Newsletter headlines:

- **5.8 kg NeoCel fibres to transform into garments**
- **Techno-economic and environmental evaluation in progress**
- **Project initiates four papers**

The NeoCel project begins to round off

With a sustainability focus the project has tested, evaluated and gained insights in producing a fibre that can offer the fashion industry a material that in the future can replace Viscose but with a significantly reduced environmental footprint and highly enhanced safety to workers. Summarising the first phases we have a lot of knowledge of what is possible and not, knowledge to be used in further research and one day be able to start commercial production.

Pilot scale trial

The NeoCel concept has been proved in lab scale and a first pilot trial has been performed. Production in pilot scale is possible but further research (in a new project) is needed to implement pilot production at a pulp mill and maintain fibre quality.

Forest > factory > fabric > fashion

We now enter the phase of creating fabric and actual garments. During this autumn we look forward to present garments made of NeoCel fibres. We seek the attention of a fashion industry whose climate consciousness is growing as sustainable alternatives become available and consumer demands on low footprint increase.

Writing reports and papers

Dissemination becomes an evident part of the project as large areas of research has been performed. Four peer review papers are planned from of a selection of the scientific achievements. The researchers will also share the knowledge attained from the NeoCel project at conferences.

The techno-economic and environmental reports will give an overview of how different choices in setting up an industrial scale production in connection to a paper mill affects economy and sustainability.

A final project report will conclude the project. A lot of tasks to complete this autumn, feel free to contact us for more information.

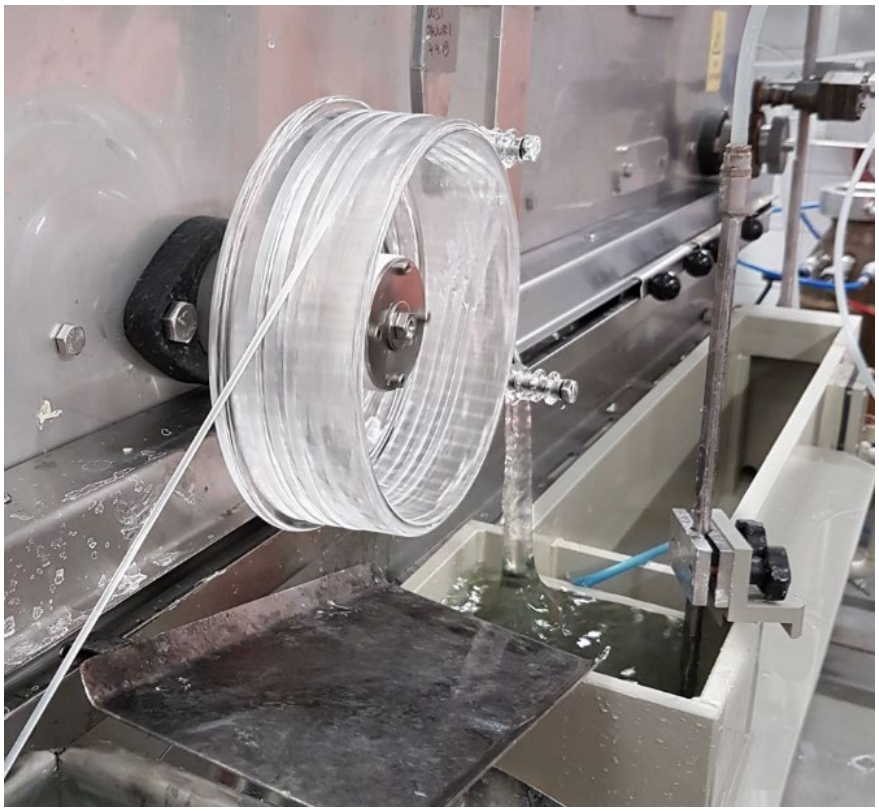
Mattias Wennerstål, project manager

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 720729.

Pilot scale trial

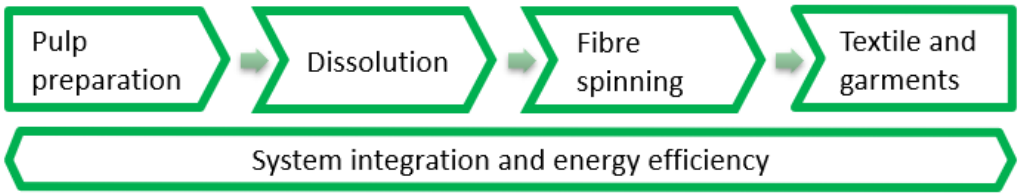
The major target for the pilot scale-up trials was to come closer to commercial production. Processes for dissolution need to be tested for continous production of dope and higher speed in spinning.

