Circular options in textile materials – PART B



Mechanical vs chemical recycling

Mechanical recycling	Chemical recycling
less energy-intensive	high pressure and temperature conditions
requires fewer resources	use of toxic degrading agents for depolymerization
low equipment cost	often necessitates purification and separation steps
	spreading hazardous substances from dyes, softeners, and other textile additives into the environment
	high-quality fibers

Chemical recycling a summary

Chemical reactions and solvents separate fiber constituents, allowing to treat also **mixed fabrics**

- **Depolymerization**: Breaking polymers into monomers.
- **Solubilization**: Dissolving at least one component.
- **Degradation** of one constituents

Efficiency depends on material purity: s**ince mixed fabrics** are treated with dyes, fillers, and additives, pre-treatment are required to remove these substances.

➔ Regenerates polymers to virgin quality.

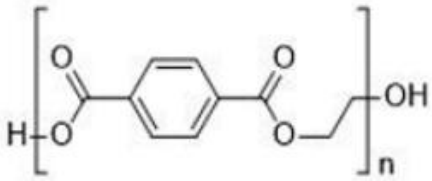
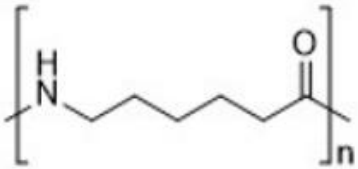
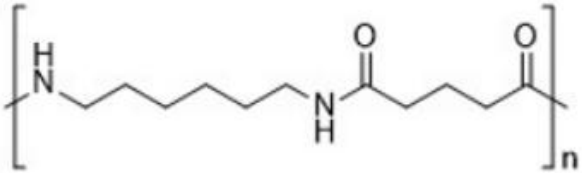
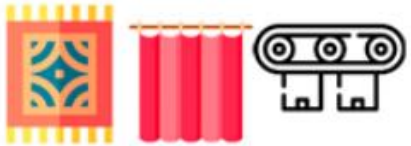
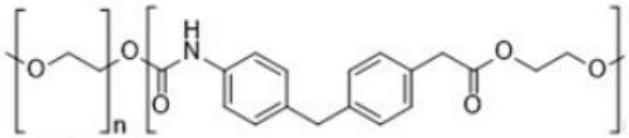
Disadvantages:

- Excessive use of solvents, catalysts, and acids.
- Efficiency depends on material purity.

PET-cotton blends

In order to recycle chemically cotton and synthetic fibers, they must be separated. This may be done by depolymerizing or dissolving one of the components while maintaining the other.

- **Recent Developments**:
  - Lab-scale process for polycotton recycling using NaOH in water at mild temperatures (70–90°C).
    - **Results**: Release of cotton fibres and degradation of PET into TPA and EG.
  - Green approach with deep eutectic solvent (DES) ($ZnCl_2/H_3PO_4/H_2O$).
    - **Outcome**: Successful separation of cellulose from polyester without post-treatment requirements.
  - Polyester glycolysis with zinc oxide.
    - **Findings**: Polyester reacted in glycolysis, while cotton remained intact, with higher temperatures (>180°C) accelerating PET depolymerisation.

Polymer	Molecular Structure	Main Applications
Polyethylene terephthalate		 Textile fibres, food containers and plastic bottles
Nylon 6		 Carpets, fishing nets and swimwear
Nylon 6.6		 Carpets, curtains and conveyor belts
Elastane	 Soft segment Hard segment	 Sportswear, swimwear and textile blends

Special case studies

Special case studies polyamides

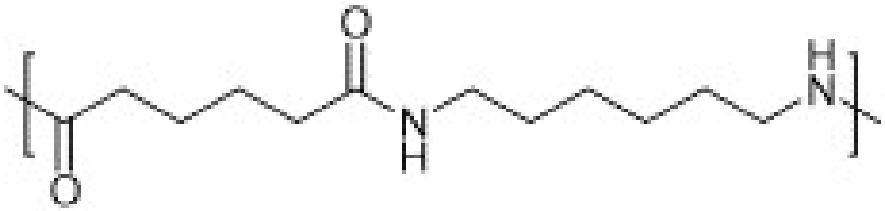
Global Nylon Production

2017 - 2022 (USD Billion)

