Hazards to environment and workers reduced with the NeoCel process

NeoCel vison and challenges

Approximately 70 % of the negative impact textile garments have on the environment (in Sweden) originate from its production. Demands for textiles are ever-increasing and cannot sustainably be met with fossil-based fibres and cotton. Cotton cultivation cannot be substantially increased and is associated with high water- and pesticide consumption. Wood-based textiles, like viscose, has a large share but today the production is energy demanding and depends on the use of carbon disulphide (CS_2) - a toxic chemical that imposes hazards both to workers and the environment.

With the NeoCel process - which utilizes cold alkali without CS_2 – the risks of CS_2 are removed. Several other risks will be significantly reduced. This alternative process is highly desirable as it can be both profitable and environmentally benign.

It goes without saying that replacing a process that was first patented in 1892 and has been fine-tuned ever since is a challenge. Solving isolated problems in lab-scale is one thing, but the NeoCel project aims at presenting a process that can be **commercially implemented and integrated into existing pulp mills** in Europe. A holistic approach has been required where environmental, economic and scalability factors are constantly considered for each part of the value chain. During March and April, we will perform large-scale verification trials for producing NeoCel fibres in continuous mode. In our next newsletter we will share the results from the pilot.

Mattias Wennerstål, project manager

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Pulp preparation

The project has been highly successful in pre-treating and optimizing commercially available pulp qualities to enable dissolution in cold alkali. To allow dissolution of cellulose in cold alkali, pulp with an optimized cellulose molecular weight and an open fibre structure

Demonstration of a reference viscose garment that will be compared to garments made from NeoCel fibres.

is required. So far, three different types of pulp have been used in the project; pre-hydrolysis Kraft pulp, dissolving sulphite pulp and recycled cotton. The NeoCel project is derived from earlier projects Fortex, Cellunova, Biocelsol and Fubio. The process that appears most promising for commercialisation is dissolving sulphite pulp that has undergone a mechano-enzymatic pre-treatment at VTT, a process that was explored in Fubio.

— In the NeoCel project we have a very good understanding of the pulp properties that provide the best base for the next step of dissolution experiments. The pulp will fulfil the criteria of being economically viable for large scale production, says Elisabet Brännvall from Rise, research leader of Pulp preparation.

— Karin Walter from Nouryon and I have started writing a scientific article about the best way to prepare pulp for cold alkali dissolution, finishes Elisabet Brännvall.

Dissolution

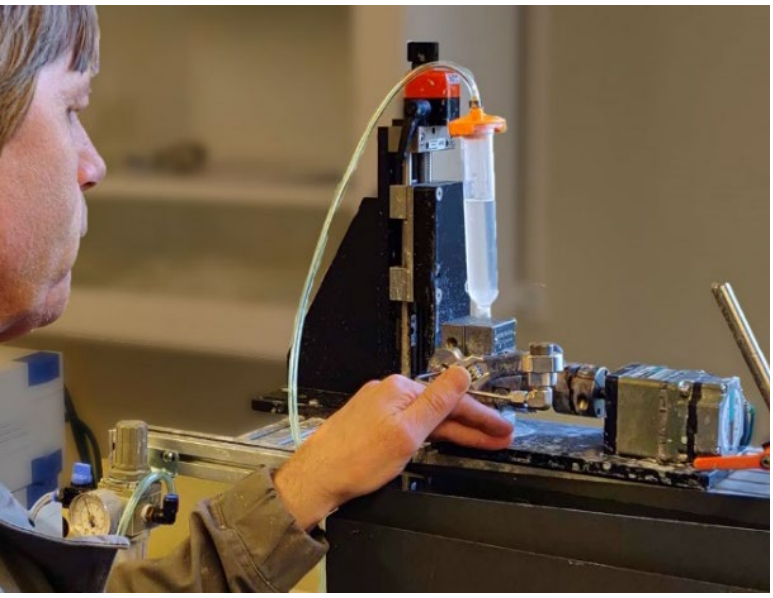
During preparation of the cellulose dope for spinning, the challenge is to maximize the concentration of cellulose. The major achievement of the NeoCel project compared to preceding projects is that continuous processes have been developed for all steps, which allows for scalable production. The first step is to go from producing a few hundred grams at a time to producing several kg of fibres. The final target is to deliver specifications for continuous mass production of high quality NeoCel fibres.

- When we started the NeoCel project, we examined three main cellulose raw materials, two main processes for preparing the dope and several spinning options. We have identified the different needs and are working on defining the most suitable equipment and parameters for continuous manufacturing. We have developed many enhancements for all processes, currently our best dope emerges when we use an enzymatic treatment in an extruder and the LIST-reactor for dissolution, says Marianna Vehviläinen from VTT, research leader of Dissolution.

