SUNPAP Newsletter 2 17.8.2010
Scale-up Nano particles in Modern Papermaking

Welcome to SUNPAP

Welcome to the second SUNPAP newsletter. Our aim is to give you a basis view of our first public results in the project. Scale-Up Nano Particles in Modern Papermaking (SUNPAP) is a new large-scale integrating project in the European Community's 7th Framework Programme under the NMP programme. It is co-ordinated by VTT Technical Research Centre of Finland (VTT), Finland.

The SUNPAP project has started well and is proceeding according to the plans. The general aim is to direct the research to more sustainable use of materials and production technologies in modern paper/board making. The project focuses on scaling up the production of nano fibril cellulose. The project covers four research topics: sustainability evaluation of the whole value chain, scaling up production of native and functionalized nano fibril celluloses (NFCs), industrial product applications for different end uses and health and safety issues in nano fibril cellulose production, application and end products. The four different research topics in different modules have a strong synergy and they are well integrated with each other. The ultimate goal of the project is to create new fibre-based paper and packaging products, which can be recycled and will reduce landfill waste and minimise the use of petroleum-based chemicals. Moreover the target is to provide radical product performance improvements, new efficient manufacturing methods and the introduction of new added value functionalities. The SUNPAP project is an industry driven project with the aims of piloting and commercialising the most feasible products within as short time frame as possible (Figure 1).

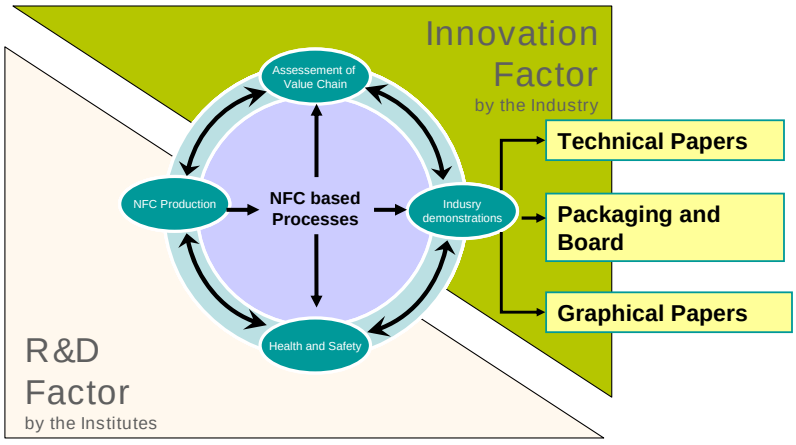

Figure 1. The complementary roles of R&D and industry in SUNPAP project targeting for improved and new paper and board products with nanomaterials

The **Module 1** deals with the whole value chain including market needs, sustainability assessments, and recyclability and biodegradability studies. The data collection is a critical part of the success, as it will feed data to the sustainability analysis conducted in the project. The sustainability analysis includes environmental, economic and social aspects. 1st phase environmental screening of the product value chains was carried out and the results from the LCA are very preliminary and based on theoretical data, approximations and fictive cases. The idea with this is to direct the project and researchers to more sustainable methods and focus on sustainable product and process solutions.

Nanocellulose is used in various forms to an ever greater extent in industrial applications, in particular, when it is obtained from renewable raw materials. The heart of the project is the **Module 2** where we are scaling up the production of native and functionalized nano fibril celluloses. The first aim of the research work into cellulose-based nano material production is to identify optimal pulp raw material and pre-treatment conditions for energy-efficient NFC preparation. The experimental trials with different chemical, enzymatic and mechanical pre-treatment processes are ongoing. The main target of the project is to scale up the technologies to produce natural or functionalized nano fibril cellulose. The quality of nano fibril cellulose is aimed at different current and novel industrial paper and board products. NFC can be produced on a laboratory scale using a high-pressure homogenizer at 150 to 200 MPa. This process is not suitable on a pilot scale, however, due to the low throughput and energy efficiency. PTS studies new processes, in co-operation with various research and industrial partners, in order to be able to demonstrate energy-efficient production on a pilot scale. The Figure 2 shows the quality of the NFC produced in the project.

