

Smart Usage of Recyclable Textiles State of the Art Report

October 2015



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Development Centre UMT



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Innovationsnetværket Livsstil - Bølg & Beklædning



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Smart Usage of Recyclable Textiles

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1 Summary

The report examines the status quo of technology and output in spinning mills using textile waste material. We have contacted 20 businesses within the textile industry that are involved in textile recycling: textile sorting, textile shredding and/or spinning. The questions address the textiles that are used in the production, how they are handled (manually or automatic), the product and market opportunities as well as the challenges.

We have received answers from four businesses, two of them working with dissolution-based recycling (Re:newcell and VTT), one working with recycling of fibres into new yarns and textiles (Camera di Commercio Prato) and one working with recycling of carpets into felts (Anglo Recycling Technology).

In general the respondents use both post-consumer/post-installation and post-industrial textiles, yarns, clothing and carpets. For VTT the post-industrial and post-hired textiles are ways of securing raw material for the production. Collected clothes have zippers, buttons etc. that have to be removed manually. Fibre types depend on the recycling process as well the outcome. VTT and Re:newcell only collect cotton and cellulosic based textiles, while the Prato factories use all types of fibres and Anglo uses both wool rich and polypropylene carpet off cuts with fibre lengths of minimum 5 cm. The sorting criteria are fibres and/or colours.

In general they work with clean textiles. VTT washes all textiles thoroughly first. VTT also have some reservations concerning chemicals; they do not use textiles with fire retardant, Teflon, membranes or similar. Water repellence makes the process more demanding. At Anglo surface treatments is passed through the system and they do not use chemicals in the recycling process.

The collection of textiles takes place through sorting companies, waste management companies and from stock lots. The offloading and sorting process is handled manually while the recycling process seems to be handled automatically.

None of the respondents produces yarns, but fibres/filaments and dissolving pulp that are sold to spinner and weavers e.g. as sub vendors to certain brands. Anglo processes the fibres into felts and have a direct sale to flooring markets as well as horticultural, automotive and acoustic.

The greatest challenges for these companies are finding investors to scale up production (VTT) and production capacity expansion to follow the increasing demand from growth in sustainability drivers in the market (Anglo). Off course direct competitors/other yarns suppliers are also a challenge.

2 Introduction

Society is in a transition phase, where too many resources are tied up in products that are not designed for disassembly in order to recycle resources and be resource efficient. There are great advantages for both society, climate and environment in recycling resources in a systematically designed valuechain from raw material to the end-of-life product. So far long-term solutions for resource efficient use of textile waste has not been thought out and therefore it is not yet technologically possible to close the textile loop. Instead of textiles going to the landfill there must be developed technologies that can separate and sort textiles in order to reuse them. This Danish project, Smart Usage of Recyclable Textiles, addresses that problem.

The project's aim is to develop a technology that enables a fully automatic large-scale textile recycling production. The technology developed in the project will be an automatic receival and individualization unit that receives and lays out each piece of textile/clothing individually before going into a sorting unit, which delivers clean and mixed fractions of fibres for further processing and up-cycling into semi-finished goods for the textile industry. The receival and individualization unit will make it possible to recycle the huge amounts of textile waste material that is not designed for disassembly and recycling. Belgian firm Valvan Baling System has developed the automatic sorting unit in the Dutch Fibersort project, but with a manual feeder line. This project will develop an automatic feeder liner. The outcome of the project will lead to the establishment of a large scale manufacturing plant and in the long term a new industry cluster in Denmark.

The project is supported by The Danish Environmental Protection Agency



The diagram illustrates the process in the circular textile loop.

2.1 Project partners

The project is lead by Development Centre UMT by project manager:

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2.2 The Survey

The aim of the survey is to examine the status quo of technology and output in spinning mills using textile waste material. For this purpose we have contacted a number of businesses within the textile industry that are involved in textile recycling: textile sorting, textile shredding and/or spinning. The questions address the textiles that are used in the production, how they are handled (manually or automatic), the product and market opportunities as well as the challenges.

The questions that were sent out are:

- Which textile fractions does the mill use? E.g. industrial, interior or apparel textiles (small/large sizes or scraps?), clothing or other textile products with zippers, buttons etc.? Are the fibres mixed or pure, coloured or white, with chemical treatment or not?
- How does the collection of textiles take place?