NeoCel

Fibre spinning

The fibers are spun using a wet-spinning technique in which the dope is pumped through spinneret holes in acidic bath. The dope is coagulated into filaments when contacted with acid. The fiber filaments are stretched in the spinning line between the godets. Typically the higher the stretch the higher the fiber tenacity.



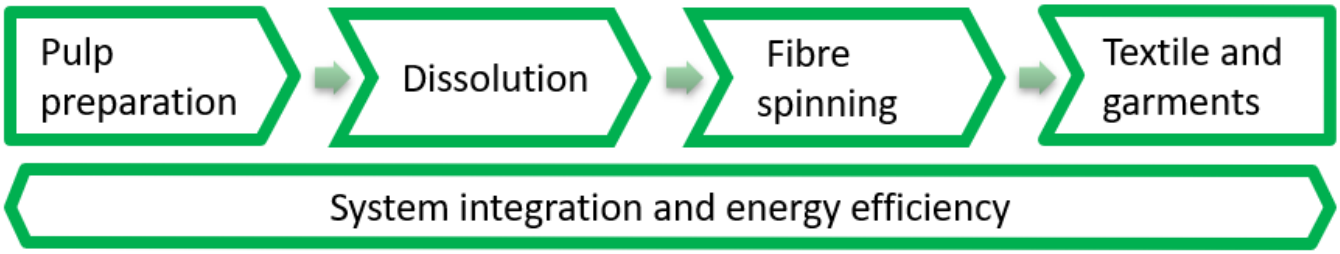
Spinning tests are performed both at Rise and VTT. The small-scale tests at Rise in Sweden (above) make it possible to perform numerous tests using only small amounts of material. The larger tests performed at VTT in Finland enable the production of fibres for further applications.

— It is very inspiring to work with the regeneration of the dope into fibres, as there are endless options to explore in spinning. We explore how additives, the composition and temperature of the spin baths, and how stretching and washing conditions affect the fibre formation. We are about to perform a demonstration of one of the NeoCel concepts with large-scale equipment in Finland. I look forward to analysing the results, says Marjo Määttänen from VTT, research leader of Fibre spinning.

Textile and garments

Using their knowledge and long experience in the textile industry - Söktas, FOV and Katty Fashion have defined the desired characteristics of the woven fabrics that will be produced from the NeoCel fibres regarding properties like fabric weave, specific weight, width of standard fabric, fabric perception etc. Söktaş and FOV will produce yarn and fabrics from the NeoCel fibres using their respective best available process to fulfil the requirements set by Katty Fashion. Protypes will be made by Katty Fashion to demonstrate the quality and usability of garments made from NeoCel fibres.

— After having overcome many obstacles in the project, it is exciting that we now are approaching actual production of garments and are able to test the whole value-chain. With the large-scale trial beginning this month, we will obtain fibre for fabric and garment production. The more successful the trial is, the more weave qualities and finishing treatments can be evaluated. To demonstrate success of the project, it is important to show that the quality of garments made from sustainable NeoCel fibres are equal or surpass the quality of



garments made from Viscose, says Mattias Wennerstål from Rise, research leader of Textile and garments.

System integration and energy efficiency

To identify the most competitive and sustainable NeoCel process, a complete techno-economic and environmental analysis is being carried out on the different variants. Lab-scale and pilot-scale data is collected from the pulp preparation, pulp dissolution and fibre spinning research work. A simulation model of the NeoCel process has been built to enable mass and energy balances to be extracted. The results are used to calculate operational costs and evaluate the environmental impact of each process. After the large-scale trials, the theoretical models will be fine-tuned with the optimized operational parameters.

— So far, the most important conclusion is the positive impact on economy and environment achieved by regeneration of process chemicals. In addition, integration of a NeoCel plant with an existing dissolving pulp mill will result in significant energy savings. Currently, we are estimating investment costs for a NeoCel plant with a capacity of 50 000 tonnes of fibre per year, in collaboration with equipment suppliers and project partners Maurer, Andritz and Nouryon. The assessments performed so far for the NeoCel process show favourable numbers when economical and sustainability factors are compared with the state-of-the-art viscose process, says Marta Lopes from Rise, research leader of System integration and energy efficiency.

The next newsletter will focus on the results of the large-scale test in Finland.

This newsletter is published on the project official site www.neocel.eu. Here you can learn more about the project and sign up for future newsletters. Feel free to share this newsletter to colleagues.

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Research institutes: RISE Research Institutes of Sweden
VTT Technical Research Centre of Finland

Partners: Andritz, Domsjo, AB Enzymes, FOV Fabrics, Katty Fashion, List Technology, Maurer, Nouryon, Re:newcell, Roal Oy, Söktaş