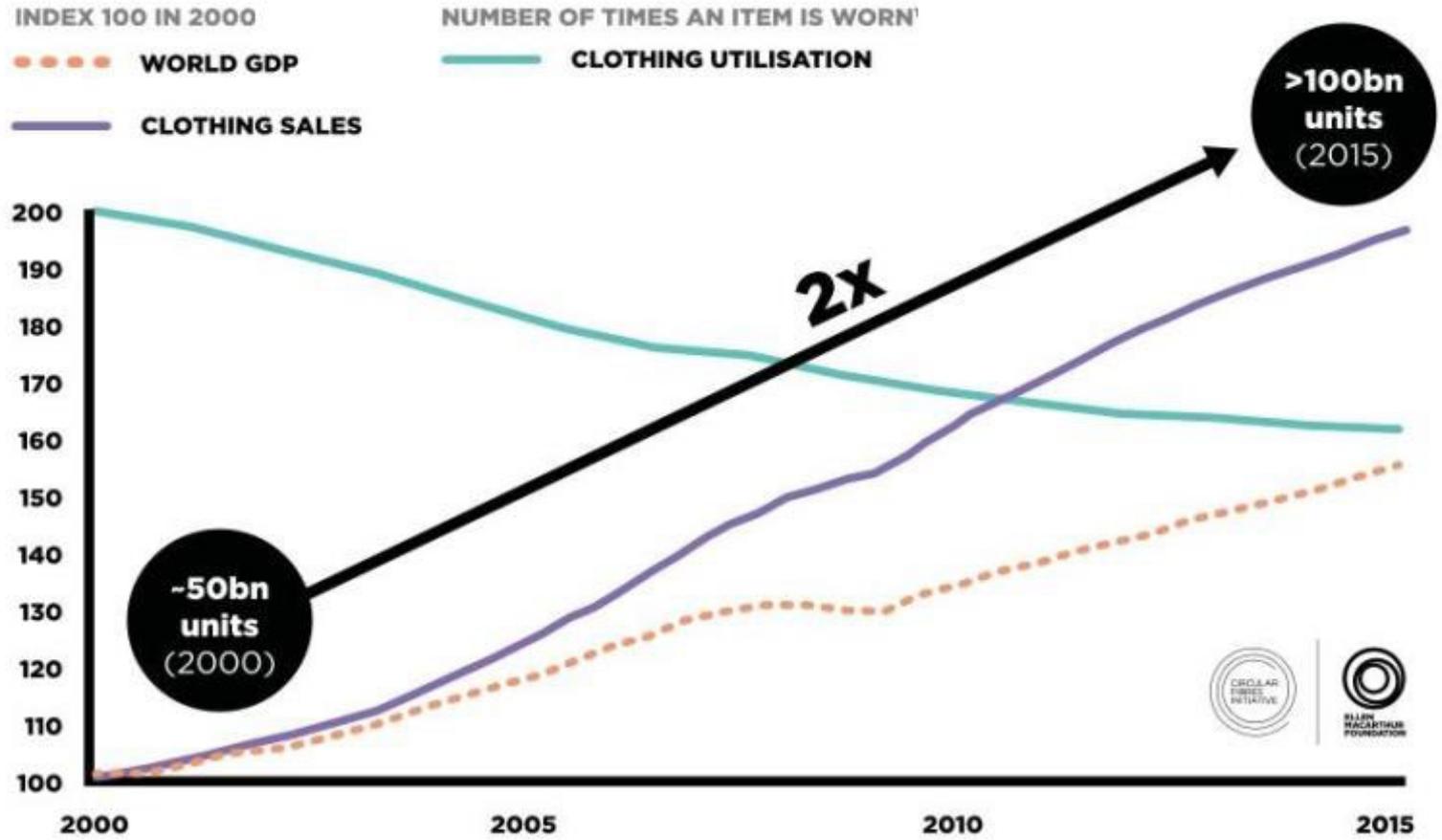




Separation und Gewinnung von Polyamid aus Textilmischungen

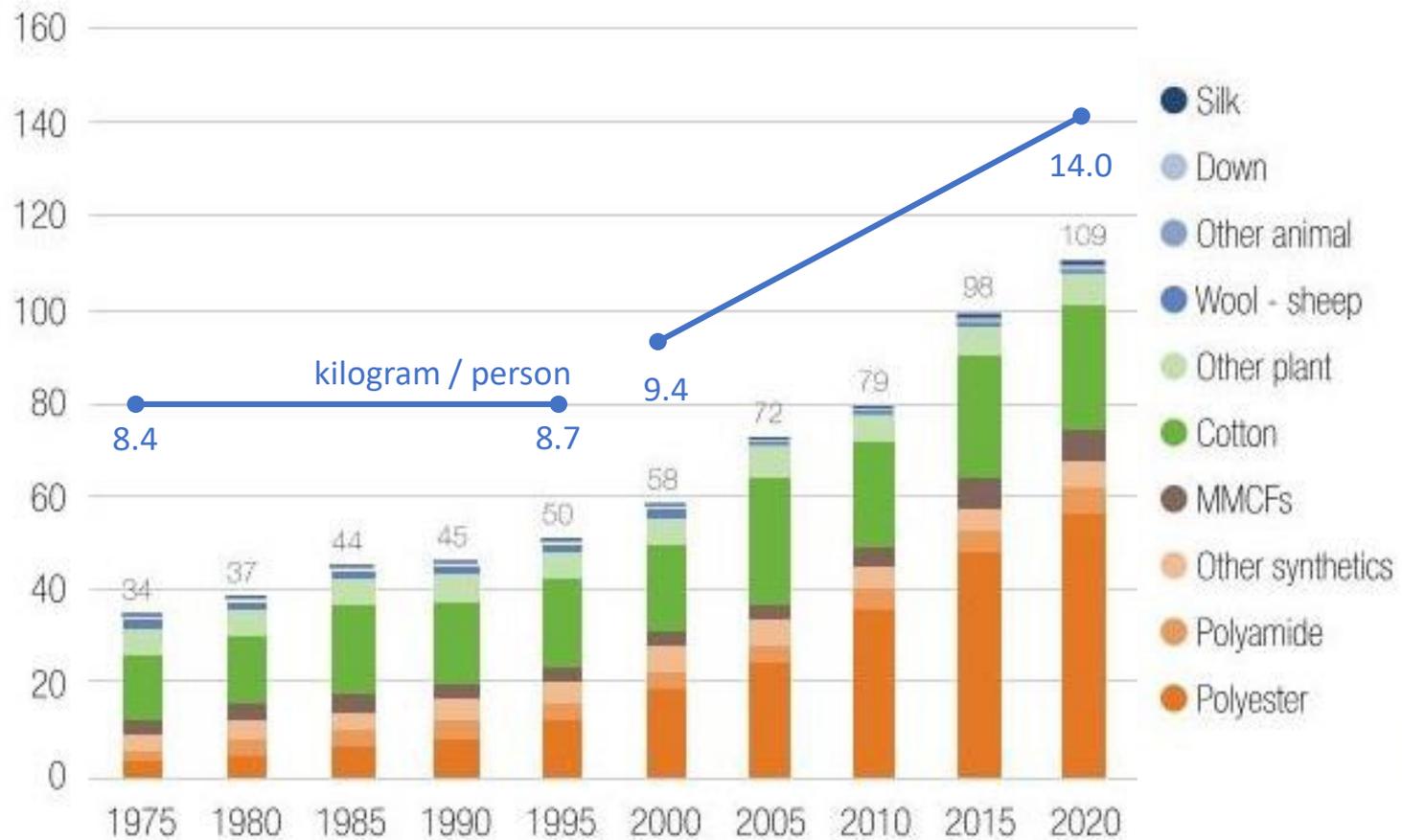
Avinash P. Manian



1 Average number of times a garment is worn before it ceases to be used

Ellen MacArthur Foundation. A New Textiles Economy: Redesigning fashion's future.
<https://www.ellenmacarthurfoundation.org/publications/a-new-textiles-economy-redesigning-fashions-future>

GLOBAL FIBER PRODUCTION IN MILLION TONNES



Preferred Fiber & Materials Market Report 2021, Textile Exchange
<https://textileexchange.org/preferred-fiber-and-materials-market-report/>

EU consumers discard about 5.8 million tonnes of clothing annually. Only 25% is recycled, while the rest is incinerated or landfilled.

Advancing Resource Efficiency in Europe, 2014. European Environmental Bureau
<https://eeb.org/library/advancing-resource-efficiency-in-europe/>

By 2025, all EU member states should put in place systems to collect waste textiles separately and ensure they are not incinerated or landfilled.

