RISE TO THE CHALLENGE: FIBERSORT



Officially presented this past March, the Fibersort is a semi-automated machine that identifies and sorts textiles by composition. Now close to commercialisation, it could increase the value of used garments and facilitate the recycling of post-consumer clothing into new fibres.

Fibersort powers up

The challenge is colossal. In northern Europe alone (France, Netherlands, Belgium and Britain), an estimated 4.65 million tonnes of clothing are thrown away every year, said Traci Kinden, Circular Textiles Project Manager at Circle Economy, at the Fibersort Demo Day held in Wormerveer, the Netherlands in March. She believes that the buying of clothes by consumers will continue to increase by as much as 60% in the years to come.

Anyone who has visited a collecting and sorting facility is immediately struck by the mountains of used clothing and home linens that end their first useful life in organisations such as Le Relais in France, Soex in Germany or Wieland Textiles in The Netherlands, where the Demo Day took place. The workers at these companies process incoming goods in several time-consuming stages: each bag is opened, each item inspected to determine whether it can be resold or not and then placed in one of many bins. This is the stage at which the Fibersort comes into play, reading the composition of each item of pre-sorted clothing and automatically grouping all like garments together.

The latest version of the Fibersort machine has been in operation since this January at Dutch company Wieland Textiles. It has been in development since 2011 at Valvan Baling Systems, a Belgian machinery manufacturer that specialises in sorting and baling systems for the used clothing industry.

A project financed by Interreg Europe North West, it is the result of a collaborative effort with many partners, including Reshare, a collector linked to the Salvation Army, Belgian shredder and spinner Procotex, UK-based Worn Again, a project investigating the chemical recycling of poly-cotton clothing, and Dutch social enterprise Circle Economy, which is aiming to create a closed-loop textile industry. These are all members of the consortium along with Wieland Textiles and Valvan Baling Systems.

The latest iteration of the project has received €3.53 million in funding and is running from September 2016 to September 2019, when the Fibersort should be ready for commercialisation. The machine will have then been in development for close to a decade as it is an evolution of several earlier projects starting with the Textiles4Textiles and Jeans4Jeans circular economy projects launched in 2010 by Wieland.

The Fibersort machine conveyor belt is lined with nozzles that blow each garment into a collection box of clothes of the same composition.

Circle Economy

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Optical reading

After testing various options, the technology that has been chosen to equip the Fibersort is near-infrared (NIR) spectroscopy. This method analyses the molecular structure of a textile and identifies the types of fibre it features based on the wavelength at which it reflects light. Advanced software and algorithms have been used to build up a material library, against which each garment that passes through the optical reader can be checked. The system is also capable of machine learning, so as to continually improve the accuracy of the identification process. As this method is sensitive to organic constituents, and all textiles are organic, the project partners believe there is no limit to the type of fibre that can be recognised.

The Fibersort does, however, require a manual input. The process begins with the arrival of a batch of garments on a sorting table, which must be placed by hand one piece at a time on a scanner. The near-infrared spectrometer detects the type of fibre, which it can do in less than a second. The garment is then moved onto a conveyor belt lined with 14 high-powered air nozzles and collection boxes, one for each of the pre-determined fibre categories. Once the fibre type has been identified, the system communicates with the relevant air nozzle, which is directed to blast air as the garment passes, blowing it into the correct collection box.

The fourteen composition categories it currently analyses cover six pure compositions (wool, cotton, acrylic, viscose, polyamide and polyester) and eight blends (cotton/polyester, cotton/polyamide, wool/polyamide, wool/acrylic, and so on).

The system is incorporates a 15th nozzle and collection box for material that either cannot be identified or can be identified but does not fall into one of the 14 categories. At present, the 15th box takes around 60% of the total material input, meaning only 40% of the materials passing through the machine are accurately sorted. The machine's inability to identify a composition can be due to several causes: the clothes may be wet or dirty, or a non-fibre component (zipper, sequin, button) may skew the reading. The optical technology may also be thrown off by dark coloured clothing. For future iterations of the machine, Valvan would like to reduce the proportion of clothes left unidentified. "If we can bring the current rate of 40% uncategorised down to 20% that will be a great achievement," Valvan sales engineer Gaétane Decloedt told *WSA*.

