



Code breakers

Pioneering technology business Worn Again claims to be able to fully recycle cotton-polyester blends – and is confident it can replicate its promising lab results on a commercial scale

LONDON – UK tech business Worn Again has told *Apparel Insider* it is confident its futuristic textile recycling technology will be able to demonstrate cost effectiveness at scale. It is claimed that Worn Again's technology can take used polyester, cotton or a blend of the two, put then through its patented chemical recycling process, and provide virgin equivalent PET resin and/or cellulosic pulp equivalent to that of dissolving wood pulp. Perhaps most significantly, the outputs are said to compare with their virgin equivalents in terms of quality and, it is claimed, will be price competitive once commercialised. Worn Again, which has been around for several years – and at one point appeared to have slipped off the textile recycling radar – says it has now hit its £5m investment target to accelerate its polymer recycling technology. This is the most pertinent point here. We've come across plenty of research papers over the past five years in

which scientists or PhD students have demonstrated the separation of cotton-polyester blends in the lab, generally using ionic liquids (salt in a liquid state). As science goes, this is not particularly cutting edge. The missing link, however, has always been money. Backers for such technology are few and far between for several reasons, perhaps the most obvious of which is that this whole area is such a leap of faith. Can lab results be replicated, cost effectively, at scale? Will there be a market demand for the newly created fibres? Where will feedstock come from? How challenging will it be to set up a supply chain infrastructure for such a process? Which fibre makers are willing to get involved? CEO, Cyndi Rhoades acknowledges finance has been a major hurdle. She says: "The task of finance raising has been just as challenging, if not more, than the technology itself! We're not alone on this. Like other innovations

“We have no interest in producing premium price outputs which remain a niche market and more expensive than virgin prices”

in development, we've seen a huge industry demand for textile to textile recycling solutions, which many brands are making sweeping commitments around, in terms of future circular/recycled raw materials sourcing targets. Yet it's been surprisingly difficult to find those willing to put finance towards solutions that can actually help to deliver those goals." On this front, it is notable that as well as fashion retailer H&M, Worn Again's work has now also been joined by other new partners, including Sulzer Chemtech, one of the world's largest chemical engineering companies; Mexico based Himes Corporation, a garment manufacturer; Directex, a textiles producer, and Miroslava Duma's Future Tech Lab. The business now has a serious, credible partner and investor network behind it. Worn Again is also, successfully, addressing other issues highlighted above. Rhoades told us: "Central to the original design brief for the chemistry and process behind our technology is the need for it to be able to deliver outputs which compare in quality and compete on price with virgin equivalent raw materials, once industrialised.

"We have no interest in producing premium price outputs which remain a niche market and more expensive than virgin prices. The industry is crying out for one thing: textiles to textiles raw materials recycling solutions that can deliver cost competitive 'circular' raw materials to go into clothing and apparel. We have been working closely with the industry from very early on and have understood this to be an essential parameter, unlike other costly processes in the past which have not succeeded in creating a real and competitive alternative to virgin raw materials."

Rhoades tells us Worn Again is using its own patented protic ionic liquids which are well known and widely reported in the literature as being significantly cheaper than conventional ionic liquids. "Regardless, solvent recovery is key to commercial viability at scale and is a crucial aspect of our developments as we scale the process industrially," she adds.

In terms of timescales, Rhoades says the first industrial demonstration plant will be launched in 2021 with full commercialisation to follow soon after.

Probed further on the scaling issue, Rhoades added: "Feasibility studies on our process are carried out at each stage in developments and have provided a clear indication that this will be achievable for our two outputs, virgin equivalent PET resin and cellulosic pulp equivalent to that of dissolving wood pulp, even in

comparison to historical market lows for both of these commodities.

"However, achieving the goal of virgin cost competitiveness is not just about the processing cost. Being able to deal with blended fibres to produce dual outputs and the cost of 'feedstock', or inputs into our process, are equally important. Our feedstock specification is textiles made up of pure polyester, pure cotton and/or any combination of the two, with a tolerance of up to 20 per cent 'other', i.e. wool, nylon, elastane, etc. This feedstock specification represents about 80 per cent of clothing and apparel made today."

Staying on the issue of feedstock, this is an area Worn Again has clearly given strong consideration to. Adds Rhoades: "Understanding what gets collected in the end of use textile supply chain by charities and private collectors is key. From the sorting trials we've carried out independently and as part of the European funded Interreg 'Fibersort' project we've found that there is on average about 40 per cent pure cotton and only 7 per cent pure polyester found in the end of use textiles supply chain, with poly cotton blends making up around 33 per cent."

"Because our process can handle all of these variations, our future plants will be able to buy in a higher proportion of feedstock than a polyester or cotton only recycling process. While there's a lot more pure cotton, the price per tonne can be as high as US\$400/tonne, while the price of low value polyester and poly/cotton blends goes

“Because our process can handle all of these variations, our future plants will be able to buy in a higher proportion of feedstock than a polyester or cotton only recycling process”

for between US\$50-100/tonne in downcycling markets. But what about contaminants? On this front Rhoades tells us that Worn Again's technology is based on a dissolution process which selectively targets and dissolves only the polymers it is after - PET and cellulose from cotton. She adds: "All dyes, finishes and other contaminants which went into the original materials are separated out to produce pure, uncontaminated outputs. We have carried out rigorous testing regimes on end of use textiles sourced from all over the world, from both known and unknown sources and have not yet come across a contaminant that can't be removed by our exhaustive leaching process." These are the kind of questions those in the know about this area have been asking for several years. Credible answers have been few and far between, and Worn Again has clearly done some serious homework on this issue. There is much talk of closing the loop in apparel industry circles. This work is as close as we have seen anything get to actually making that happen.

Our special thanks to Nick Morley for technical input on this article. Nick is the chair of Mistra Future Fashion, one of the world's largest research programmes in sustainable fashion. His own business Faering aims to help make fashion innovative, responsible, clean and local.

