SUSTAINABILITY: FOREST TO FASHION

Growing demand for cellulose-based fibres along with the evolution of the paper industry are attracting investment and research into new processes and raw materials for lyocell, a fibre many believe has some of the best eco-credentials.

New additions to the lyocell family

While Vancouver-based non-profit environmental organisation Canopy strives to raise awareness in the fashion industry regarding the sourcing of wood-pulp fibres, research into alternative cellulose-dissolving processes may lead to a new family of regenerated cellulose fibre.

In Finland, Aalto University and the University of Helsinki are working together on new end markets for the wood pulp industry on a fundamental and applied research level. With Ioncell, one of the projects under way, the goal is to develop a new lyocell-type fibre for the textile industry.

Ioncell is made via the lyocell cellulose-dissolving process but it substitutes the usual solvent used, N-Methylmorpholine-N-oxide (NMMO), with ionic liquid. Compared to the traditional process, this new chemistry is seen as having a number of advantages, one of them being the ability to dissolve many types of pulp, including wood, which would widen the range of raw materials available for lyocell processing. The resulting fibre is said to possess the same properties as lyocell, including its high tenacity when wet. But the Ioncell research team says its process is both more sustainable and more versatile, as it claims the fibre can be modified during spinning, which is carried out at lower temperatures than conventional lyocell. Though there is still much research to be done, "we have proof of concept," says Michael Hummel, a researcher working with project head, Herbert Sixta, professor of biorefineries at the department of forest products technology at



Few consumers realise that their viscose, modal or lyocell garments originally come from wood pulp. The non-profit Canopy is looking to change that.

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Aalto University's school of chemical technology. Among the properties that can be added, Professor Sixta and Mr Hummel mention the integration of additives to improve moisture management, provide antibacterial functions, reduce fibrillation, or pharmaceutical substances for medical uses.

At the moment, Professor Sixta is confident that Ioncell will present the same properties as conventional lyocell. "Our ionic liquid solvent has a number of advantages compared to NMMO. The dope can be modified, we can produce bicomponent fibres, containing cellulose and lignin, for instance, and the solution properties seem to be better, but we remain cautious." Experimentation has been conducted on Nordic wood species, primarily pine, spruce and birch woods. BASF is one of the suppliers of ionic liquid, and would be a logical candidate to produce the solvent.

Several challenges lie ahead, including one crucial stage—the ability to recover and reuse the ionic liquid solvent. In current lyocell production at Lenzing, 99% of the NMMO solvent is recycled. "For environmental reasons, we have to be able to recover close to 100% of the solvent," says Professor Sixta. Work on the recyclability of the ionic liquid solvent is the subject of a three-year research project to start later this year.

Ioncell is therefore far from market-ready. "It is too early to say when we will be ready and there are many variables," says Professor Sixta. Considering the history of NMMO, which was discovered in the 1930s and only became commercial in the 1990s, he says it is unrealistic to expect that a new solvent will be found and brought to market within a three-year period.

Dissolving garments

Renewcell is yet another innovative approach to cellulose fibre making, coming from a Swedish company formerly in the wood pulp business. "We believe that if paper can be recycled, then it should also be possible to recycle cellulose fibre textiles," says Renewcell head of business development, Henrik Norlin.

After research into different methods of dissolving clothing made of cellulosic fibres, Renewcell was founded in 2012 and set up a pilot plant that is now said to produce dissolved cellulose on a semi-industrial scale. "We produce 2,000 tonnes per year, which is not much, but sufficient to show commercial feasibility," says Mr Norlin. The solvent chosen is said to produce dissolved pulp from viscose in a cheap, environmental and low-energy manner.

Renewcell is investigating two different recycling options. One is to separate the non-textile elements mechanically, as is done currently, by ripping, centrifuging or sinking methods. The other is to separate the cellulose from non-cellulose matter chemically, which is the long-term goal. The company says it has made progress on its ability to recycle blended fabrics.



The Renewcell process starts with high cellulose content garments that are dissolved to obtain regenerated cellulose.

Renewcell

As with the few other existing garment recycling processes, getting hold of high-quality raw material is one of the main challenges. "Our process ideally requires high cellulose content apparel, but we also want to lower the bar on the types of materials that can be treated and this has been the focus of research this past year," says Mr Norlin. He believes this is an attainable objective if one looks at how paper recycling evolved over time. "In the beginning only clean cardboard and paper could be recycled. With time, the bar was lowered for what could be recycled into paper suitable for reuse." Renewcell is actively campaigning to set up a supply chain, and is optimistic. "The companies that recycle paper and glass are now making money and are interested in adding textiles to their businesses," says Mr Norlin.

