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Preliminary Studies on the Production of Nanofibrils of Cellulose from Never Dried Cotton, Using Eco-Friendly Enzymatic Hydrolysis and High-Energy Sonication

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Abstract

An ecologically friendly method, to obtain cellulose nanofibrils, starting from Never Dried Cotton (NDC) is described, where cotton bowls are opened and maintained in water. NDC cotton exhibits a highly accessible structure and porosity, thus allowing a more efficient enzyme action and chemical treatments and derivatization. In this work, the conditions utilized to synthesize nano-fibrils from NDC were also tested on once dried cotton; the latter failed to produce nano-fibrils when submitted to the experimental conditions applied. A first-drying of cotton fibers results in a structure characterized by a collapse of the NDC fiber structure , which change from a circular cross section to its typical "bean- like" cross section, with reduced accessibility and porosity, and lower water sorption capacity. Those changes are of the same nature as the well known *hornification* described in pulp and paper science studies, associated with irreversible reduced accessibility, which affects paper properties, and in general, the utilization of cellulose for utilization as materials or fuel (i.e. alcohol) . In this work, enzymatic hydrolysis of the fibers was followed the by high energy sonication for 20 to 50 minutes, resulting in the production of nanofibrils when using NDC. Similar treatment applied to once-dried cotton failed to produce nanofibrils. Although analysis of films made from hydrolyzed and sonicated NDC material, with scanning electronic microscopy, disclosed micro-fibers lengths of approximately 30 µm, and some nano-scale structures, only with Transmission Electron Microscopy was possible to confirm the presence of nanofibrils, Structures with 50 nm in diameter, were present after submitting the NDC to enzymatic hydrolysis , and high-energy sonication. Both processes are considered eco-friendly: enzymatic hydrolysis and, especially, high energy sonication which is gaining impressive industrial utilization in the last decade.

Keywords: *Never -Dried Cotton, Cellulose, nanofibrils, ultrasound, hydrolysis*