European Environment Agency. Textiles in Europe's circular economy
<https://doi.org/10.2800/904911>

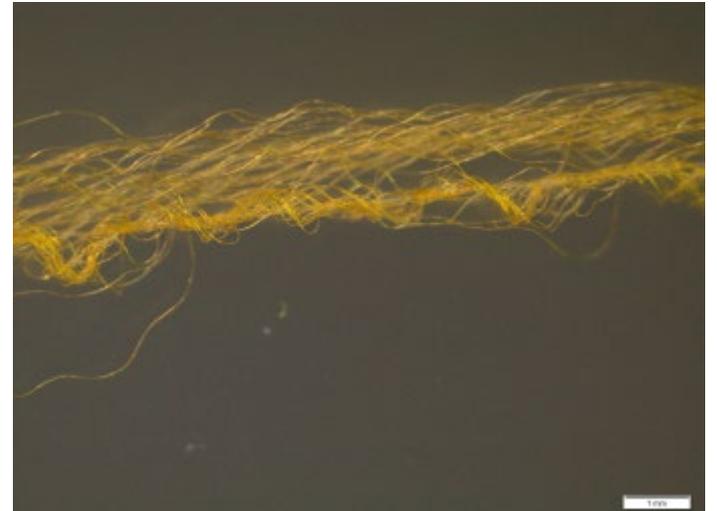
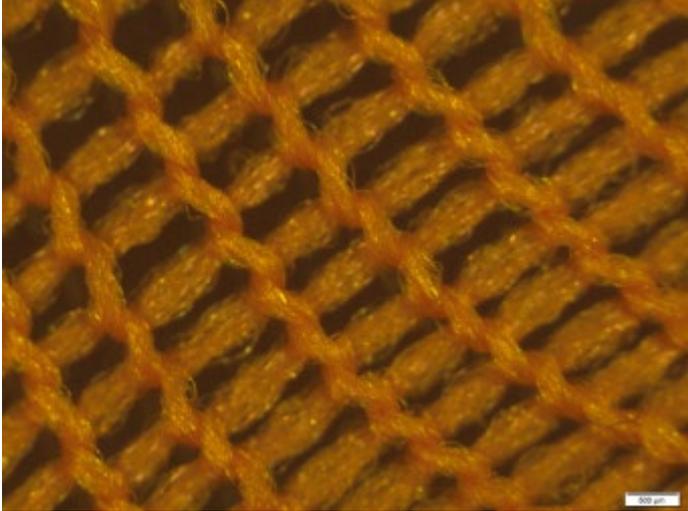
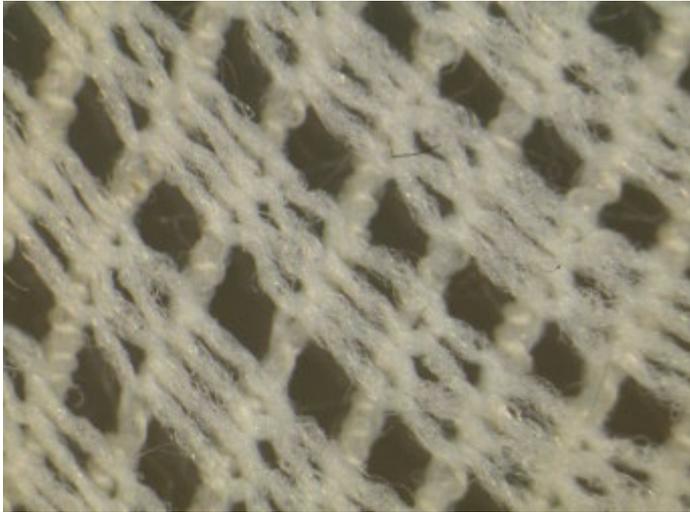
“...clothes, fabric, and fibres are kept at their highest value during use, and re-enter the economy after use, never ending up as waste.”