The basics of the NeoCel process remained the same as in smaller scale pretests. The challenge of the scale up trial was to find and examine obstacles for continuous production.



Picture from the VTT lab in Espoo, Finland. The as-spun fibre bundle with two thousand filaments is rolled up on the first godet.

The starting material for the regenerated fibres was commercial dissolving grade sulphite pulp from Domsjö. In the first stage, the pulp was activated by using enzymes. The enzymatic treatment proved to be the most effective process for the scale-up trials. The crucial breakthrough for larger scale trials was, however, the successful development of continuous dissolution. The close cooperation between VTT and LIST resulted in a procedure applied for the pilot trials. The pulp was fed together with alkali solvent in the LIST reactor and the dissolved cellulose collected from the other end. Next, the dope was filtrated and wet-spun into filaments using a 2,000-hole spinneret. The filament bundle was cut to 4.5cm staple fibres, that were washed, finished and dried.

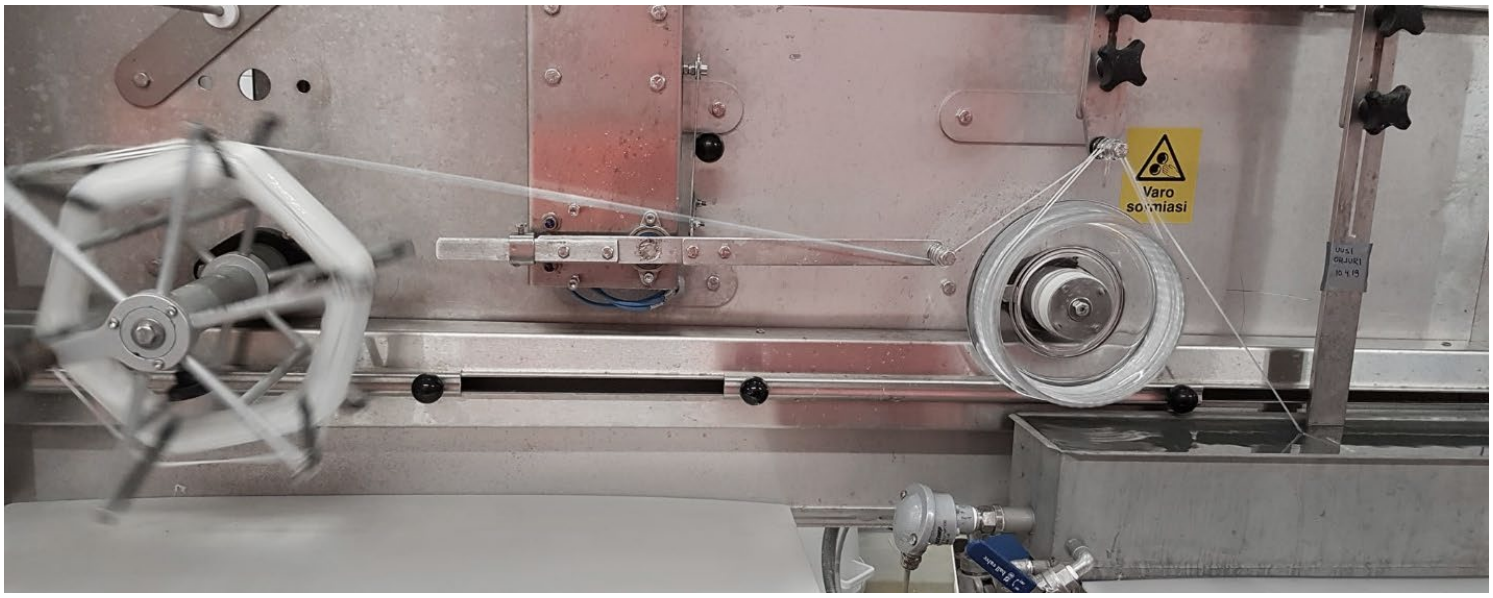


In the Textile and garments phase the staple fibres are carded, spun to yarn and weaved to fabric. The fabric finishing treatment gives the textile certain features in appearance and sensation. Then the fabric is handed over to a fashion house for cutting and sewing.

The NeoCel project has examined three main cellulose raw materials, two main processes for activating pulp and preparing dope as well as several spinning options for regenerated fibres. With continuous manufacturing in mind, automation of pulp activation and dissolution stages would be beneficial to maintain stable conditions.