- Which textile types (e.g. fibre length, nonwoven, clean or dirty) are collected and used in the production?
- Which processes are handled manually and which are automatic (by machine)?
- According to which criteria are the textiles sorted? E.g. colour, fibres, size or other.
- How does the mill relate to chemicals in the textiles? Are any procedures taken?
- Does the mill spin yarns and thread from long fibres?
- Who buys the mill's products? (Not necessarily by name, but business)
- What is your mill's greatest challenge?
- Are you interested in cooperation with the project?

2.2.1 Spinning mills

We have contacted:

Soex Group, Wolfen (Germany)
Margasa (Spain)
Marchi e Fildi (Italy)
Sama Textiles (Italy)
Re:newcell (Sweden)
Anglo Recycling Technology (UK)
James Robinson Fibres/Textfelt Ltd. (UK)
Edward Clay and Son, Ossett (UK)
VTT Technical Research Centre of Finland
Econyl®/ Aquafil (Slovenia/Italy)
HB Textiles (UK)
John Cotton Ltd. (UK)
Rawson Ltd. (UK)
Multifibres Ltd. (UK)
Flock and Wipers / Rose Mill Companies (UK)
JBS Recycling Group Ltd. (UK)
Hivesa Textil (Spain)
Sempere Puerto (Spain)
Textile Fibre Recycling (Hungary)
Pure Waste Textiles (Finland)

Textile sorting

Valvan Baling Systems (Belgium)
Wieland Textiles (Holland)
Recycling Textiles (Czech Republic)

Responds from

Re:newcell (Sweden)
Anglo Recycling Technology (UK)
VTT Technical Research Centre of Finland
Soex Group, Wolfen (Germany)
Marchi e Fildi (Italy)

2.2.2. Researching organizations and businesses

As a part of the research for this survey we have also contacted a number organizations and businesses working with textile recycling asking for their help to find spinning mills. This has given us an overview of the operators and co-operators within textile recycling as well as the development of new technologies and business models. Therefore chapter 3 will review the organizations and businesses that responded to our inquiry.

We have contacted:

Circle Economy (The Netherlands)
Texperium (The Netherlands)
Vereniging Herwinning Textiel (VHT) (The Netherlands)
Worn Again (UK)
Carpet Recycling (UK)
UK Textile Recycling (UK)
Uniform Reuse / Centre for Remanufacturing and Reuse (UK)
SCAP – Sustainable Clothing Action Plan (part of WRAP) (UK)
Humana (Spain)
Vigga børnetøj v/ Vigga Svensson (Denmark)
DutchSpirit (The Netherlands)
Dutch aWEARness (The Netherlands)
Bureau of International Recycling (UK)
Textile Recycling Association (TRA) (UK)
Mariacatia Brunetti (agent)/ Camera di Commercio Prato (Italy)
Unione Industriale Pratese (Italy)
Launch Nordic (Denmark)

Responds from

Circle Economy (The Netherlands)
Texperium (The Netherlands)
Worn Again (UK)
Carpet Recycling (UK)
Uniform Reuse / Centre for Remanufacturing and Reuse (UK)
SCAP – Sustainable Clothing Action Plan (WRAP) (UK)
Dutch aWEARness (The Netherlands)
Textile Recycling Association (TRA) (UK)

2.3 The Report

First part (chapter 3) is a presentation of each respondent and a schematic presentation of their answers to questions. The second part (chapter 4) will give a presentation of organizations and businesses in the textile recycling industry. The third part (chapter 5) is structured by questions giving an overview of the answers to the each of them.

3 Answers by Company

3.1 Re:newcell (Sweden)

About

Re:newcell is a small technology company that was founded in January 2012 by a group of researchers from KTH Royal Institute of Technology and a small investment company. Re:newcell has developed a recycling process that can recycle cellulosic-based textile into dissolving pulp. Today the company is only active within a large laboratory scale production but is planning to have a complete semi-industrial plant within the next 1.5 years. Therefore, re:newcell does not have the capacity to sell its product on a commercial market today.

