OAKDENE HOLLINS

RESEARCH & CONSULTING

Chemical recycling – A solution for Europe's waste textile mountain?

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Textile production accounts for 10% of the world's carbon emissions and the sector is the second most polluting in the world (following oil).[i] The responsible treatment of textiles at their end of life (EoL) is important to prevent further negative environmental impact. Textiles are a problematic waste stream, and outside of well-established reuse markets and capacity limits for textile recycling processes, there remains a large proportion of low-value materials for which there is no market pull to utilise. Current treatment options for these unrecyclable textiles are incineration and landfill, where - at best - a miniscule fraction of the energy used in their production is recovered. At worst, textiles enter landfill where they remain for decades and emit methane gas, a well-known contributor to global warming.

In a recent market study carried out on behalf of the RESYNTEX consortium[ii], we quantified the textile waste being landfilled or incinerated in the European Union (EU) at 9.35 million tonnes, across a variety of sectors. This total, equivalent to 18 kg per inhabitant, hammers home the fact that an unsustainable quantity of textiles is currently slipping through the cracks in the provision of environmentally responsible EoL textile treatments in the EU. Blended fabrics present significant problems for high-value recycling, as it is not possible to separate blended fibres by using mechanical processing and previous attempts at chemical recycling have proven both to be impractical and to raise environmental concerns.[iii] A potential answer to this is the development of innovative chemical recycling technologies for textile materials, which brings us to the discussion of RESYNTEX, an international project led by SOEX and part-funded by the EU's Horizon 2020 programme.

This project, which Oakdene Hollins is delighted to have been part of, is addressing some of the technological barriers associated with the chemical recycling of blended textiles, and low quality textiles in particular. The RESYNTEX project is aimed at providing a valorisation route for the estimated 9.35 million tonnes of textiles which are currently incinerated or landfilled in the EU every year. Collectors and sorters operating in this area in some cases will have to pay to dispose of unrecyclable textiles, increasing the need to find alternative solutions to this problematic waste. To achieve this, the consortium is aiming to build a four-stage pilot plant to extract a separate chemical product at each stage:

- proteins from animal fibres (wool, silk, alpaca, mohair etc.), for use in wood-based adhesives;
- glucose, for conversion into bio-ethanol, derived from cellulosic fibres (cotton, viscose / rayon etc.);
- polyamide oligomers, from polyamide; and
- polyester (PET) monomers, from polyester.

The technological challenges faced at each stage, and in combining the stages into a viable process, are significant. Oakdene Hollins' contribution was a market study of the inputs (residual textiles) and outputs (chemical products) of the process, including an in-depth quantification and description of the residual textile waste available in the EU to use as inputs to the process. We added value by describing and mapping the waste streams containing the residual textiles in sufficient detail to help the consortium to identify the accessible residual textiles most suited to their input needs.

Whilst the RESYNTEX process is focused on low-value textile waste, there are notable examples of wider activity in chemical recycling technologies for textiles. Encouragingly, partnerships are being seen between brands and innovators to move this technology closer to a commercial reality, examples include:

- Evrnu™ fibres, derived from recycled cotton, have been demonstrated in prototype jeans for Levi Strauss & Co.;[iv]
- the Re:newcell plant in Sweden under construction which, when complete, will have the capacity to recycle 7,000 tonnes of cotton and other cellulosic fibres per year;[v]
- Lenzing's collaboration with fashion retailer Inditex to source inputs for its plant producing lyocell fibres from waste cotton;[vi]
- Ioniqa, primarily a PET bottle and packaging recycling company, has developed a process enabling it to accept and recycle coloured polyester textiles;[vii] and
- Worn Again, in collaboration with H&M and Kering, has developed a chemical recycling process for polycotton blends able to separate and extract polyester and cellulose from textiles.[viii]

Of these five examples, only one addresses blended textiles - and then only polycotton, a specific type of blended textile. The other processes accept only single-fibre textiles, cotton or polyester. The focus of three of these processes on cotton may reflect the concern over the particularly high environmental impact of this fibre. These developments are encouraging and although they are on a smaller, more niche scale than RESYNTEX, will provide opportunities for specific types of textile waste.

One point of note is that the quality requirements on the inputs of the five aforementioned processes are not clear from the available literature and hence the potential impact each process could have on the 9.35 million tonnes could not be quantified. However, the prevalence of partnering with retailers - where returned garments are typically of particularly high quality - may suggest that these processes have a low tolerance for impurities and contaminants. It is also important, from a sustainability perspective, that garments which are suitable for reuse are not recycled as a first option. It is well known that reuse reduces the overall life cycle impact of a textile product significantly more than recycling and therefore should be considered as the primary option, followed by recycling if reuse is not possible.

The report produced by Oakdene Hollins will be available in due course through the RESYNTEX consortium. In the meantime, if you have any questions or comments, please get in touch with us.

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About Oakdene Hollins:

Oakdene Hollins is a consultancy and research business that advises on sustainability and the circular economy. We work with policy makers in government and business wishing to effect change in their organisations. Our customers look to us for innovation and thought leadership, but also for sound and evidenced advice on:

- *putting sustainability and resource efficiency at the heart of business operations*
- *researching and designing interventions throughout the product life cycle from raw material supply and product manufacture to use and end-of-first-life strategies*
- *enabling successful product and service innovation.*

The company has developed substantial global expertise in resource management and economics. We have a growing involvement in business models that enable a more circular economy and we operate Europe's only centre that focuses on remanufacturing and reuse (see www.remanufacturing.org.uk).

We aim to contribute to sustainable development not only through our advice and research, but also in the way we conduct our own business. We seek substantial improvements in resource- and carbon-intensity that mean a long-term transformation in how we work. Oakdene Hollins is registered to ISO 9001:2008 and ISO 14001:2004, and has gained certification to the Government-approved Cyber Essentials Standard.