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Scale-up Nano particles in Modern Papermaking

Welcome to our fifth SUNPAP newsletter. SUNPAP project is moving into the demonstration phase. VTT coordinates this large scale project aiming for scaling up nano fibrillated cellulose based novel applications in paper and board value chain. The research done in cooperation with several research partners has shown great potential to produce cellulose nano fibrils from commercial chemical pulps.

Chemical pulps produced from wood offer novel possibilities to produce sustainable products from renewable resources. These new bio-based nano fibrils can find applications in several industrial value chains. The SUNPAP project is focused to look for applications within paper and board value chains. Consumer and market needs have been studied in order to focus the work properly to right products. The chosen value chains have been reviewed and the sustainability of the value chains have been calculated based on the laboratory data and the best knowledge about the nano fibrillated cellulose production and its scaling up work. Different preliminary safety studies as well as other published safety studies of different nano-scale celluloses have shown no safety concerns.

The research work has been done in cooperation with several research partners. In laboratory phase the studies have shown that cellulose nano fibrils can be produced from commercially available chemical hard- and softwood pulps. Raw material, chemical pulping technology and pretreatment explain the main differences in energy consumption of fiber disintegration into nano fibrils. Both oxidation with chemicals and loosening the fiber wall structure with a combination of mechanical and enzymatic pretreatment before homogenization look promising ways to produce cellulose nano fibrils (Figure 1). The novel mechanical fractionation device is ready for characterization of NFCs. Reproducibility was in good level and differences between nanocelluloses could be detected.

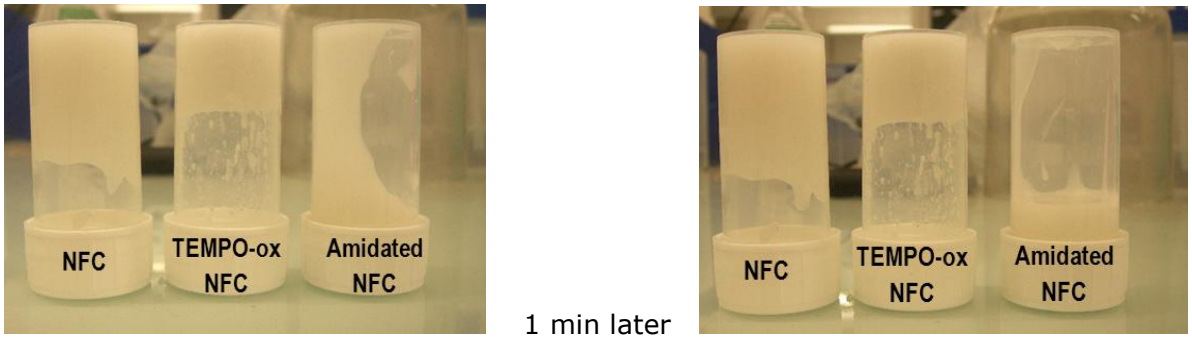

Figure 1 a) after turning and b) 1 min later. NFC produced with mechanical and enzymatic pretreatment before homogenization NFC with tempo oxidation and NFC with tempo oxidation and amidation, consistency 2 %. Gel viscosity decreased after amidation.

Several interesting technologies and concepts based on chemical modifications were studied in order to increase the solids content by reducing viscosity properties (e.g. amidation, Figure 1). These functionalized NFCs were also tested for different applications.

Functionalization with inorganic nanoparticles (Ag, TiO_2 and ZnO) can impart totally new functional properties to NFC. The papers coated with these modified derivatives have novel active antibacterial and catalytic properties (photoactivity).

The studies with the applications are now in demonstration phase, several pilot trails are on-going. The addition of nano fibrillated cellulose in the wet-end showed high potential with softwood chemical or CTMP pulps when compared to more intensive refining (Figure 2).

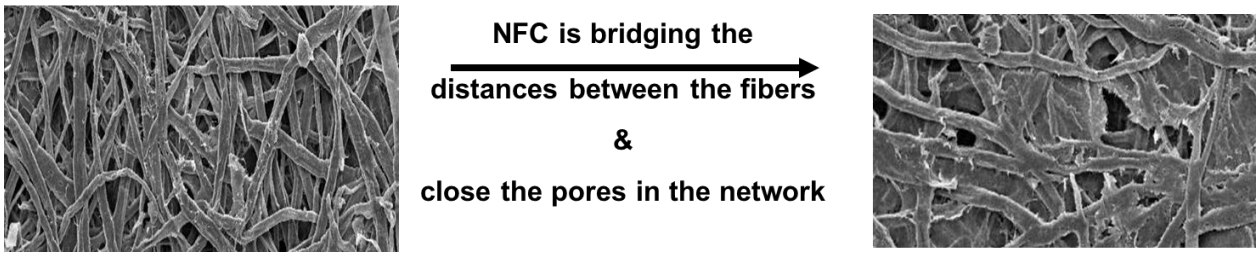

Figure 2 a) and b) Possible applications of NFC in wet end are based on more dense structure or better bonding ability.

In traditional pigment coating the big challenge is the low solids content and insufficient bonding between cellulose nano fibrils and pigment particles. It is a challenge especially in products where high surface strength is needed. The cellulose nano fibrils can be applied on the surface by using novel foam coating applicator. Using of air instead of water makes the application of viscous cellulose nano fibril solutions possible (Figure 3). The applied amounts are smaller than in traditional coating. This technology could be used for application of novel materials giving special functionality to the products.

Figures 3 a) and b). NFC in feeding tank and foamed NFC before application unit

These first results and possibilities to produce cellulose nano fibrils and challenges to make applications based on these novel materials were presented in our first public workshop. For further information visit our www-pages http://sunpap.vtt.fi/workshop2011.htm or contact us directly by e-mail.

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