Cellulose nanofibres obtained by TEMPO mediated oxidation and mechanical treatment: effect of the mechanical treatment

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Abstract

The size and size distribution of nanofibres is always an important parameter to consider, but it should be mentioned that presently no standard methods or validated techniques are available for the size evaluation of polydisperse nanomaterials with a high aspect ratio [1].

In the present work, four samples of cellulose nanofibers were produced from an eucalypt kraft pulp pre-treated with 15 mmol of NaClO per gram of cellulose and catalytic amounts of TEMPO (2,2,6,6-tetramethylpiperidine-1-oxyl radical) and NaBr, according to the methodology described by Saito et al. [2]. After the chemical treatment the fibers were subjected to different mechanical treatment intensities during homogenization.

Three samples were obtained after passing through the homogeneizer one time (at 500 bar) (1P15R), two times (one at 500 bar and one at 1000 bar) (2P15R) and four times (one at 500 bar and three at 1000 bar) (4P15R). In addition, for control, one sample was left without any mechanical treatment (0P15R).

The samples were then characterized in terms of yield of nanofibres production assessed by centrifugation, transmittance of the suspensions in the 400-800 nm visible range (Fig.1), concentration of carboxylic groups determined by conductimetric titration and zeta potential. The size distribution of the material was evaluated by laser diffraction spectroscopy and by dynamic light scattering (Fig.3) of the cellulose nanofibres suspensions (Fig. 2 and 3 respectively). Generally it was concluded that the homogeneization highly increases the amount of nanofibrils but no significant further effects, both in terms of yield and size, are detected with more extensive mechanical treatment.

References

[1] Fraschini, C., Chauve, G., Le Berre, J-F., Ellis, S., Méthot, M., O' Connor, B. and Bouchard, J. Nordic Pulp and Paper Research Journal, **29** (2014) 31-40.

[2] Saito, T., Kimura, S., Nishiyama, Y., Isogai, A., Biomacromolecules, **8** (2007) 2485-2491.

Figures

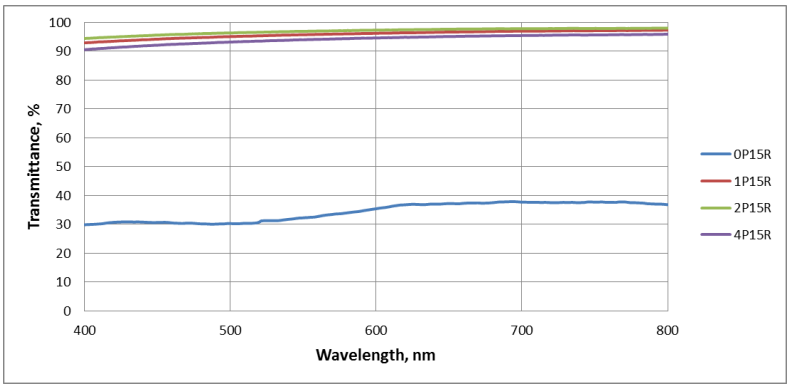

Fig.1- Visible spectra in the transmittance mode.

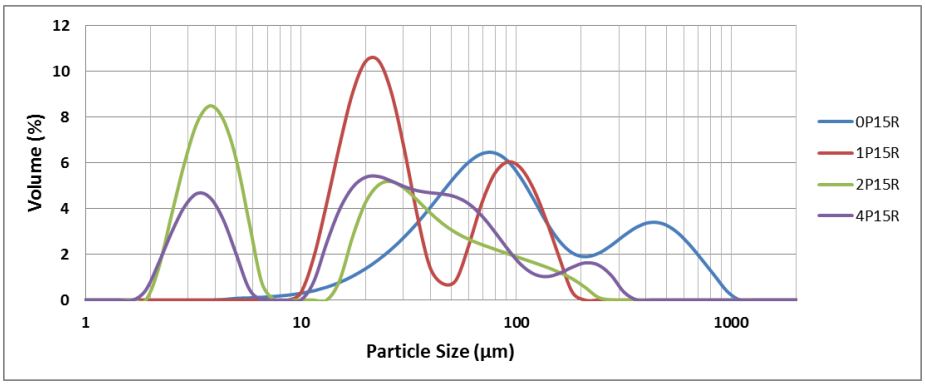

Fig.2- Volume distributions obtained by laser diffraction spectroscopy.

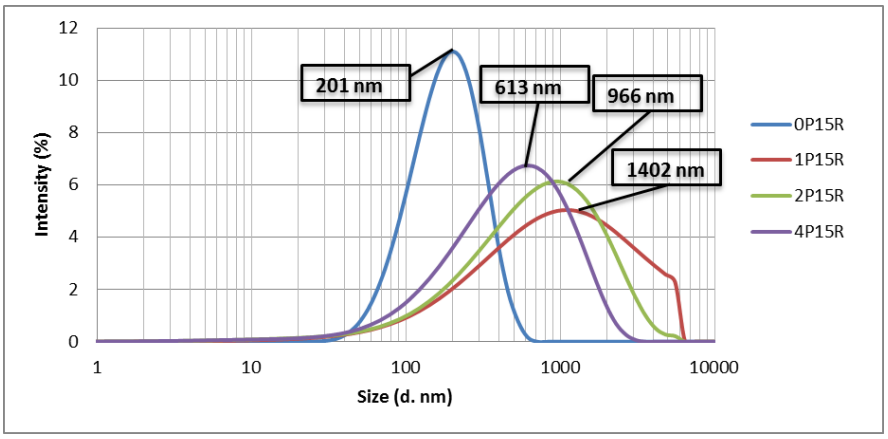

Fig.3- Intensity distributions obtained by dynamic light scattering.