Contact info

Re:newcell
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111 31, Stockholm
Sweden

Tel: +46 (0)73 98 98 895
Website: www.renewcell.se
Email: info@renewcell.se

Contact: Louise Norlin, louise@girindus.se

QUESTION	ANSWER
1. Which textile fractions does the mill use? E.g. industrial, interior or apparel textiles (small/large sizes or scraps?), clothing or other textile products with zippers, buttons etc.? Are the fibres mixed or pure, coloured or white, with chemical treatment or not?	Re:newcell does not have a mill yet, however the business will recycle cellulosic based textiles on a larger scale once the semi-industrial plant is complete.
2. How does the collection of textiles take place?	Re:newcell will when the plant is finished be purchasing sorted textiles from collecting and sorting companies.
3. Which textile types (e.g. fibre length, nonwoven, clean or dirty) are collected	Cellulosic-based textiles will be used in the production.

and used in the production?	
4. Which processes are handled manually and which are automatic (by machine)?	Not answered
5. According to which criterias are the textiles sorted? E.g. colour, fibres, size or other.	Cotton-, Lyocell- and viscose textiles are of interest for us.
6. How does the mill relate to chemicals in the textiles? Are any procedures taken?	We do not have a mill yet but we are doing tests on the matter.
7. Does the mill spin yarns and thread from long fibres?	The mill will not spin yarns or thread long fibres but produces dissolving pulp.
8. Who buys the mill's products? (Not necessarily by name, but business)	Re:newcell does not sell its product yet on a commercial market but the potential future buyers of the dissolving pulp are fibre spinners.
9. What is your mill's greatest challenge?	Not answered
10. Are you interested in cooperation with the project?	Re:newcell does not have the capacity to take part in it, as the organisation is fairly small.

3.2 VTT Technical Research Centre of Finland

About

VTT is a leading research and technology company in the Nordic countries with a national mandate in Finland serving both private and public sectors. In May 2015 VTT initiated The Circular Economy of Textiles (TEKI) project in partnership with Ethica and a group of Finnish organizations in the value chain. The project is aimed at piloting and modelling a closed-loop textile ecosystem in line with the principles of the circular economy. The project also aims to study the technological requirements of dissolution-based recycling of textiles that cannot be reused. VTT is in the process of turning the material into a cellulose carbamate solution using a technique developed in-house and will be fiberising the solution in October–November 2015.

Contact info

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P.O. Box 1000
FI-02044 VTT
Finland

Website: www.vttresearch.com
Email: info@vtt.fi

Contact: Harlin Ali, Research Professor, ali.harlin@vtt.fi, +35 84 05 33 21 79

QUESTION	ANSWER
1. Which textile fractions does the mill use? E.g. industrial, interior or apparel textiles (small/large sizes or scraps?), clothing or other textile products with zippers, buttons etc.? Are the fibres mixed or pure, coloured or white, with chemical treatment or not?	<p>In our first pilot we are using post-consumer clothing, which is collected by waste management companies. All components (zippers, buttons) are removed manually. We have indicated possible lots industrial and hired textiles from e.g. hotels etc., but this is a separate issue related securing raw material logistics.</p> <p>We are actively in a project to establish a concept also for polyester, but it is not possible in the first phase.</p>
2. How does the collection of textiles take place?	Collection takes place through waste management companies and NGOs based on

	<p>their programmes. There is a development of return package for customers by Repack.</p>
<p>3. Which textile types (e.g. fibre length, nonwoven, clean or dirty) are collected and used in the production?</p>	<p>Target is to collect as cotton rich fraction as possible. Interior or similar is not included due high content of acrylic and other synthetic fibres. Nonwovens are dominantly synthetic and not for the first development phase materials. Dirt as such is not a problem, because all textiles are washed thoroughly anyhow. Neither torn nor other way damaged materials are a concern. Burned material is however not allowed.</p>
<p>4. Which processes are handled manually and which are automatic (by machine)?</p>	<p>We have not yet automated material handling, but are interested in solutions for automated technologies.</p>
<p>5. According to which criteria are the textiles sorted? E.g. colour, fibres, size or other.</p>	<p>Typical selection is light, blue/black and red much like at home. Printed and multicolour can be added on either coloured lots according to main colour.</p>
<p>6. How does the mill relate to chemicals in the textiles? Are any procedures taken?</p>	<p>We try to avoid fire retardant (special work clothing and furniture textiles). Teflon, membranes (Gore-Tex) and similar products are excluded. Water repellence makes processing a bit more demanding. The applied solutions have to be waste water treated due accumulation of chemicals.</p>
<p>7. Does the mill spin yarns and thread from long fibres?</p>	<p>We produce filaments; no yarns or ready textiles are produced. All filaments are produced by wet processes.</p>
<p>8. Who buys the mill's products? (Not necessarily by name, but business)</p>	<p>Stable fibre is delivered for especially for ring spinning and open-end plans (vertical lines), as a sub vendor for certain brands.</p>
<p>9. What is your mill's greatest challenge?</p>	<p>To find right investors and ramp up production. Production is yet on leased premises and equipments.</p>
<p>10. Are you interested in cooperation with the project?</p>	<p>It is possible to be discussed.</p>