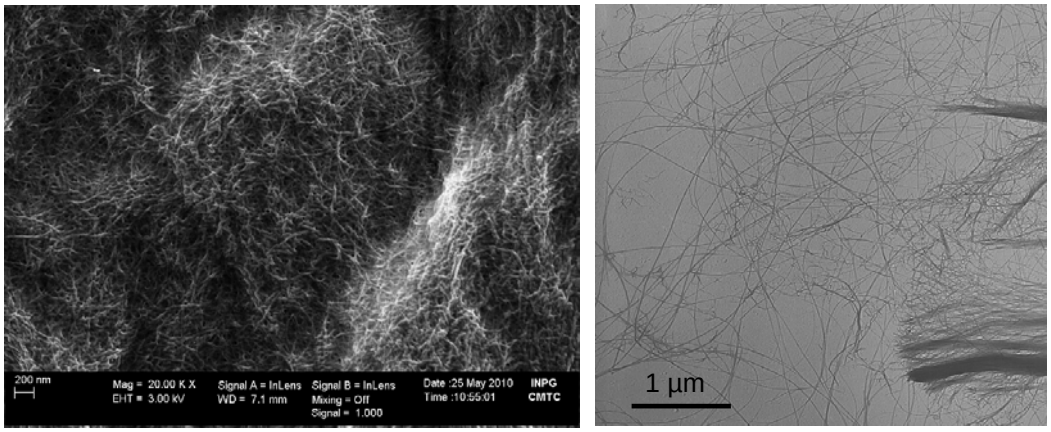

Figure 2. SEM and TEM examination of NFC suspension obtained with spruce sulphite pulp.

The industrial product targets for the different end use applications are set, studied and demonstrated in the **Module 3**. The paper and board applications in five different end-use areas will be studied using native or modified NFC in order to increase the strength of or give new functional features to the end products. The NFC-based products now under development lay the foundations for revolutionising existing papermaking processes and developing new processes that will only be possible with NFC. The use of NFC at the wet end is studied to determine whether its strength can be increased in combination with a new product design and, if so, how this could be done. Synthetic binders will be replaced by NFC in the coating of paper surfaces to influence the traditional coating layer properties as required for specific purposes. VTT in Finland is developing foam coating as a new surface application method for fibre-based webs in the KCL's pilot plant together with several SUNPAP partners. The new application method uses special features of NFC, film-forming properties and the high specific surface area. The foam coating under development will apply a thin, uniform coating layer of special-purpose particles.

The **Module 4** is dealing with the health and safety issues in nano fibril cellulose production, application and end products, which will be studied in cooperation with all other modules. The health and safety issues of NFC production, application and end products will be studied in cooperation with all the other research groups. At the same time, the impacts of the products on recycling behaviour and occupational health and safety must also be taken into consideration. Cellulose as such is considered a safe natural material, but the characteristics of NFC differ slightly from those of cellulose. In addition, nanocellulose has three properties that

are associated, to some extent, with pathogenicity in particles. First, the nano form of cellulose can have a higher level of toxicity than larger-sized particles. Second, they are fibres and may therefore behave like asbestos and other pathogenic fibres, which have toxicity associated with their needle-like shape. As a third point, they are expected to be bio-persistent in humans. The testing methodology suggested for the risk assessment of NFC includes in vitro cytotoxicity and immunotoxicity tests to give an indication of whether NFC will cause cellular damage and whether systemic effects are likely. In addition, a nematode model-based test organism is used to investigate potential systemic effects and neurotoxicity. As exposure to NFC is likely to be through inhalation, an inhalatory toxicity study on animals is planned to be included. This ensures that new packaging, and graphic and specialty papers will be able to be produced in an even more sustainable way in the future in Europe.

The SUNPAP project has public web pages http://sunpap.vtt.fi. The public reports and all scientific papers will be available there in the future. The research leading to these results has received funding from the European Community's Seventh Framework Programme under grant agreement n° 228802. The EU will cover almost 70% of the 9.8 million € research costs. The collaborative project will run until June 2012. Most of the project work will be carried out in Finland, Germany and France at research centres committed to the regeneration of forest industries (VTT, PTS and CTP). The biggest industrial partners – and future beneficiaries of project results on an industrial scale – are Stora Enso, Ahlstrom, UPM-Kymmene, Felix Schoeller, Poyry and J. Rettenmaier & Sohne. The SUNPAP project consortium consists of twenty-two partners from eight European countries: Finland, Germany, France, Italy, Sweden, Portugal, Austria and the UK, and they are all EU-member states. The partners include altogether six research organizations, four universities, four SMEs and eight large industrial companies.

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