GRAND VIEW RESEARCH



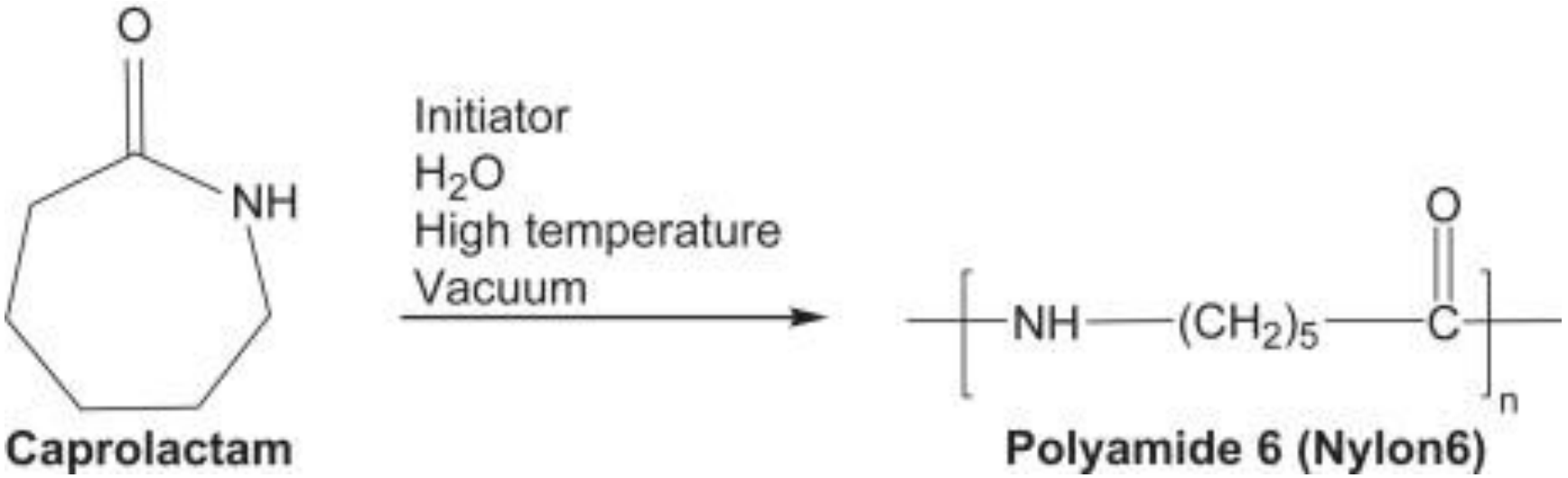
Nylon 6 (ROMP)



Nylon 6,6



Nylon 6

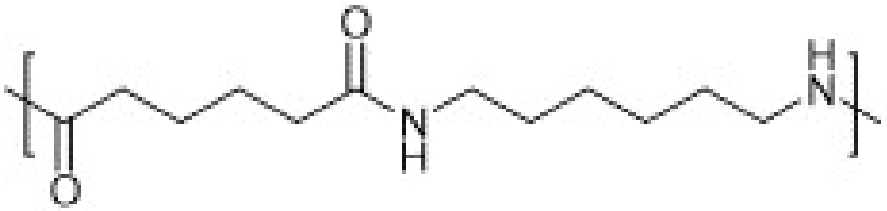


Caprolactam

Polyamide 6 (Nylon6)

https://www.sciencedirect.com/topics/chemistry/nylon-6

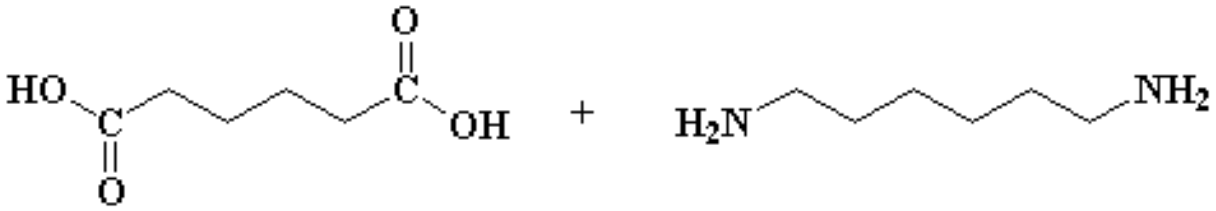
Nylon 6,6 (step-growth polycondensation)