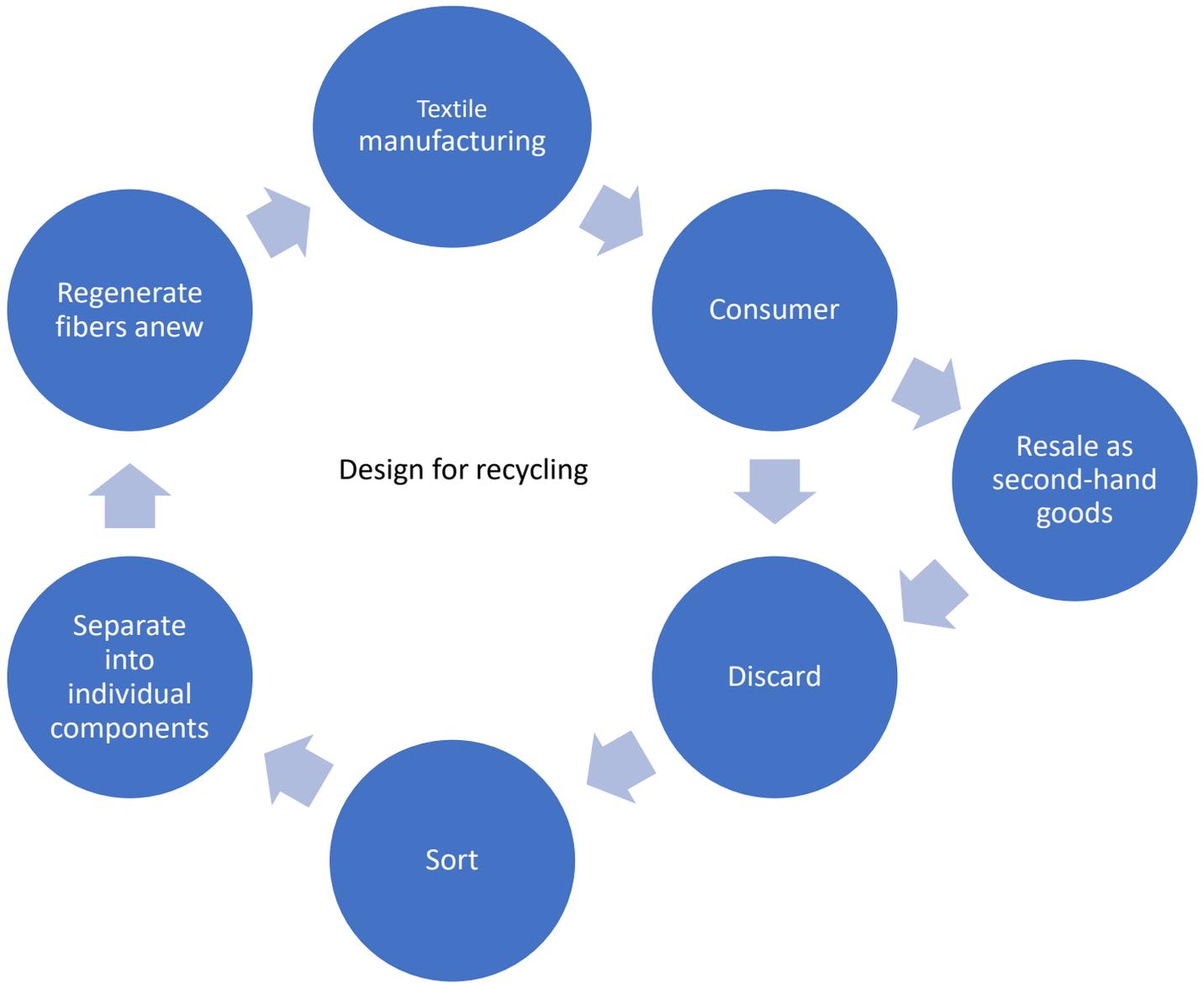
Ellen MacArthur Foundation. A New Textiles Economy: Redesigning fashion's future.
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<https://calpirg.org/blogs/blog/cap/fashion-industry-waste-drastically-contributing-climate-change>