3.3 Anglo Recycling Technology (UK)

About

Anglo Recycling Technology was established in 1939 and is situated in a 150-year-old cotton mill. Anglo manufactures a large range of felts from recycled fibres for the flooring, horticulture, building insulation, automotive and acoustic industries. In 2010 Anglo installed a recycling plant, which over a period of 12 months diverts 600 tonnes of carpet from going to landfill. The products are manufactured using low energy techniques and 100% recycled fibres. In January 2011, Anglo installed a pulling line, which enables them to pull the fibres from wool rich carpet edge trims and to produce a 100% recycled carpet underlay, Reco.

Contact info

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OL12 8BG
United Kingdom

Tel: +44 (0)8458 350218

Website: www.angloreycling.com

Email: info@angloreycling.com

Contact: Andy Hall, Managing Director, +44 (0) 7791 097 274,
andy.hall@angloreycling.com

QUESTION	ANSWER
1. Which textile fractions does the mill use? E.g. industrial, interior or apparel textiles (small/large sizes or scraps?), clothing or other textile products with zippers, buttons etc.? Are the fibres mixed or pure, coloured or white, with chemical treatment or not?	Post Industrial and Post Installation carpet flooring waste from carpet manufacturers and carpet fitters.
2. How does the collection of textiles take place?	Either delivered by the manufacturer and fitters, or collected by use of our 3PL (third-party logistics, ed.) operation.
3. Which textile types (e.g. fibre length, nonwoven, clean or dirty) are collected	Clean tufted and woven carpet off cuts, manufacturers waste including joints and

and used in the production?	edge selvedge, fibre lengths in excess of 5cm.
4. Which processes are handled manually and which are automatic (by machine)?	Manual offloading of waste materials from either bales or bags from delivery truck. Whole bales, bags of material put into recycling line and dealt with automatically from then onwards.
5. According to which criteria are the textiles sorted? E.g. colour, fibres, size or other.	Some sorting of fibre type between wool rich and polypropylene carpets.
6. How does the mill relate to chemicals in the textiles? Are any procedures taken?	No chemicals used in recycling process. Any surface treatments on carpet waste passed through system.
7. Does the mill spin yarns and thread from long fibres?	No
8. Who buys the mill's products? (Not necessarily by name, but business)	Recycled fibres used in needle felting of carpet underlays for flooring market and other products for horticultural, automotive and acoustic markets.
9. What is your mill's greatest challenge?	Production capacity expansion due to increasing demand of recycling capability required from growth in sustainability drivers in the markets.
10. Are you interested in cooperation with the project?	Yes

3.4 Camera di Commercio Prato (Italy)

About

Camera di Commercio Prato is the chamber of Commerce in Prato. Amongst other activities the chamber connects fashion designers with manufacturing companies covering the entire supply chain. Prato has long tradition for recycling textiles going back to app. 1900 when carded wool from production scraps and old clothes became a significant resource for the growing industry. The fibres where used for either rugs and blankets or for textiles for clothing. Later on with the introduction of nylon it became possible to spin the wool into finer yarns.

An agent at Camera di Commercio, Mariacatia Brunetti, has answered the questions here below.

Contact info

Camera di Commercio Prato
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59100 Prato
Italy

Tel: +39 0574 612 715

Website: www.po.camcom.it

E-mail: relazioni.esterne@po.camcom.it

Contact: Mariacatia Brunetti, agent, mariacatia@virgilio.it

QUESTION	ANSWER
1. Which textile fractions does the mill use? E.g. industrial, interior or apparel textiles (small/large sizes or scraps?), clothing or other textile products with zippers, buttons etc.? Are the fibres mixed or pure, coloured or white, with chemical treatment or not?	Apparel textile cloth and house textile, yarn leftover, leftover spinning yarns, all in large sizes. Can be cloth with buttons /lining, zipper ect., with mixed fibres, but always with wool content. 90% are coloured. Cleaned, not dirty. No chemical treatment.
2. How does the collection of textiles take place?	They will buy stock lots from several countries, which makes already a selection (clean/wool mix).
3. Which textile types (e.g. fibre length, nonwoven, clean or dirty) are collected and used in the production?	All types of fibres clean.