Nylon 6,6

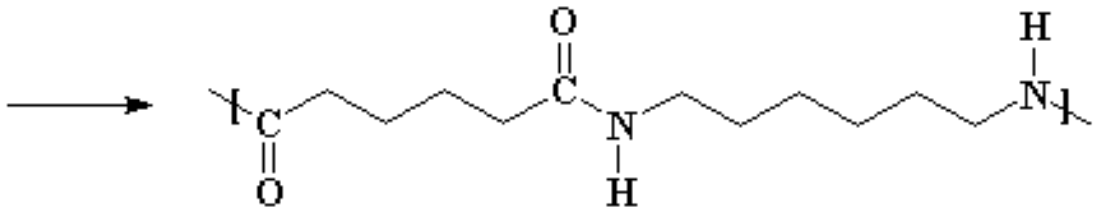


Nylon 6



adipic acid

hexamethylene diamine



nylon 6,6

https://www.sciencedirect.com/topics/chemistry/nylon-6

Recycling of textiles: Nylon 6

Nylon-based products are: fishing nets, carpets swimwear, activewear, and other performance garments due to its durability and stretchiness.

High mechanical strength, elasticity, rigidity, viscosity, and resistance to the external environment of thermoplastic polyamides are due to hydrogen bonds formed between amide groups

Nylon is a type of polyamide and a thermoplastic polymer which uses the same chemical recycling routes as PET.

However, due to technical recycling challenges and comparatively lower prices for virgin fossil-based polyamide, recycled nylon only made up 2% of the total polyamide market share

Recycling of textiles: Nylon

- Nylon is often combined with other polymers (polyesters, polypropylene, polyurethanes) and fillers (e.g., TiO_2, glass fibers, carbon black, dyes).
- Contaminants complicate both **mechanical** and **chemical recycling**, limiting purity and efficiency (➔catalyst poisining) .
- For these reasons nylon recycling is limited to the post-industrial scraps and few PA-based materials such as fishing nets (➔ see Econyl process)

Dissolution/Precipitation process

1: Dissolution: Selective dissolution using specific solvents or solvent mixtures.
2: Filtering residual solids: Nylon is separated from impurities.
3: Precipitation: Two methods:

- **Anti-solvent precipitation**
- **Temperature lowering/concentration increasing**