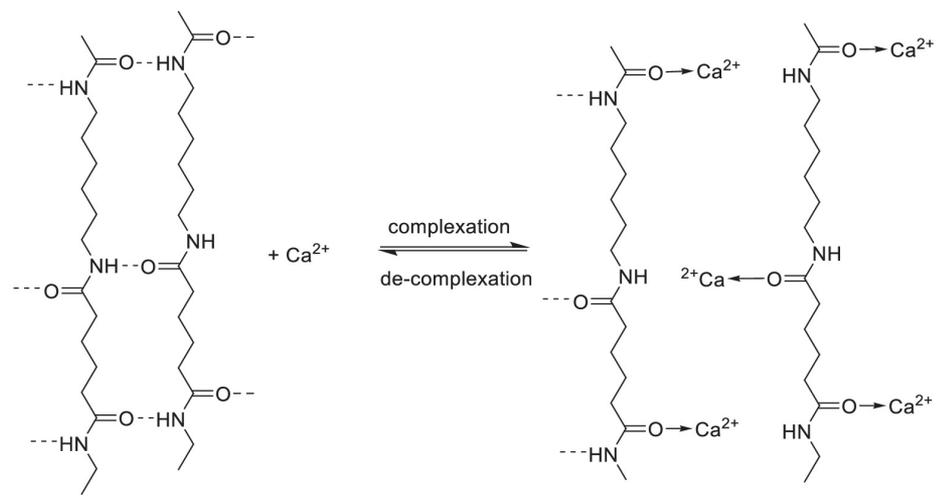
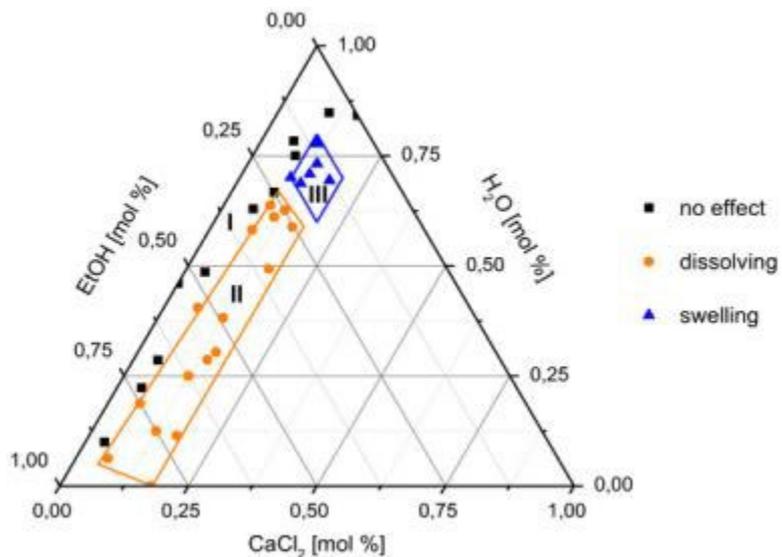




Construction techniques

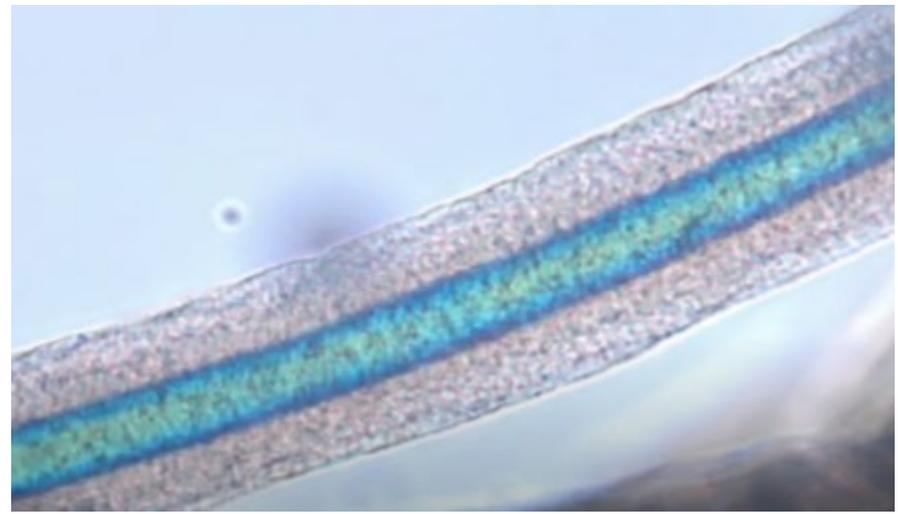
Number and proportions of different components

Additives and colorants



Effect of Solvent	CaCl ₂ (mol %)	EtOH (mol %)	H ₂ O/EtOH Mole Ratio
No effect (area I)	6 < x < 10	x ≤ 25	x > 2.5
No effect (area I)	x < 6	x > 25	x < 2.5
Dissolving (area II)	x > 6	x > 25	x ≤ 2.5
Swelling (area III)	x > 10	x < 25	x > 2.5