4. Which processes are handled manually and which are automatic (by machine)?	Handled manually to make 1 st choice (divided by colours)
5. According to which criteria are the textiles sorted? E.g. colour, fibres, size or other.	Fibres and colours.
6. How does the mill relate to chemicals in the textiles? Are any procedures taken?	No answer
7. Does the mill spin yarns and thread from long fibres?	No the result of this process is material short fibres
8. Who buys the mill's products? (Not necessarily by name, but business)	Yarn makers and weaving companies – they buy the material to spin yarns
9. What is your mill's greatest challenge?	Yarns suppliers in our Prato area
10. Are you interested in cooperation with the project?	No answer

4 Organizations and businesses in the recycling industry

4.1 Circle Economy (The Netherlands)

Circle Economy
Nieuwe Herengracht 95
1011RX Amsterdam
The Netherlands

www.circleeconomy.com

Contact: Gwen Cunningham, Circular Textiles Researcher, +31 (0) 616684704,
gwen@circle-economy.com

Circle Economy works as a consultancy business on circular initiatives within different sectors one of them being textiles. CE has an ongoing Circular Textiles Program focusing on four pilot projects: The Visioning Project, The Textile Sorting Project, The Polyester Project and The Consumer Behaviour Project. The Textile Sorting Project called FIBERSORT is very closely related to Project Smart Usage of Recyclable Textiles. FIBERSORT is developing “a commercially feasible sorting technology that accurately detects the fibre composition of post-consumer recyclable textile materials to enable high value recycling of old textiles into new textiles.” The project is a joint effort of Wieland Textiles, Valvan Baling Systems, Metrohm, Worn Again, Faritex, Reshare and Circle Economy.

Read more about FIBERSORT at:

<http://circle-economy.com/projects/sector/textiles-programme/textile-sorting-project/>

4.2 Texperium (The Netherlands)

Texperium Foundation
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7483 PG Haaksbergen
The Netherlands

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E-mail: info@texperium.eu

Website: www.texperium.eu

Contact: Peter Bos, chairman, +31 (0)6 53 38 65 86, peter.bos@texperium.nl

Peter Bos explains the work of Texperium:

Texperium is an Open Innovation Center for high-end quality textile recycling in The Netherlands with impact across Europe. We are working in different national and international projects to establish this high-end reuse of post-consumer textiles.

Texperium is a research and developing institute and is operating in a precompetitive phase of the projects. Texperium is also involved in the production of new yarns out of recycled post-consumer textiles.

For this purpose Texperium has a state of the art technicum available for companies and institutions to support the development of innovations in textile reprocessing and the use of recycled materials in sustainable and profitable applications. In our technicum you will find all equipment for textile recycling on industrial machinery for fast testing and prototyping.

We are able to facilitate the chain from post-consumer textiles recycling from recycled fibres into yarns again. We are also able to produce some weft or knitted material on a small scale. The research facilities bridge the gap between scientific research (small-scale, science-driven) and industrial development by experimental and pilot facilities on a semi-industrial scale.

For the implementation of projects we usually form consortia of complementary industrial partners with our educational and R&D partners. Within these consortia the industrial company will always be in the lead in order to maximize the marked and commercial potential of the results.

In one of these consortia we are working together with second hands clothing collectors, sorting companies and local communities. The post-consumer textiles will be collected within a newly developed collection and sorted system by people with a high SROI (social return). The clothing, that is sellable as second hand clothing, will be sold as such. The unsalable clothing and household textiles will be reprocessed and redeveloped for reuse into new products and textiles in corporation with Texperium and its partners.

Texperium main goal is to achieve that post consumer recycled textiles will be integrated in all sorts of new developed products and fashionable textiles, so that the reuse of postconsumer textiles will become business as usual.

If you click at the link below, you will see a film about the reuse of textile waste.

<http://www.youtube.com/watch?v=r4RZwQxNz8E&feature=related>

4.3 Dutch aWEARness (The Netherlands)

Dutch aWEARness
Lage Markt 65
6511 VK Nijmegen
The Netherlands

Tel: +31 (0)24 - 675 9200

Website: www.dutchawearness.com

E-mail: info@dutchawearness.com

Contact: Rien Otto, rien@dutchawearness.com

Dutch aWEARness is developing a scanning system involving all partners in the supply chain to inform about materials, dyeing and production methods as well as being a track and trace system and a management tool for purchasing. It also includes a Life Cycle Analysis. According to Dutch aWEARness circular economy recycling is 80 percent about management and 20 percent about the production. Open for partnership if it is relevant and beneficial to them.