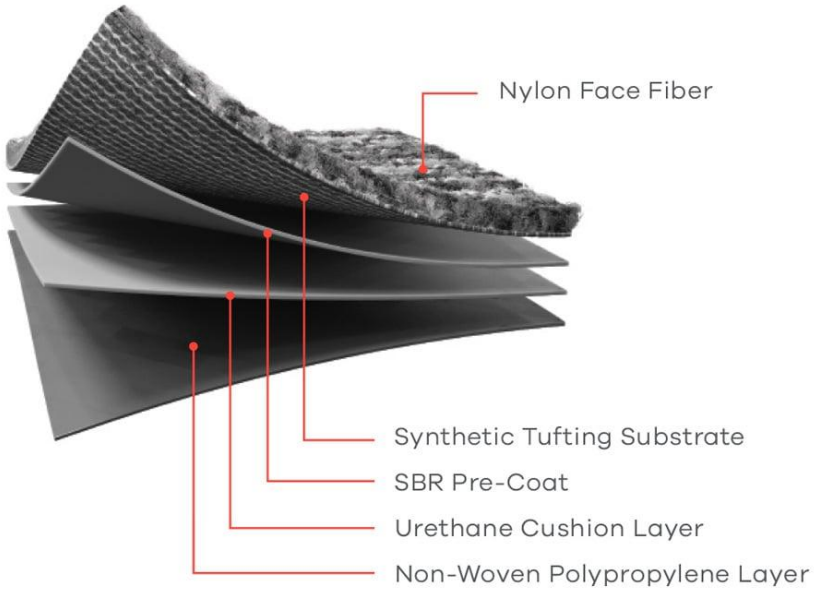
Recycling of textiles: Econyl



https://www.aquafil.com/

Recycling of textiles: Nylon carpets

Carpets consist of three main components: face fibers (usually nylon 66, nylon 6, or polypropylene), a backing (typically polypropylene), and an adhesive material (styrene-butadiene rubber, SBR) often filled with calcium carbonate.



While there are recycling processes to separate and recover materials, they are expensive and energy-intensive, reducing their environmental benefits.
Monsanto has proposed a solution involving a melt blend of the unseparated carpet materials under controlled temperature, pressure, and mixing conditions.