- Rietzler, B., Bechtold, T., Pham, T. Controlled Surface Modification of Polyamide 6.6 Fibres Using CaCl₂/H₂O/EtOH Solutions. *Polymers* 2018, 10, 207. <https://doi.org/10.3390/polym10020207>
- Rietzler, B., Manian, A. P., Rhombert, D., Bechtold, T., Pham, T., *J Appl Polym Sci* 2021, 138 (40), e51170. <https://doi.org/10.1002/app.51170>



Polyamide (PA) fibers in mixture with other fibers



Immerse in CEW to selectively dissolve the PA



Separate the dissolved PA from the undissolved “others”



Recover the dissolved PA by precipitation – add water



Wash the recovered PA with water to remove residual calcium

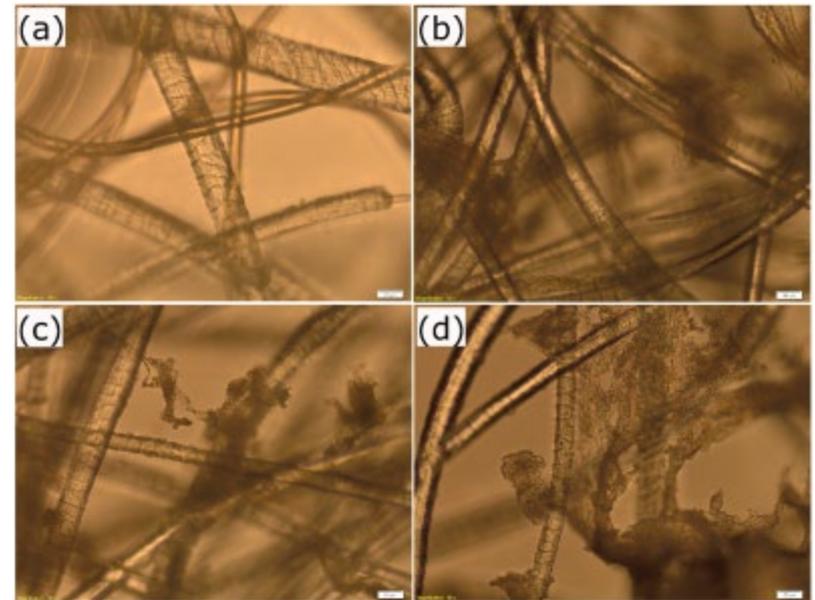
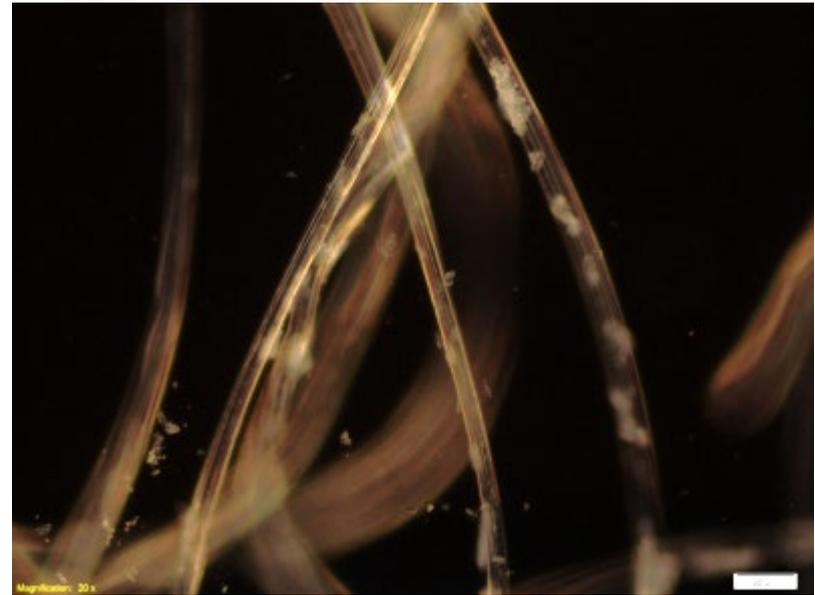