4.4 Worn Again (UK)

Worn Again
Rich mix | Unit co2, 35-47 Bethnal Green Road
London e1 6la
United Kingdom

Tel: +44 (0)207 739 0189

Website: www.wornagain.co.uk

Email: info@wornagain.co.uk

Contact: Mel Knudsen, circular supply chain researcher, mel@wornagain.co.uk

Worn Again work collaboratively with partners across the global textile industry towards creating circular supply chains for textiles and clothing through the development of new circular recycling technologies and new circular business models. The way is to *design in* 'closed loop' solutions. In March 2015 Worn Again announced their partnerships with H&M and Kering, via its brand Puma.

Worn Again is involved in Circular Economy's FIBERSORT project and developing a technology designed to recapture polyester and cellulose from cotton from blended or pure textiles, with the resultant PET chips and new cellulosic fibres to go back into the supply chain. The feedstock will be the low-grade textiles no longer suitable for reuse. Short fibre bales could also be a feedstock for this process. Sorting technologies like FIBERSORT or Smart Usage of Recyclable Textiles is a key part of the supply chain for such technologies.

4.5 Carpet Recycling (UK)

Carpet Recycling UK Limited
c/o Axion Consulting
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Meadway, Bramhall
Stockport
SK7 2DG
United Kingdom

Tel: +44 (0)161 440 8325
Website: www.carpetrecyclinguk.com
Email: info@carpetrecyclinguk.com

Contact: Marie Rhodes, membership and events coordinator,
marie@carpetrecyclinguk.com

Carpet Recycling UK works to increase the diversion of carpets from landfill and has from 2007 to 2014 increased the diversion rate of waste carpet from 2% to 28%. They have done this by finding new end uses for recycled carpet, facilitating relationships between people who want to recycle carpet and recyclers as well as providing support for carpet recyclers. Also they have been lobbying for a favourable policy environment.

4.6 Uniform Reuse / Centre for Remanufacturing and Reuse (UK)

Uniform Reuse
c/o Oakdene Hollins
Ardenham Court
Oxford Road
Aylesbury
Buckinghamshire
HP19 8HT
United Kingdom

Tel: +44 (0)1296 337 165
Website: www.uniformreuse.co.uk, www.oakdenehollins.co.uk
Email: info@uniformreuse.com

Contact: Kate Riley, kate.riley@uniformreuse.com

Uniform Reuse is a project initiated by Centre for Remanufacturing and Reuse, which is run by Oakdene Hollins, a consultancy and research business that advises on sustainable products and services, resource efficiency and clean technologies. Uniform Reuse's aim is to improve the reuse and recycling options for corporate wear through practical research and the development of an educational resource.

According to Uniform Reuse there is little re-spinning of post-consumer textile waste within the EU, however, there is more re-spinning of post-industrial waste, predominantly wool and cotton. Almost all other re-spinning takes place in North Africa, India and China, mostly of post-industrial waste.

4.7 SCAP: Sustainable Clothing Action Plan – part of WRAP (UK)

WRAP
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Blenheim Court
19 George Street
Banbury OX16 5BH
United Kingdom

Website: www.wrap.org.uk
Email: clothing@wrap.org.uk

Contact: Andrew Gilbert, Andrew.gilbert@wrap.org.uk

Sustainable Clothing Action Plan is lead by WRAP, a non-profit organization working to accelerate the move to a sustainable resource-efficient economy within three of the most resource intensive sectors: Food and Drink; Clothing and Textiles; Electricals and Electronics. SCAP's ambition is to improve the sustainability of clothing across its lifecycle. By bringing together industry, government and the third sector they aim to reduce resource use and secure recognition for corporate performance by developing sector-wide targets.

SCAP has four working groups: Re-use & Recycling, Influencing consumer behaviours, Metrics and Design for Longevity. One of the SCAP initiatives is the SCAP 2020 Commitment that 80 organisations have signed up to so far. See more at <http://www.wrap.org.uk/content/sustainable-clothing-action-plan-1>

Presently WRAP is about to kick off a 3 Year EU funded project to expand the UK Sustainable Clothing Action Plan framework into Europe. The Danish Fashion Institute (DAFI) is a partner for this work.

