RESEARCH CIRCLES

A collection of essays and interviews by researchers at Centre for Circular Design, University of the Arts London

Edited by Rebecca Earley
October 2020

ual: centre for circular design

Chelsea College of Arts
Room: D117
16 John Islip St
London SW1P 4JU
United Kingdom

+44 (0)20 7514 2978

ual: centre for circular design

A New Way to Play

Textile recycling and the Circular Economy

Cathryn Anneka Hall

Cathryn Anneka Hall is a MA Textile Design graduate of Chelsea College of Arts and has been at Centre for Circular Design since 2015 - first as a research assistant and currently as a PhD researcher. Her research explores design for mechanical textile recycling for the circular economy, conducted with industry partners. Cathryn's expertise in circular design extends to both lecturing and consulting with industry partners.

Don't be nervous. Circularity is the captain and she is picking her players - nobody wants to be picked last. We are consistently reminded that Chemical Recycling, although appearing to be the best player on the team, can hog the ball and won't involve any of the other players. We still need training in Re-use and more practice shots with Re-manufacture, but it is Mechanical Recycling that is truly stuck on the side lines. Could there be a new way to play?

Textile recycling was born from a desire to reclaim wool and was quickly adapted to recapture cotton and then polyester. In 2006, the 'Well Dressed?' report condemned recycling technology for not progressing in over 200 years (Allwood *et al.*). Since this we have aspired to reach high-quality textile-to-textile recycling and chemical technology has boomed. In the wake of this invention we now find ourselves in a transition period, one where Chemical Recycling has not yet reached commercialisation. All the while academics start to call for new policies to advance chemical processes alone (e.g. Dahlbo *et al.*, 2016) leaving Mechanical Recycling on the bench. However, it is this established and now forgotten Mechanical Recycling industry that is still dealing with the worlds textile waste. At this point do not be mistaken in thinking I am arguing against the development of Chemical Recycling. Rather I will argue that recycling, like the circular economy, is a team sport. We need both Mechanical and Chemical Recycling to play together.