Human vs machine

The process of identifying composition is where the Fibersort can make a difference in streamlining recycling processes. "It takes six seconds for a person to read a label, while the machine identifies an item's composition in just one second," says Mauritz Vandeputte, Fibersort project engineer at Valvan Baling Systems. The machine's current capacity, treating 1,260 kilogrammes of clothing per hour, is limited, he says, by the time the human operator takes to place an item of clothing to be scanned. Its advantage over human input is that used clothing sometimes no longer has a label or has a label that is illegible. In other cases, it can be inaccurate. With Fibersort, there is no need to find the label as its spectrometer identifies fibre composition in 100 milliseconds.

During the presentation, Mr Vandeputte said that 73% of today's used textiles are sent to landfill, 12% are downcycled and only 1% are recycled into a new textile. The used clothing that collectors and sorters process falls into four different categories: 50% is resold as is and reworn, 15% is unusable and disposed of as waste, and 10% is made up of multifabric clothes that are difficult to recycle. This leaves 25% made in a single material, by nature more homogenous in composition (even if a poly-cotton blend). This is the category for which the Fibersort provides an automated sorting solution and this is also the category which is arguably the easiest to recycle into a new textile.



Bales of used cotton clothing at Wieland Textiles Sorting Company that will be sorted by colour before being shredded and spun into a new yarn

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The sweater sort

The knitted sweaters category was the product family chosen for exhibition at the Fibersort Demo Day. "It is a highly diverse category in terms of composition, but these types of clothes are often made in a single material throughout and tend to have few design details such as cuffs or collars. Furthermore, once shredded, knitted garments produce fibres that are longer in length, and therefore more suited to being re-spun, making them potentially more valuable," says Mr Vandeputte.

"We chose the most difficult product category to identify because of the variety of materials used to make sweaters, but also because it can generate the longest fibres," says Hans Bon, founder and CEO of Wieland Textiles Sorting Company and one of the initiators of the research project that has led to the development of the Fibersort. "The volume of non-rewearable clothing continues to grow. In the Netherlands, cities are now required to recover five kilogrammes of clothing per inhabitant yearly. This means more clothing will be collected, but of lower quality," he says. In the past, up to 60% of the items that the company sorted could be sold as 'rewearable', a proportion that has fallen to barely 50%. And though 'rewearable' clothes are the most lucrative, their price has fallen from €0.30 per kilogramme in the past, to €0.07 today. "That is the financial aspect of this project, but there is also a critical need to reduce waste and to reuse existing available materials in a circular economy," he says.

Critical mass

The need for high volumes of homogenous used clothing for recycling is critical to its potential reuse by the garment industry. "Even a small run at H&M can reach the thousands of items. Major brands will require a large and constant flow of recycled material if and when they decide to add more recycled content to their product offering," says Antonio Roade, Circle Economy Textiles project manager. To which Mr Bon adds: "If Nike or H&M integrate 20% of recycled post-consumer cotton into their collections, we will then have the demand we need. And even if they combine 20% of recycled content with virgin fibre, that is still better than nothing."

The early focus of the project has been on knitted materials, although the partners insist the technology is also capable of accurately sorting woven materials. Valvan intends to add more categories, other fibres, fabric structure and even colour, and increase production speed to maximise yield.

Since the development of the first prototype machine, several iterations have already been introduced. Mrs Decloedt expects high demand for the final version of the Fibersort, even if there is still room for improvement before scaling up production.



Examples of post-consumer fibres from clothes processed by Belgian spinner Procotex, shown at the Demo Day in Wormerveer, Netherlands.

Circle Economy

Rethinking garment design

As the machine is fine-tuned for a future roll out, the partners point out that the garment industry could also contribute to optimising the system by making a few design tweaks. Narrowing down the variety of fibre blends is one evolution they recommend. "Why make products in blends of 85/15, 80/20 and 75/25, do we really need all three?" asks Mr Vadenputte. He says the Fibersort works best with products made in a single fibre type or in a blend in which the main fibre accounts for at least 80% of total content.

In addition to more homogenous compositions, the sorting process of used textiles could benefit from more streamlined designs. In the world of post-consumer recycling, what designers call embellishments, collectors call contaminants.

Changing attitudes towards designs and embellishments are just a few of the many challenges the apparel industry faces in the need to reduce waste and increase the proportion of used garments being recycled into new textiles. The Fibersort does, however, usher in a novel and useful solution. "A sorter knows the value of unsorted input and the cost of the machine and can therefore calculate with more precision the value of the output," says Ms Decloedt. The hope is that it will create a better business case for recycling textiles into fresh textiles and thus be more than a small cog in the large wheel of the circular economy.

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