Recycling of textiles: post-consumer Nylon

Post-Consumer Nylon Waste:

- Heterogeneous waste: often mixed with polyurethane, polyester, and glass fibers.
- Requires re-extrusion above 260°C, leading to:
  - Degradation of for non-nylon components with lower stability.
  - Formation of impurities, affecting final product quality.

Potential Solutions:

- Improved separation techniques.
- Use of stabilizers and compatibilizers to maintain properties.

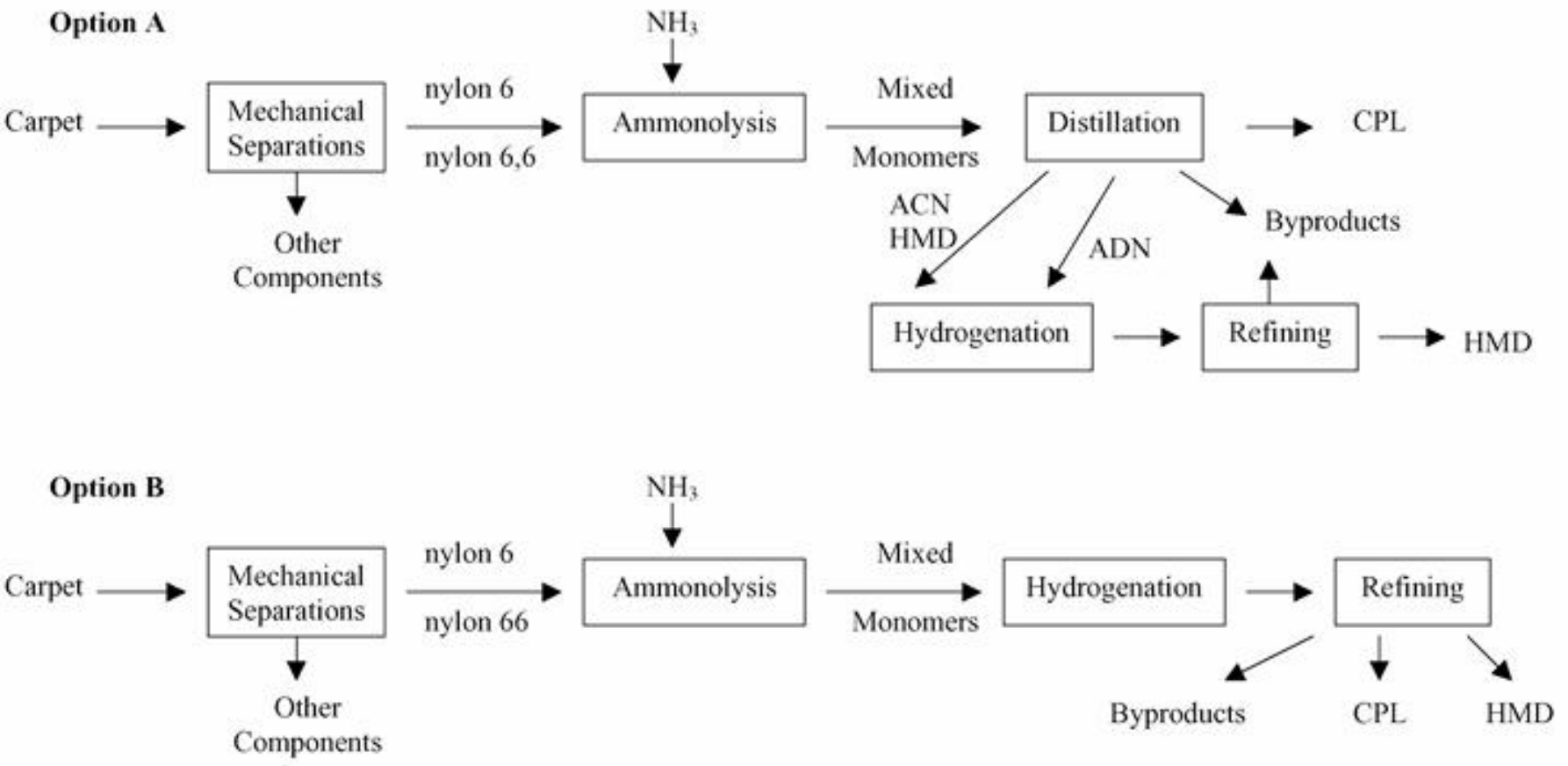
Recycling of textiles: post-industrial Nylon 6