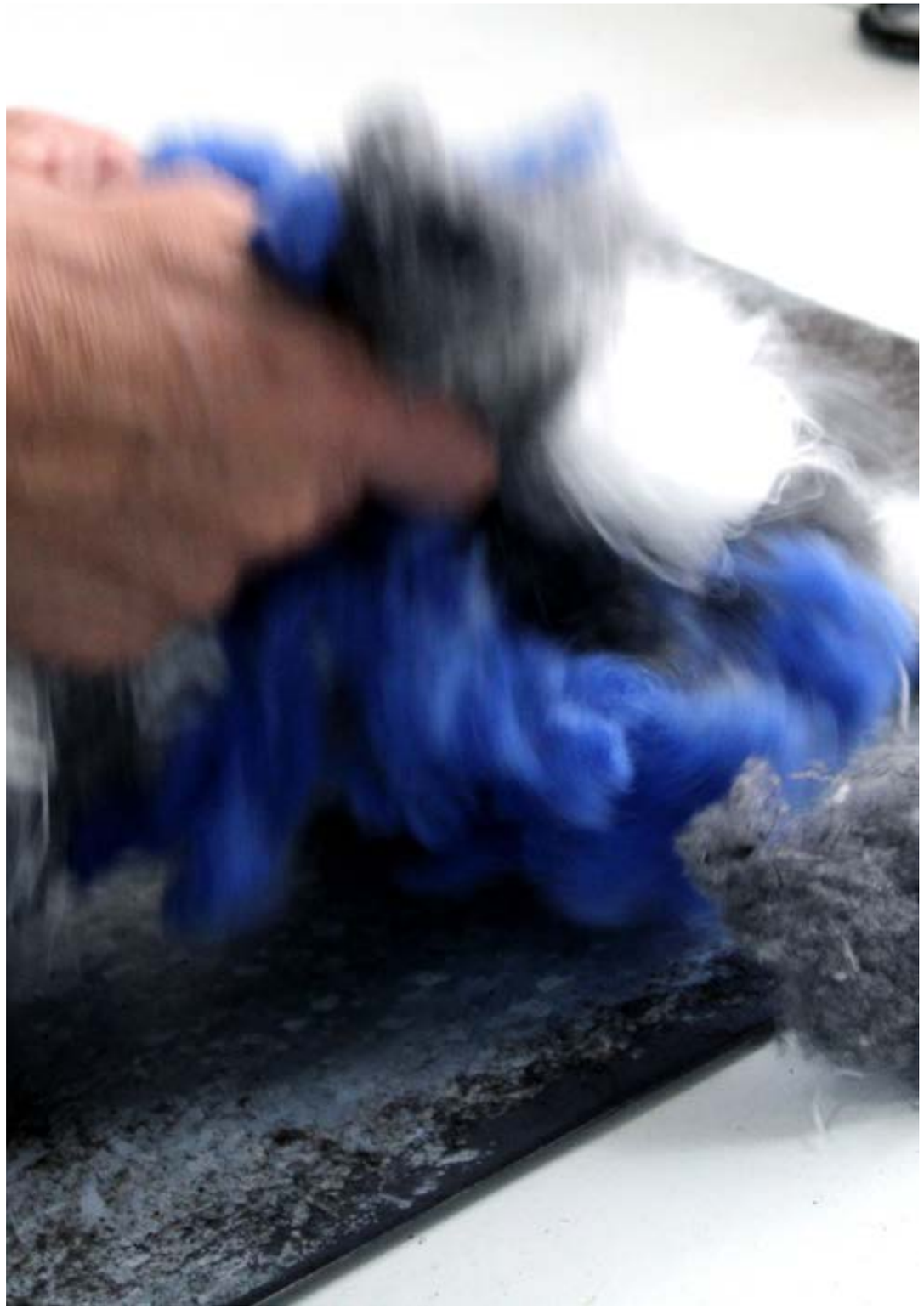
THE PROBLEM WITH MECHANICAL RECYCLING

The Mechanical Recycling of textiles is the process of ripping fibres from their cloth. It is because of this harsh process that recycled fibres reduce in length and therefore it is more difficult (but not impossible) to spin them into yarns (Merati and Okamura, 2004:640). Therefore, to process and extend the lives of the recycled fibre, it is often necessary to blend them with longer virgin ones. This practice has been conducted since the invention of recycling to return our textiles into clothing amongst other applications. For Chemical Recycling blending is not required, although much like in virgin textile production blending is used to create functional, creative and economic textile materials. Therefore, it often faces the same challenges.

THE PROBLEM WITH CHEMICAL RECYCLING

Chemical recycling is celebrated for its ability to return textile fibres to the same quality as virgin. This works particularly well with synthetic materials such as PET (polyethylene terephthalate, commonly known as polyester).

For wool, this chemical process is at lab stage and transforms the proteinous building blocks of the fibre into resins or wood-based adhesives but not textile applications (Bell *et al.*, 2017; Quartinello *et al.*, 2018). For cotton, chemical recycling has progressed in some cases to small-scale manufacturing levels. However,



Testing blends of mechanically recycled fibre.

the regenerated cellulosic textile generated from the process is different from the virgin cotton input. In simple terms, if you were to send a cotton shirt to a chemical recycling process the resulting fabric would be more like a viscose when it came out the other side. It is therefore not a direct replacement (WRAP, 2019; Östlund, Sverige and Naturvårdsverket, 2015). For example, the H&M Conscious Exclusive S20 dress made from partly Circulose® (2020) a chemically recycled cotton. The dress' composition is described as 100% viscose of which 50% is FSC certified wood and 50% is Circulose® recovered from post-consumer denim.

UNINTENDED CONSEQUENCES

The chemical recycling of wool textiles into resins, or cotton textiles into 'viscose like' fabrics is most certainly not something to be avoided. Rather I might suggest we need to consider the consequences of the systems we implement. We are remined by Zink and Geyer (2017) of the 'Circular Economy Rebound' effect - the creation of materials that do not replace new production. If recycled materials are of lower quality or produced to solely enter new markets, they could create further demand.