Ultimately, Renewcell plans to model its business on that of companies such as Tetrapak, by licensing the technology and selling the machines. The company intends to sell dissolved pulp, not produce fibre. "We would like to see our recycled pulp mixed with virgin pulp, as our pulp is of a quality comparable to that used to make viscose or lyocell," says Mr Norlin.

Bamboo lyocell

Bamboo-derived Monocel is yet another lyocell fibre with an environmental edge and a Nordic background, launched a few years ago by a company based in Norway. However, bamboo sourcing as well as fibre and fabric manufacturing take place in China. Monocel's current fabric range covers three markets: knits, shirting and denims (including an ozone-treated



Monocel has developed a bamboo-based lyocell that is used to make denims, shirting and knit fabrics.
Goldspot/Tom Christian Henriksen

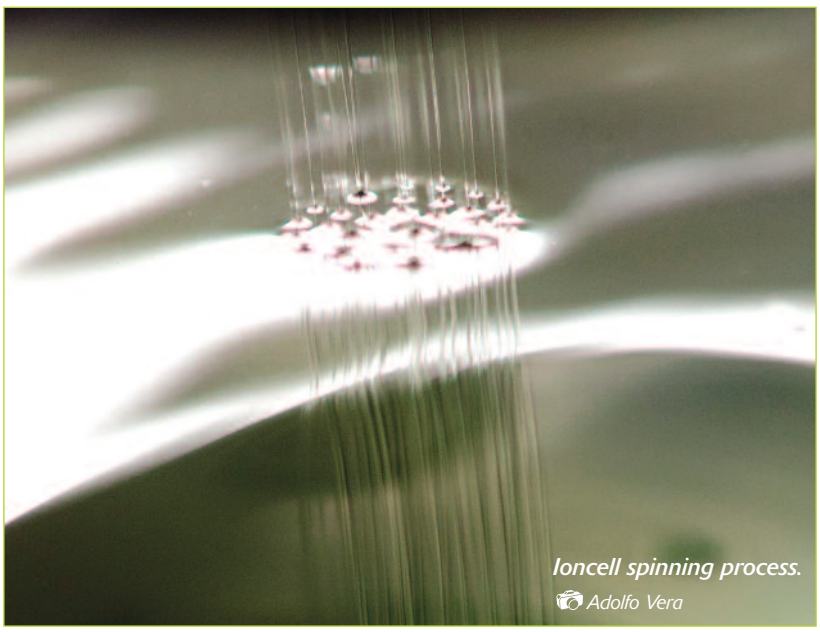
four-way stretch denim with Lycra). In the future, the company plans to offer blends with other eco-friendly fibres such as linen, hemp or organic cotton, which is why the young company has decided to abandon the use of the brand Nankatan. Intended to evoke the notion of "non-cotton", Nankatan was the name used to market the company's fabrics made from the bamboo lyocell fibre branded Monocel. Founder and CEO Jonny Kristiansen's strict vision of the future of fashion was to replace all cotton with regenerated cellulose fibres. But the supplementary cost of bringing two brands to market weighed in on the decision. "The two names were confusing for clients and consumers, and Monocel is easier to pronounce," says Monocel communications manager, Ellen Tviberg Moran.

Compared to conventional lyocell, the young company is adamant that Monocel is different, because it is made from bamboo. "Bamboo is a grass, not a tree. It grows fast, even after having been harvested, and requires no watering. The bamboo root system is quite different from that of trees, bamboo grows on poor quality soil and actually improves the quality of the soil," says Mr Kristiansen.

While bamboo viscose is regarded as not environmentally friendly, Monocel would be an acceptable alternative to the conventional wood pulp cellulosic fibres that non-profit environmental organisation Canopy says depletes endangered forests. On matters of environmental impact and traceability, Monocel takes this issue quite seriously, says Mr Kristiansen: "From farm to fabric manufacturing, we work with a few carefully selected and monitored suppliers. Fibre spinning is done in a single factory. The farmers we work with apply organic or traditional farming methods, without chemicals or artificial fertilisers. For the single pest that attacks bamboo, old-fashioned practices are applied such as limewater, bull's urine or rice soup."

Like Tencel, Lenzing's lyocell brand, Monocel uses the NMMO solvent, which is nearly entirely recovered and recycled. The lyocell process leads to a fibre that possesses higher strength than viscose and cotton, in wet and dry conditions. It is however not a cheap process. Again similar to Tencel, Monocel is more expensive than other regenerated cellulose fibres. However, Mr Kristiansen says it is cheaper than natural fibres such as linen, wool and hemp.

From Finland to Sweden and Norway, Nordic companies may have many reasons to seek out new markets for wood pulp, but the region is also at the cutting edge of new-generation cellulose fibres that have the potential to provide new options for the textile and fashion industries in the medium to long term.



Ioncell spinning process.
Adolfo Vera

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