RHEOLOGICAL BEHAVIOUR OF AQUEOUS SUSPENSIONS OF CELLULOSE WHISKERS

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The rheological behaviour of cellulose whiskers suspensions has been studied from the diluted to the concentrated domain. Two kinds of whiskers issued from natural sources have been investigated: the first one was obtained from Sisal fibres, whereas the second was extracted from Cotton counterpart. In a set of experiment, the resulting nano-fibres were previously grafted with an octadecyl isocyanate after a solvent exchange procedure in toluene. The aspect ratio was found to depend on the starting raw material and was found to be equal to 62 and 11, for Sisal-based and Cotton-based nano-elements.

Samples with different concentrations were prepared from the initial suspensions by centrifugation and evaporation, in order to remove the distilled water. Sisal whiskers suspensions were concentrated up to 5 wt%, in the case of non-grafted fibres and up to 15 wt% in the case of grafted counterpart. Cotton whiskers suspensions have been concentrated up to 15 wt%.

The rheological behaviour of whiskers suspensions, under shear, was studied using a controlled speed rotating rheometer with a parallel-plate configuration of 25 mm in diameter and 1 mm in gap, at a temperature of 20°C. Start-up shearing tests were performed in which a constant shear rate was suddenly applied to the sample whose initial state is controlled. The transient response under stress was recorded until reaching steady conditions. The stress levels for the steady regime were then used to establish flow curves for the suspensions under shear.

The suspensions presented a shear-thinning behaviour under permanent shear flow which was found to fit well the Hershel-Bulkley law. At constant shear rate, the viscosity of these suspensions depends on the cellulose source, the concentration, and the aspect ratio of the particles. Furthermore the viscosity of the suspensions depended strongly on the surface treatment of cellulose nanocrystals, i.e. whether or not whiskers have been grafted. Thus, similar viscosity can be obtained with higher concentrations of the grafted whiskers, compared with untreated ones. Such a treatment allows having aqueous suspensions with higher solid content of whisker and could be therefore considered as a very promising route for coating applications since it solves, at least partially, the drying issue with such materials.