The fibre regeneration is affected by additives and the composition and temperature of the spin baths. Stretching, washing and finishing also impacts the fibre properties. Different methods of preparing the dope were evaluated and the project found only one method to be viable for continuous production. Here we only account for this solution, more information of the decision parameters will be submitted in the final report of the project.

- Continuous preparation of pulp can be achieved through a mechano-enzymatic pre-treatment in an extruder.
- Continuous dissolution is best achieved using a LIST-reactor.



From the final washing bath, the multifilament fibre runs two rounds on the last godet before it is wound up on the collector.

In earlier lab scale studies, the dope was prepared batch-wise to obtain 6-12 kg of dope for filtration and 1-6 kg dope for fibre spinning. In order to study multiple different wet-spinning variants, a spinneret with 200 holes was typically used.

In up-scale trials, 90 kg of dope was prepared continuously for filtration in four separate runs. Around 50-60 kg of filtrated dope per run was transferred into regenerated fibres using a 2,000-hole spinneret. The spinning speed was up to 40 metres per minute.

In verification trials before the actual test run, different spin dope and bath chemicals were examined to select the optimal conditions for the trial. The final NeoCel fibres had slightly higher titre than targeted, this is partly due to more porous fibres compared to viscose fibres, as the parameter-setting is based on the equations used in the viscose fibre spinning. The higher porosity decreases the tenacity. 5.8 kg of fibres were produced but of a quality slightly lower than anticipated.

5.8 kg fibres in progress to become garments

At project start the desired characteristics of the woven fabrics that would be produced from the NeoCel fibres were defined. The partners Söktaş, FOV Fabrics and Katty Fashion specified properties like fabric weave, specific weight, width of standard fabric, fabric perception etc. Even if the properties of the NeoCel fibres produced now are slightly below the initial specifications, garments can be produced for comparison.

5.8 kg of fibres are currently at Söktaş in Turkey for fabric finishing treatment, yarn spinning and weaving. Katty Fashion in Romania will use it to design and sew prototype garments. With that, the NeoCel project demonstrates the full value chain, from wood to garment, on a scale relevant to large pulp mills.

As in any research project there has been obstacles to overcome. The project is now approaching production of actual garments and thus testing the last links of the value-chain. A more sustainable material production process has been defined; now there is a need to fine-tune it to maintain the quality in pilot and industrial scale. To demonstrate the accomplishments of the project, it is important to be able to show garments made from sustainable NeoCel fibres side by side with garments of other man-made materials.

NeoCel

Techno-economic and environmental evaluation in progress

To identify the most competitive and sustainable alternatives in the processes to produce NeoCel fibres, both a techno-economic and environmental analysis are being carried out. Lab-scale and pilot-scale data have been collected from the pulp preparation, pulp dissolution and fibre spinning. A simulation model of the NeoCel process has been built to enable mass and energy balances to be extracted. The results can be used to compare operational costs and evaluate the environmental impact of each process. With the scale-up trial done, the theoretical models are updated with the optimized operational parameters. The reports will include recommendations on the alternatives that have produced the most competitive fibres and the environmental footprint of each. Within the project, RISE will make an estimate of investment costs for a NeoCel plant with a capacity of 50,000 tonnes of fibre per year, will be made in collaboration with equipment suppliers and project partners LIST, Maurer, Andritz and Nouryon.

The positive impact on the environment by the high degree of regeneration of process chemicals was evident already in the first LCA assessment. A NeoCel plant integrated with an existing kraft dissolving pulp mill would result in significant energy savings. The NeoCel process has highly favourable numbers in sustainability factors compared with state-of-the-art viscose process.

Scientific papers and conference presentations

- Elisabet Brännvall at RISE and Karin Walter at Nouryon are writing an article about the pulp preparation and dissolution methods and experiences.
- Another article is currently being prepared by Marianna Vehviläinen, Stina Grönqvist and Marjo Määttänen at VTT. It will cover their work of the enzymatic pre-treatment of pulp and aspects of continuous dissolution in a LIST reactor.
- Marta Lopes and Marta Bialik from RISE are co-writing a paper on regeneration processes of NeoCel chemicals and process simulation of the different NeoCel variants. Marta Lopes is also presenting at the AvanCell conference in Gothenburg.
- Ana Martha Coutiño and Marta Lopes at RISE are preparing a scientific paper on the environmental impact of variations in the NeoCel process and LCA methodology. Ana Martha Coutiño is going to present at the international conference Greening of Industry Network in Mexico City.

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. Contact: contact@neocel.eu

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