A team of researchers from Finland claims to have come up with a greener alternative to Lyocell because it uses enzymes rather than "harsh chemical processes" to produce cellulosic fibres.

Greener cellulosic fibres



Researchers in Finland believe one of the uses the country should make of its forestry resources is to make cellulosic fibres for textile applications, but using a greener method based on enzyme technology.

Lobke Thijssen/Wikipedia

A project announced in 2006 by the authorities in Finland to find ways of turning some of the wood from the Nordic country's forests into "resource-efficient production technologies" immediately attracted the attention of serious players in industries such as paper and chemicals. One of the focal points was always intended to be cellulose, using cellulose from the trees in material applications, and by March last year, a bio-refinery had been set up with the project leaders looking for new value chains to supply. According to one academic who has been active on the research side of the project, Professor Pertti Nousiainen, director of the institute of fibre materials science at Tampere University of Technology, the textile industry is a logical candidate.

The objective for this part of the project, called FuBio, is to find and develop technologies to use bio-refineries to modify cellulosic fibres into "future valuable materials and solutions". Given the stakeholders that the project attracted, the initial examples were applications in wood products, biofuel and packaging; textiles came some distance down the list. Professor Nousiainen and his research colleagues saw quite quickly, though, that the success of Lyocell means textile applications could fulfil one of the main criteria of FuBio, that the textile value chain is large enough in scale and value to cover the cost of using bio-refineries to extract fibres.

The producer of Lyocell, Lenzing, reported its best-ever six-month results in 2010, net profit of €80.4 million on sales that increased by 43.6% compared to the first half of 2009 to €847.2 million. In 2009, it issued a prediction for this year that, in 2010, fabric and garment manufacturers would use around five million tonnes of cellulosic fibres (not just Lenzing's, but across the board), a bigger share of the market than these fibres have ever had before. Part of the reason for the increase may be the association between cellulosic fibres, which come from plants, and sustainability. Lenzing itself says using wood as a renewable resource, and an "environmentally sound" production process help make its sustainability status "exemplary".

For Professor Nousiainen, the cellulosic fibre production he and his colleagues believe can arise from FuBio will prove to be more sustainable still. "Our approach is to use enzymes," he explains. "Enzymes open the nanofibrilar structure of the cellulose system allowing manufacturers to produce regenerated fibres that are very similar in tensile strength to viscose fibres."



The professor points out that wood cellulose is important, but has a compact physical and chemical structure and does not dissolve easily. He calls the processes current producers employ "difficult, expensive and often harmful to the environment" and says the use of enzymes instead is "an interesting green alternative to dissolving cellulose".

He explains that commercialising this is an important aspect of FuBio and that the research team has been co-operating intensively to create a development plant,which will use machines that are used to produce viscose at the moment.

The bigger picture

According to Lenzing, using enzymes to produce cellulosic fibres rather than chemicals might not be such a bad idea; however, the company is not convinced it can be done effectively.

Dieter Eichinger, vice president, business unit textile fibres, agrees with Professor Nousiainen that dissolving cellulose is not a straightforward process. If it was possible to do this in water, for example, trees would be dissolving in lakes and seas across the globe. Cellulose is a polymer that has quite a long chain and as far as Mr Eichinger is aware, there are only two commercial ways of dissolving it. The first is to do so using a chemical process, as textile manufacturers do for example in the case of viscose. The second is to use a solvent as Lenzing does in the Lyocell process.



Lenzing fibres such as Modal, Lyocell and Tencel are widely used in a range of apparel applications now.

Lenzing AG/Elisabeth Grebe

"So far the enzymes I'm aware of only degrade the polymer to a level to remove fibrils; this is used in textile technology to polish the surface," says Mr Eichinger. "I don't know exactly



Lenzing is enjoying strong growth as demand for its cellulosic fibres remains high.

Lenzing AG/Markus Renner

what the technology behind this [new development] is but of course it is always interesting testing new technologies on a commercial scale."

The end result of using an enzyme rather than chemicals would be the same, he says; however the benefits of using enzymes would greatly depend on the process. Isolating any one aspect of the production process is a mistake, according to Lenzing, because the only real benefits come from improving the whole chain. In the case of textiles, this can be very complicated, Mr Eichinger explains.

"Spinning is the first hurdle," he says. "Then there is dyeing and finishing. Lenzing has dedicated itself to working on this much more than in the past because the biggest impact on the environment takes place on the dyeing and finishing side. If you really want to save the world you're better off looking at that. When we talk about green stories, we always have to think about what impact we are having overall."

In terms of the solvent Lenzing uses to dissolve the polymer, he claims it is comparable to the type of detergent used in shower gels around the world on a daily basis. As a result, he suggests looking for an alternative might not be as necessary and impactful as it might sound.

Getting the focus right

Mr Eichinger suggests that there is a lot of hypocrisy within the "green" textile sphere. He recently gave a presentation in New York that focused on green issues. Despite the subject matter, people flew from all over the world to attend the conference and had no qualms about the air conditioning that was being used to keep them cool and comfortable. "If you think about what is happening in society we have to compromise, you can't be perfect," he says. "You try to think about all of the elements and the impact of them, and then compromise. You have to be transparent, this is what we are doing, and always trying to improve," he continues. "It's a never-ending story."

The two most important things, he claims, are having a product that feels right and performs well, and that this product has a viable story behind it. "Technology is one thing and product properties are another," he says. "For example, with Tencel and Modal, the first thing is that you feel the difference. The combination of personal experience and the confidence you have that something is also greener draws the attention. It is something to talk about."

Mr Eichinger compares Lenzing to consumer electronics brand Apple, which not only offers individual products, but provides a much broader concept. "It's about providing the whole package, hardware and software," he says.

He explains this by saying that the problem for most textile and clothing brands is that they have very little research and development capacity, so they have to be careful where they focus their efforts. This, says Mr Eichinger, is where Lenzing has the edge. "We give them the stories, the product development information, the marketing help. We also reduce the risk for our customers because we have tested our fibres extensively. For a new company it's not easy to have the whole package available. People build businesses on confidence."

According to Mr Eichinger, Lenzing isn't worried about technological advances that are being made by its competitors. "The market is so big and everything takes time. There is plenty of capacity," he concludes.