- **Challenges of Recycling PA6 Fibers:**
  - PA6 significantly oxidizes during long-term storage and at high melting temperatures.
  - PA6 fibers and yarn waste cannot be directly recycled into new fibers.

- **Thermomechanical Recycling Process:**
  - Fibrous waste is ground.
  - It is sent through a forced feeding system with simultaneous drying.
  - Material enters the extruder.
  - Melt is filtered to remove physical impurities.
  - Degassing occurs to eliminate volatile substances.
  - The processed melt is discharged into standard-sized chips.

- **Uses of Recycled PA6 Chips:**
  - Can be used as-is, combined with virgin granulates
  - Additives can be included during extrusion for injection molding-grade products.

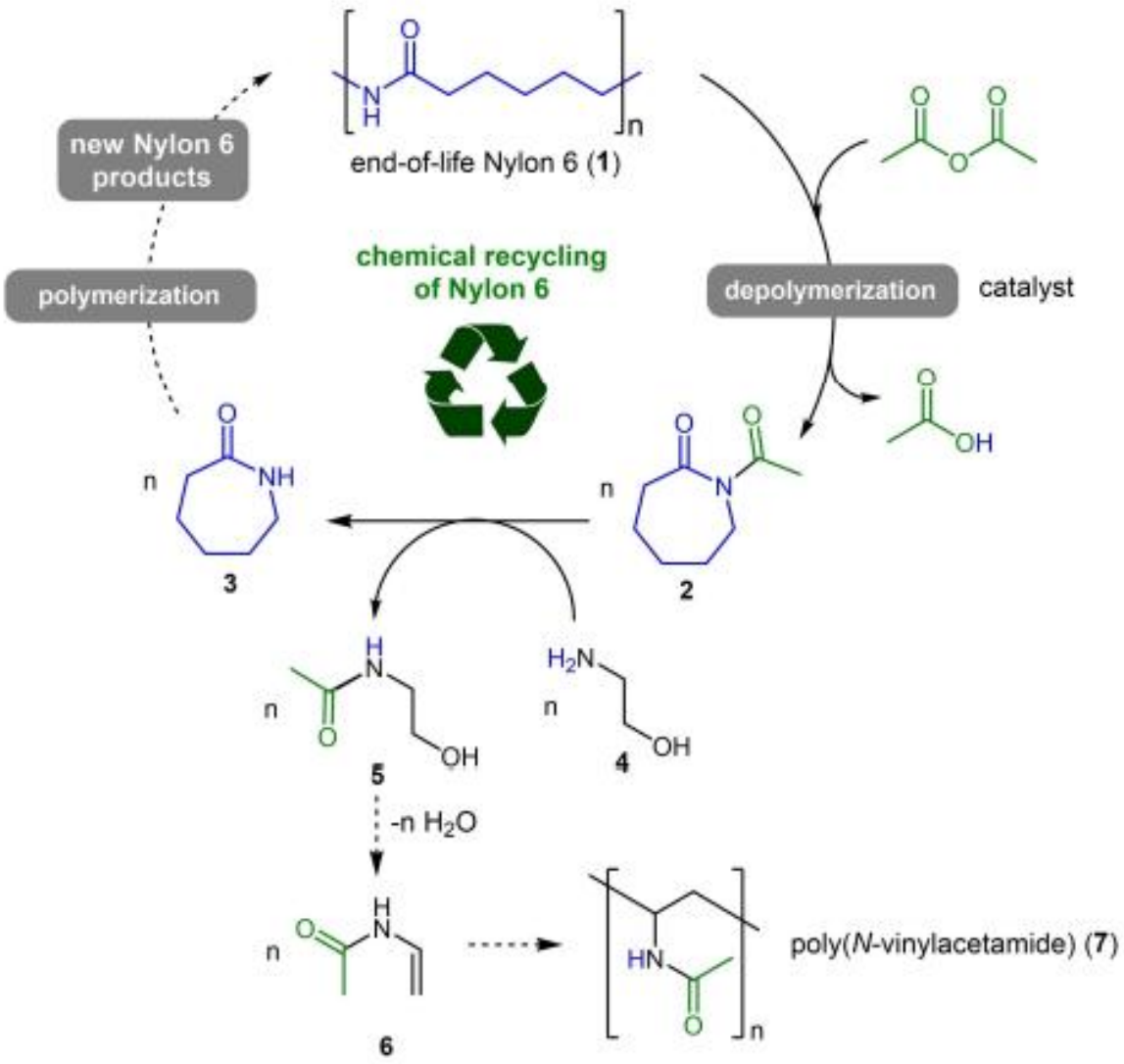
Recycling of textiles: Nylon 6



Block diagram of nylon-6 and-6,6 recycling process. ADN, adiponitrile; ACN, 6 aminocapronitrile; HMD, hexamethylenediamine; CPL, caprolactam