4.8 Textile Recycling Association (TRA) (UK)

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Tel: +44 (0)345 459 8276

E-mail: info@textile-recycling.org.uk

Web: www.textile-recycling.org.uk

Contact: Alan Wheeler, director, info@textile-recycling.org.uk

TRA is the UK's trade association for used clothing and textile collectors, sorters and reprocessors. TRA's objectives are to create a favourable climate for its members and to promote textile recycling as well as second hand clothing and shoe industry. TRA works with WRAP supporting the Sustainable Clothing Action Plan and with Bureau of International Recycling (BIR).

5 Answers by Question

5.1 Textile fractions

COMPANY / QUESTION	WHICH TEXTILE FRACTIONS DOES THE MILL USE? E.G. INDUSTRIAL, INTERIOR OR APPAREL TEXTILES (SMALL/LARGE SIZES OR SCRAPS?), CLOTHING OR OTHER TEXTILE PRODUCTS WITH ZIPPERS, BUTTONS ETC.? ARE THE FIBRES MIXED OR PURE, COLOURED OR WHITE, WITH CHEMICAL TREATMENT OR NOT?
Re:newcell (Sweden)	Re:newcell does not have a mill yet, however the business will recycle cellulosic based textiles on a larger scale once the semi-industrial plant is complete.
VTT Technical Research Centre of Finland	<p>In our first pilot we are using post-consumer clothing, which is collected by waste management companies. All components (zippers, buttons) are removed manually. We have indicated possible lots industrial and hired textiles from e.g. hotels etc., but this is a separate issue related securing raw material logistics.</p> <p>We are actively in a project to establish a concept also for polyester, but it is not possible in the first phase.</p>
Anglo Recycling Technology (UK)	Post Industrial and Post Installation carpet flooring waste from carpet manufacturers and carpet fitters.
Camera di Commercio Prato (Italy)	<p>Apparel textile cloth and house textile, yarn leftover, leftover spinning yarns, all in large sizes.</p> <p>Can be cloth with buttons /lining, zipper ect., with mixed fibres, but always with wool content. 90% are coloured. Cleaned, not dirty. No chemical treatment.</p>

5.2 Collection of textiles

COMPANY / QUESTION	HOW DOES THE COLLECTION OF TEXTILES TAKE PLACE?
Re:newcell (Sweden)	Re:newcell will when the plant is finished be purchasing sorted textiles from collecting and sorting companies.
VTT Technical Research Centre of Finland	Collection takes place through waste management companies and NGOs based on their programmes. There is a development of return package for customers by Repack.
Anglo Recycling Technology (UK)	Either delivered by the manufacturer and fitters, or collected by use of our 3PL (third-party logistics, ed.) operation.
Camera di Commercio Prato (Italy)	They will buy stock lots from several countries, which makes already a selection (clean/wool mix).

5.3 Textile types

COMPANY / QUESTION	WHICH TEXTILE TYPES (E.G. FIBRE LENGTH, NONWOVEN, CLEAN OR DIRTY) ARE COLLECTED AND USED IN THE PRODUCTION?
Re:newcell (Sweden)	Cellulosic-based textiles will be used in the production.
VTT Technical Research Centre of Finland	Target is to collect as cotton rich fraction as possible. Interior or similar is not included due high content of acrylic and other synthetic fibres. Nonwovens are dominantly synthetic and not for the first development phase materials. Dirt as such is not a problem, because all textiles are washed thoroughly anyhow. Neither torn nor other way damaged materials are a concern. Burned material is however not allowed.

Anglo Recycling Technology (UK)	Clean tufted and woven carpet off cuts, manufacturers waste including joints and edge selvedge, fibre lengths in excess of 5cm.
Camera di Commercio Prato (Italy)	All types of fibres clean.

5.4 Manual and automatic processes

COMPANY / QUESTION	WHICH PROCESSES ARE HANDLED MANUALLY AND WHICH ARE AUTOMATIC (BY MACHINE)?
Re:newcell (Sweden)	Not answered
VTT Technical Research Centre of Finland	We have not yet automated material handling, but are interested in solutions for automated technologies.
Anglo Recycling Technology (UK)	Manual offloading of waste materials from either bales or bags from delivery truck. Whole bales, bags of material put into recycling line and dealt with automatically from then onwards.
Camera di Commercio Prato (Italy)	Handled manually to make 1 st choice (divided by colours)

5.5 Sorting criteria

COMPANY / QUESTION	ACCORDING TO WHICH CRITERIA ARE THE TEXTILES SORTED? E.G. COLOUR, FIBRES, SIZE OR OTHER.
Re:newcell (Sweden)	Cotton-, Lyocell- and viscose textiles are of interest for us.
VTT Technical Research Centre of Finland	Typical selection is light, blue/black and red much like at home. Printed and multicolour can be added on either coloured lots according to main colour.
Anglo Recycling Technology (UK)	Some sorting of fibre type between wool rich and polypropylene carpets.
Camera di Commercio Prato (Italy)	Fibres and colours.