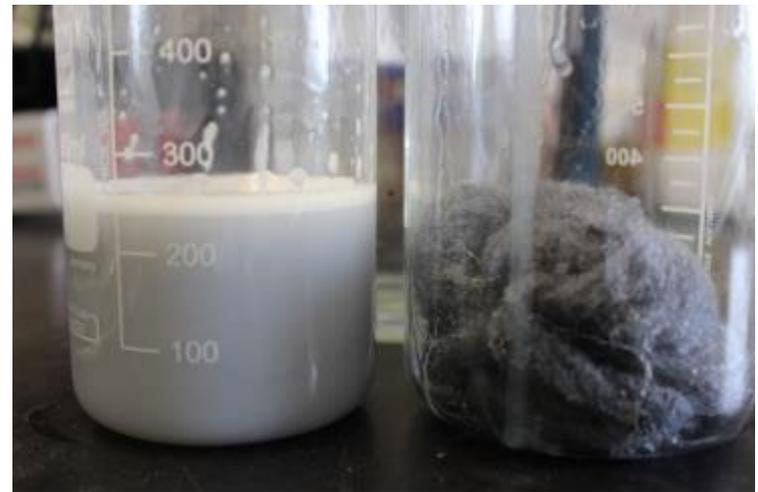
Analyze the recovered PA to determine suitability for spinning back into fibers

Can the other fiber be reused in manufacture of new textiles?

If one or both of the PA and other fibers are colored, where goes the colorant?

Recovery of ethanol and calcium chloride for reuse





Amount of CEW needed depends also on “other” fiber

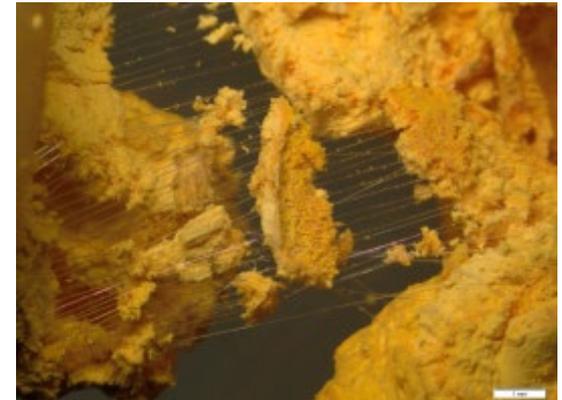
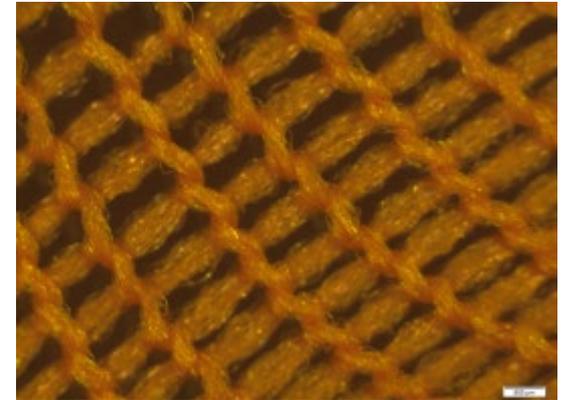
Polyamide recovery extents estimated at ca. 80–95%, but further optimization possible

Residual calcium content in recovered polyamide found to be between 1–8 wt%

- Contents of more than ca. 4 wt% appear to influence melt behavior
- Some of the calcium appears to be in the form of calcium carbonate for reasons unknown

The “other” fibers (cotton, wool) appear undamaged

Initial results on fate of colorant in wool/PA mixes suggests acid dyes wash out of fibers while metal complex dyes stay with host polymer – much more work required to get better understanding



The pilot project: with your support, we aim to analyse the usage and traceability of a textile product as a basis for recovery and subsequent separation and reuse of the valuable materials. Each product is provided with an extra QR code where the product data is stored at the producers.

What to do: please scan the QR code with your cell phone and enter the product description (manufacturer and product number) and the date of purchase on our homepage. You can enter the same information again when you dispose of the garment.

With your valuable support, the first steps towards an integrated sustainable textile circular economy can be taken:

- Sustainable product design (design-for-recycling).
- Collection and sorting
- Chemical separation and recovery of raw materials for new textile fibre based on recorded product information



<https://circular.tccv.eu>



<https://circular.tccv.eu/product/jacke>

Co-workers: Felix Krägeloh, Amalid Mahmud-Ali, Paul Mayer, Barbara Paul

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Innovation und Technologie



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