STUDY OF THE POSSIBILITY TO PRODUCE CELLULOSE MICROFIBRILS BY APPLYING SHEARING TREATMENTS TO CELLULOSE FIBERS

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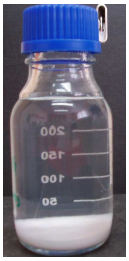
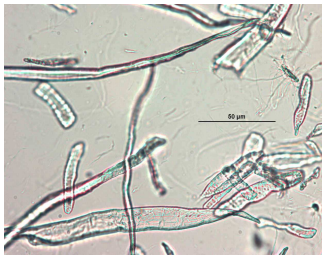
ABSTRACT

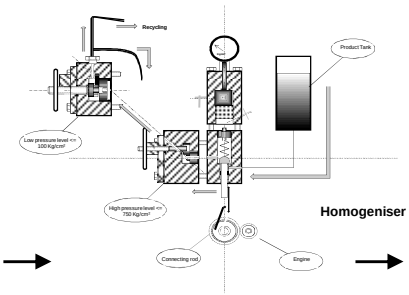
Cellulose is a linear biopolymer composed of glucose residues linked by β 1-4 glucosidics bonds. These characteristics enable cellulose molecules to adopt an extended rod-like configuration. In the microfibrils, the multiple hydroxyl groups on the glucose residues hydrogen bond with each other, holding the chains firmly together and contributing to their high tensile strength. This study has shown the possibility to produce cellulose microfibrils by applying shearing treatment. Homogenisation and microfluidisation treatments permit to obtain microfibrils with 5 to 20 µm length and a 20 to 50 nm diameter. This study also shows that a tridimensional network, typical of a gel, appears in the treated samples.

METHOD

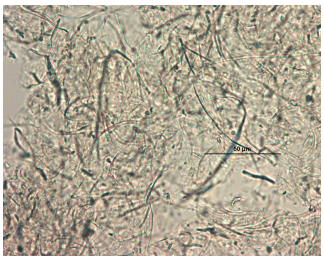




Photomicrography of cellulose fibers suspension
Concentration : 10 g/l



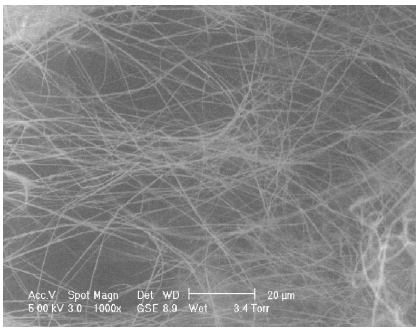
Shearing treatment
homogenisation 500 bars, 50 cycles



Photomicrography of cellulose microfibrils suspension
Concentration : 10 g/l

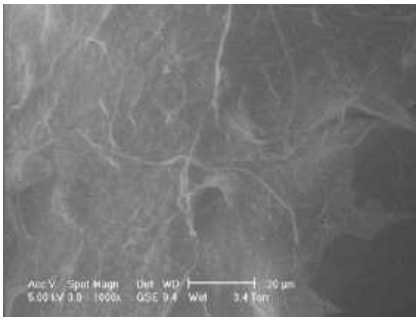
RESULTS

Size properties of cellulose microfibrils



Photomicrography ESEM of cellulose microfibrils

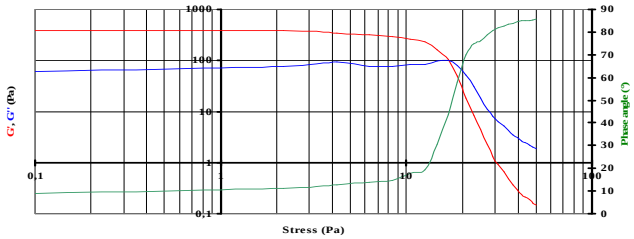
Homogenisation treatment applied to cellulose fibers permit to obtain cellulose microfibrils with 5 to 20 µm length and a 20 to 50 nm diameter



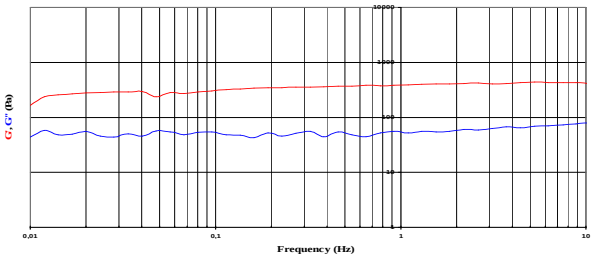
Photomicrography ESEM of cellulose microfibrils built in a « weft of cellulose »

Photomicrography ESEM of a sample area where cellulose microfibrils are built in a « weft of cellulose ». This weft appears following to the application of shearing treatment

Viscoelasticity properties of cellulose microfibrils suspension



Storage modulus (G'), loss modulus (G'') and phase angle (δ) measurement of cellulose microfibrils suspension in oscillation stress sweep test



Storage modulus (G') and loss modulus (G'') measurement of cellulose microfibrils suspension in oscillation frequency sweep test

CONCLUSION

This study has shown that is was possible to obtain cellulose microfibrils by applying shearing treatment on a suspension of cellulose fibers. Nevertheless, most of these microfibrils can't be reached easily. These microfibrils are built in a « weft of cellulose » following to shearing treatment. The oscillation stress and frequency sweep tests show that the elastic properties dominated at all frequencies and indicate that, for a magnitude below 20 Pa, the structure of cellulose microfibrils is a « weak gel ».