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Hydrodynamic alignment of Nano-Fibrillated Cellulose in extensional flow KARL HÅKANSSON, FREDRIK LUNDELL, LISA PRAHL WITTBERG, Linne FLOW Centre, KTH Mechanics, Royal Institute of Technology, SE-10044 Stockholm, Sweden, LARS WÅGBERG, Fibre and Polymer Technology, Royal Institute of Technology, SE-10044 Stockholm, Sweden, DANIEL SÖDERBERG, Innventia AB, Box 5604, SE-11486 Stockholm, Sweden, WALLENBERG WOOD SCIENCE CENTER TEAM — The aim of this work is to manipulate the orientation of cellulose fibrils in order to enable control of material properties. Cellulose fibrils are the load bearing component of wood and separation of the fibrils from the cell wall is possible through enzymatic and mechanical treatment. The resulting product is called Nano-Fibrillated Cellulose, NFC, consisting of elongated particles with diameters of 40 nm and lengths of a few μm. Films and fibers made by NFC show great potential in terms of material properties. This work includes experiments, computations and simulations in order to determine the alignment of NFC in a laminar extensional flow. A flow focusing setup is used where water is accelerating a semi-dilute NFC-dispersion, this particular design minimizes the shear on the NFC-dispersion. The relative mean orientation is found through 2D birefringence measurements. The Smoluchowski equation including an orientational diffusion term and a flow forcing term is solved numerically in 1D. Flow field simulations are made in order to find the local acceleration, and also to confirm the shape of the suspension thread formed. The computations predict the same trend as is seen in the experiments; at higher accelerations the NFC-fibrils become more aligned.

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