5.6 Chemicals

COMPANY / QUESTION	HOW DOES THE MILL RELATE TO CHEMICALS IN THE TEXTILES? ARE ANY PROCEDURES TAKEN?
Re:newcell (Sweden)	We do not have a mill yet but we are doing tests on the matter.
VTT Technical Research Centre of Finland	We try to avoid fire retardant (special work clothing and furniture textiles). Teflon, membranes (Gore-Tex) and similar products are excluded. Water repellence makes processing a bit more demanding. The applied solutions have to be wastewater treated due accumulation of chemicals.
Anglo Recycling Technology (UK)	No chemicals used in recycling process. Any surface treatments on carpet waste passed through system.
Camera di Commercio Prato (Italy)	No answer

5.7 Spinning

COMPANY / QUESTION	DOES THE MILL SPIN YARNS AND THREAD FROM LONG FIBRES?
Re:newcell (Sweden)	The mill will not spin yarns or thread long fibres but produces dissolving pulp.
VTT Technical Research Centre of Finland	We produce filaments; no yarns or ready textiles are produced. All filaments are produced by wet processes.
Anglo Recycling Technology (UK)	No
Camera di Commercio Prato (Italy)	No the result of this process is material short fibres

5.8 Buyers of the products

COMPANY / QUESTION	WHO BUYS THE MILL'S PRODUCTS? (NOT NECESSARILY BY NAME, BUT BUSINESS)
Re:newcell (Sweden)	Re:newcell does not sell its product yet on a commercial market but the potential future buyers of the dissolving pulp are fibre spinners.
VTT Technical Research Centre of Finland	Stable fibre is delivered for especially for ring spinning and open-end plans (vertical lines), as a sub vendor for certain brands.
Anglo Recycling Technology (UK)	Recycled fibres used in needle felting of carpet underlays for flooring market and other products for horticultural, automotive and acoustic markets.
Camera di Commercio Prato (Italy)	Yarn makers and weaving companies – they buy the material to spin yarns

5.9 Greatest challenge

COMPANY / QUESTION	WHAT IS YOUR MILL'S GREATEST CHALLENGE?
Re:newcell (Sweden)	Not answered
VTT Technical Research Centre of Finland	To find right investors and ramp up production. Production is yet on leased premises and equipments.
Anglo Recycling Technology (UK)	Production capacity expansion due to increasing demand of recycling capability required from growth in sustainability drivers in the markets.
Camera di Commercio Prato (Italy)	Yarns suppliers in our Prato area

5.10 Cooperation

COMPANY / QUESTION	ARE YOU INTERESTED IN COOPERATION WITH THE PROJECT?
Re:newcell (Sweden)	Re:newcell does not have the capacity to take part in it, as the organisation is fairly small.
VTT Technical Research Centre of Finland	It is possible to be discussed.
Anglo Recycling Technology (UK)	Yes
Camera di Commercio Prato (Italy)	No answer

6 References

VTT Technical Research Centre of Finland (22.09.2015): *Unique production experiment in progress: Turning waste cotton into new fibre for the fashion industry*. Retrieved from: <http://www.vttresearch.com/media/news/unique-production-experiment-in-progress-turning-waste-cotton-into-new-fibre-for-the-fashion-industry>

Unione Industriale Pratese (no date): *Evolution of the Prato Textile District*. Retrieved from: <http://www.ui.prato.it/unionedigitale/v2/english/presentazione-distretto-inglese.pdf>

WEBSITES

<http://renewcell.se>

<http://www.vttresearch.com/>

<http://www.angloreycling.com>

<http://www.po.camcom.it/index.php> / <http://www.po.camcom.it/servizi/distretto/index.php>

<http://www.ui.prato.it/unionedigitale/v2/english/default.asp>

<http://www.circle-economy.com/>

<http://www.texperium.eu/en>

<http://dutchawearness.com/>

<http://wornagain.info/>

<http://www.carpetrecyclinguk.com/index.php>

<http://www.uniformreuse.co.uk/>

<http://www.oakdenehollins.co.uk/>

<http://www.wrap.org.uk/>

<http://www.textile-recycling.org.uk/index.html>