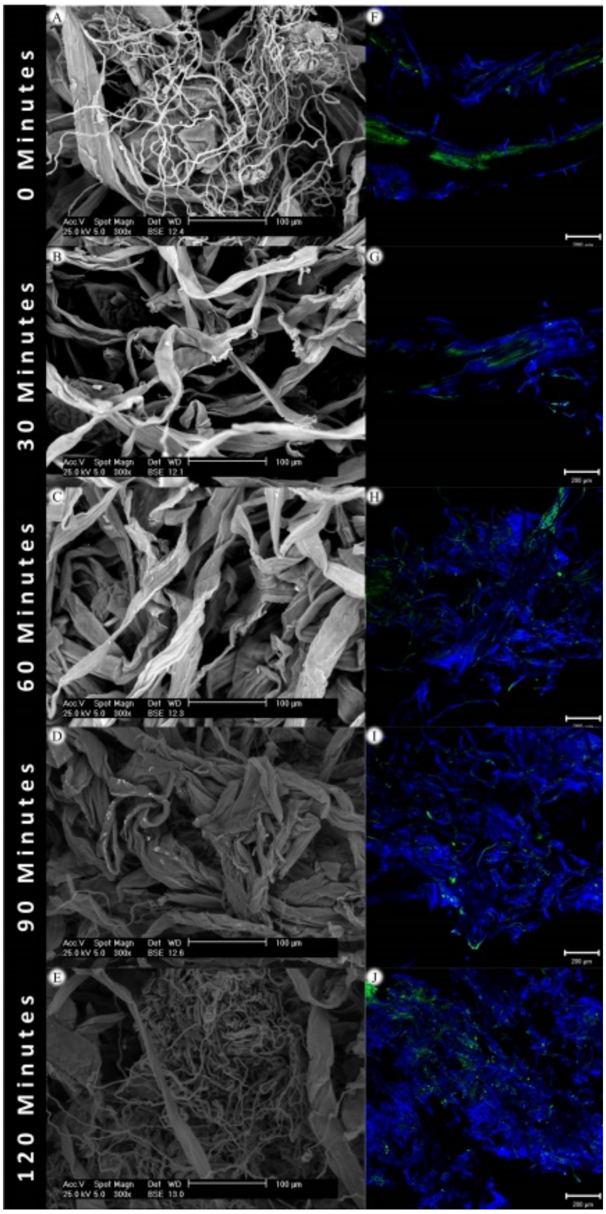

Fig. 2: SEM and confocal images of Milox pulping at different process time