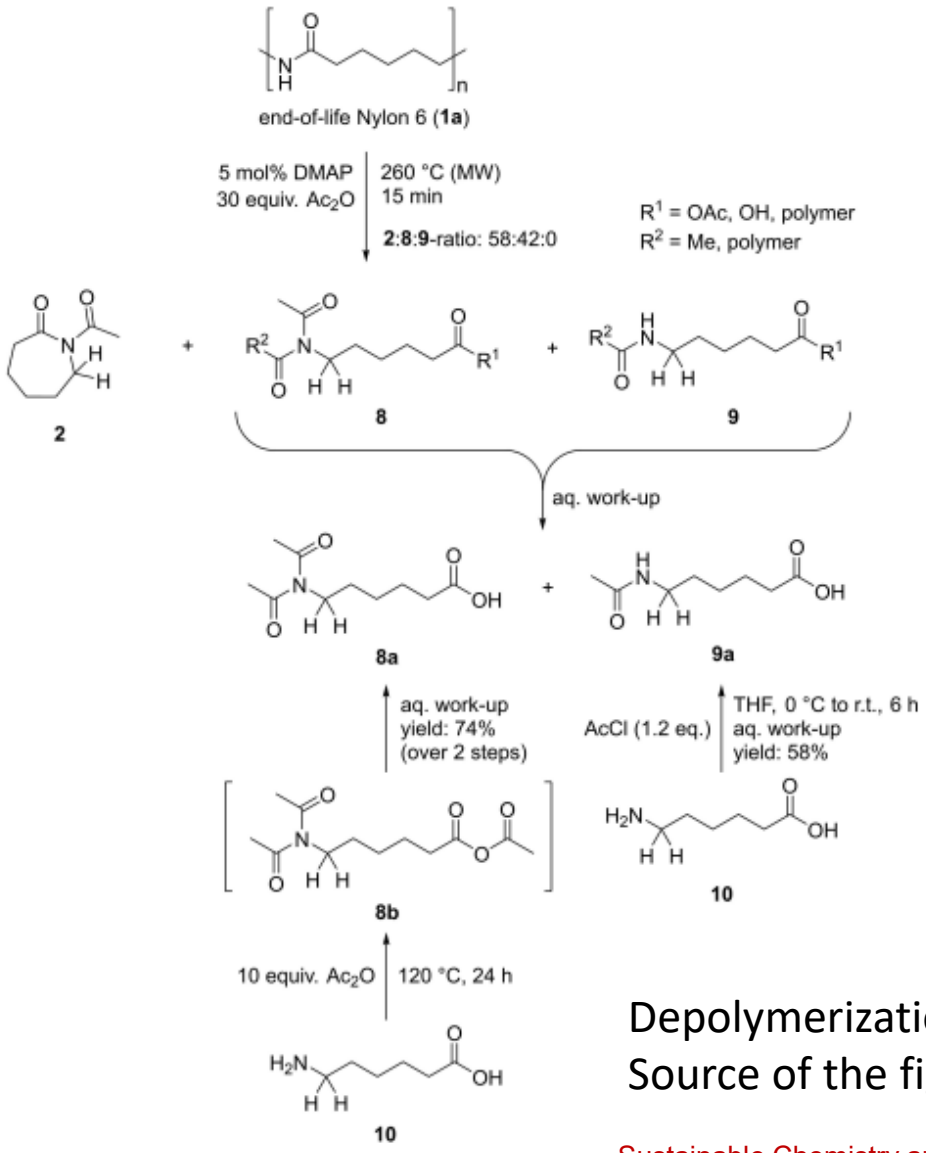
Source of the figure: Applied Catalysis A: General, 318, 20 February 2007, Pages 190-198

Recycling of textiles: Nylon 6



Valorization strategy for end-of-life Nylon 6.
Source of the figure: ChemistrySelect 2019, 4, 12638– 12642

Recycling of textiles: Nylon 6



DMAP
N,N-dimethylpyridin-4-amine

Depolymerization of Nylon 6 with acetic anhydride (Ac_2O)
Source of the figure: ChemistrySelect 2019, 4, 12638– 12642

Thermomechanical recycling of nylon

Thermomechanical recycling involves grinding and re-extrusion of plastic waste.

- Shredding & grinding into smaller pieces.
- Melting into chips/pellets.
- Molding or spun into new products.

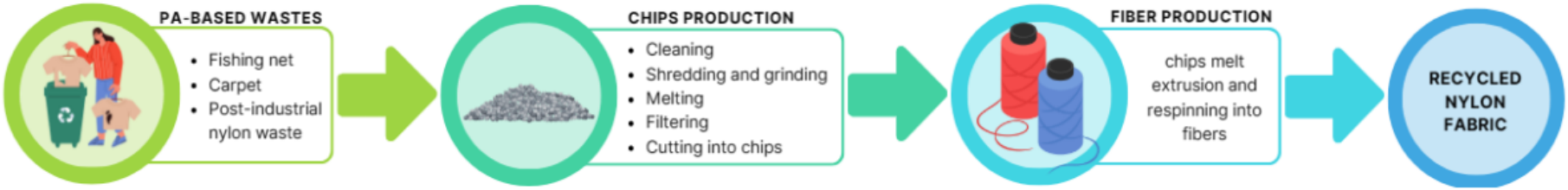
•Quality of recycled material may be lower than the original polymer.

Types of Waste Processed:

•Post-industrial waste (scraps, processing waste): homogeneous, easier to recycle.
•Fishing nets
•Post-consumer waste nylon: more challenging due to contamination.

Key Considerations:

•Drying is crucial to limit hydrolysis and degradation.
•Stabilizers can improve material quality over multiple reprocessing cycles.
•Mixing with virgin material or chain extenders can enhance recycled product quality.