For the circular system to work, all players must work toward the team goal. The quality of Mechanically Recycled material must be upheld, and Chemically Recycled materials must directly replace virgin production.

IS TOGETHER BETTER?

The challenge of transitioning towards a circular economy remains. The two technologies, mechanical and chemical, are both imperfect in their own ways, but a shift towards team thinking is starting to emerge. During the Beyond Green: Zero Waste symposium (2016) Isaac Nicolson (working for Recovertex, a mechanical cotton recycler) described a future in which both mechanical and chemical technologies might work together. This counteracts the rhetoric that chemical is the substitution for mechanical. They can share the position switching at halftime to promote their own strengths on the field. This collaborative approach is now seen across large scale projects, such as Fibersort (2020a) by Interreg North-West Europe combining both technologies.

The approaches championed for resource longevity centre around promoting material loops (RSA, 2016). Goldsworthy (2014a:1) highlights that we often forget that materials can outlive us, reminding us to take the long view. Sandin and Peters (2018) also acknowledge this potential. They propose a cascading approach, firstly through mechanical systems then, ultimately, flowing into chemical ones. For example, woollen textiles cascading across multiple applications, such as a knitted jumper to a woven upholstery fabric to a non-woven insulation product. Finally, the fibres would flow into a chemical system to be used as a resin, outside the textile remit. The problem of continued circulation, in this open loop, falls to another industry to solve.

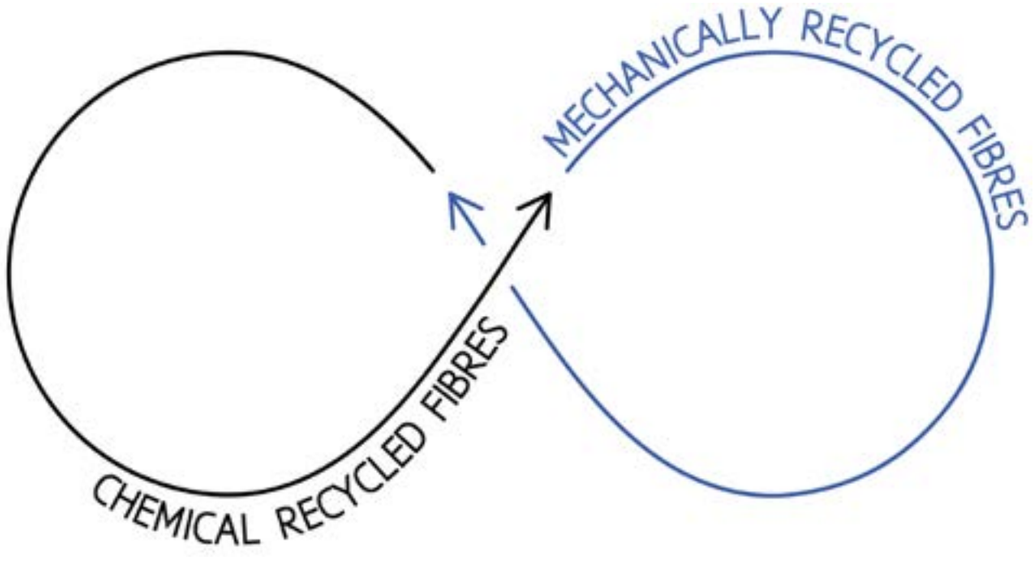


Illustration of a combined textile recycling system using both mechanical and chemical recycling technology.

Beyond linking the two systems together, what If the limitations of both Chemical and Mechanical Recycling could be used to support one another in a closed loop? Consider cotton: we have established that the resulting cellulosic material from the Chemical Recycling process is not a direct replacement for our cotton textiles. Therefore, in order to produce replacement a mechanical method is required. But these fibres need to be blended with longer virgin ones.

So, what if our future chemically recycled fibres replaced virgin content as the blending agent? By using the chemically recycled cellulose (in replacement of virgin fibres) this would not only aid the mechanical recycling process but result in a fully recycled textile.

The blending of these two cellulosic materials, without contamination, ensures that the final textiles can, at the end-of-life, flow back into the chemical process. Recycling textile fibres in this combined way, illustrated in the graphic, means materials flow back and forth between both Chemical and Mechanical Recycling systems. This, ultimately, will extend the life of our textile resources. After all, in this circular economy game both processes are on the same team, sharing the same goal. Might this be the new way to play?

Notes

https://www.annekatextiles.co.uk/

Allwood, J. M., Laursen, S. E., Rodríguez, C. M. de and Bocken, N. M. P. (2006) Well dressed? the present and future sustainability of clothing and textiles in the United Kingdom. Cambridge: University of Cambridge, Institute for Manufacturing.

Bell, N. C., Lee, P., Riley, K. and Slater, S. (2017) Tackling Problematic Textile Waste Streams. Aylesbury, UK: Oakdene Hollins Ltd. Available at: http://www.resyntex.eu/images/downloads/NiaCBell_TACKLING_PROBLEMATIC_TEXTILE_WASTE_STREAMS.pdf (Accessed: 4 December 2017).

Beyond Green: Zero Waste (2016) Beyond Green: Zero Waste - Circle Economy - Pakhuis de Zwijger. Available at: https://vimeo.com/189638719 (Accessed: 30 October 2017).

Circulose® (2020) CIRCULOSE. Available at: https://circulo.se (Accessed: 18 August 2020).

Dahlbo, H., Aalto, K., Eskelinen, H. and Salmenperä, H. (2016) 'Increasing textile circulation—Consequences and requirements', Sustainable Production and Consumption. doi: 10.1016/j.spc.2016.06.005.

Fibersort (2020) Fibersort: Overcoming barriers for long-term implementation. Amsterdam, The Netherlands: Interreg North-West Europe and Circle Economy. Available at: https://guides.co/g/fibersort-overcoming-barriers-for-long-term-implementation-case-study/173054 (Accessed: 18 March 2020).

Goldsworthy, K. (2014) 'Design for Cyclability: pro-active approaches for maximising material recovery', Making Futures, 3. Available at: http://ualresearchonline.arts.ac.uk/6871/2/Cyclability%20Diagram.pdf (Accessed: 3 October 2017).

Merati, A. A. and Okamura, M. (2004) 'Producing Medium Count Yarns from Recycled Fibers with Friction Spinning', Textile Research Journal, 74(7), pp. 640–645. doi: 10.1177/004051750407400715.

Östlund, Å., Sverige and Naturvårdsverket (2015) Textilåtervinning: tekniska möjligheter och utmaningar. Stockholm: Naturvårdsverket.

Quartinello, F., Vecchiato, S., Weinberger, S., Kremenser, K., Skopek, L., Pellis, A. and Guebitz, G. (2018) 'Highly Selective Enzymatic Recovery of Building Blocks from Wool-Cotton-Polyester Textile Waste Blends', Polymers, 10(10), p. 1107. doi: 10.3390/polym10101107.

RSA (2016) Lessons from the Great Recovery 2012-2016. Available at: http://www.greatrecovery.org.uk/resources/new-report-lessons-from-the-great-recovery-2012-2016/ (Accessed: 14 November 2017).

Sandin, G. and Peters, G. M. (2018) 'Environmental impact of textile reuse and recycling - A review', Journal of Cleaner Production, 184, pp. 353–365. doi: https://doi.org/10.1016/j.jclepro.2018.02.266.

WRAP (2019) Fibre to fibre recycling: An economic & financial sustainability assessment. UK: WRAP. Available at: http://www.wrap.org.uk/sites/files/wrap/Fibre_to_Fibre_report.pdf (Accessed: 4 February 2019).

Zink, T. and Geyer, R. (2017) 'Circular Economy Rebound', Journal of Industrial Ecology, 21(3), pp. 593–602. doi: 10.1111/jiec.12545