Recycling of textiles: Nylon 6

Solvents for Selective Dissolution of Nylon without affecting other materials or causing contamination.

- **Carboxylic Acids**: Formic, Acetic acids
- **Glycols**: e.g., Glycerol
- **Alcohols**: Methanol, Phenol, Benzylic alcohol
- **Inorganic Acids**: HCl, H_3PO_4
- **Polar Compounds**: Dimethyl sulfoxide (DMSO), Caprolactam, Ionic liquids
- **Carbonates**: e.g., Ethylene carbonate

Special Cases:

➔ The ionic liquid 1-allyl-3-methylimidazolium chloride ([AMIM]Cl) was used to recover 58% and 39% of cotton and nylon 6 fibers from waste nylon/cotton at 110 °C.
➔ Nylon + Polyurethane (PU) composites

- Selective dissolution of PU using DMSO, DMF, water-NMP

Recycling of textiles: Nylon 6

Specific pretreatment

- **Aquafil Technology**:
  - Uses **thermal treatment** for selective degradation of PU in nylon-based textiles, then polar solvents like ethanol wash away degraded chains.

- **Nylon and Silicone Resin (Airbags)** :
  - **Selective degradation of silicone**: Alkali/alcohol/surfactant mixtures, or Lewis acid/glycol mixtures.

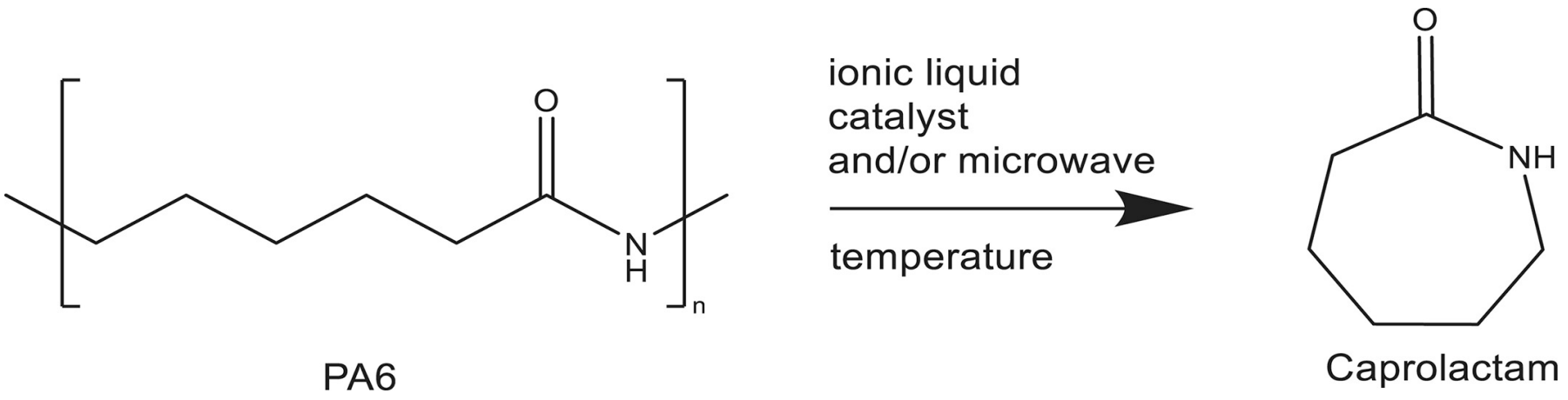
- **Colorant Removal**:
  - Difficult due to strong interactions between **acid dyes** and **amine terminal groups**.

  ➔Lactams/amines + alcohols as swelling agents.

  ➔Dimethyl sulfone + water remove colorants from PA66.

Chemical Recycling (Tertiary Recycling)

- Purity of the raw material stream is crucial for efficient recycling.
- Pre-treatment may be necessary to improve competitiveness.



Tonsi G., et al. *Chemical Engineering Transactions*, 2023, 100, 727-732

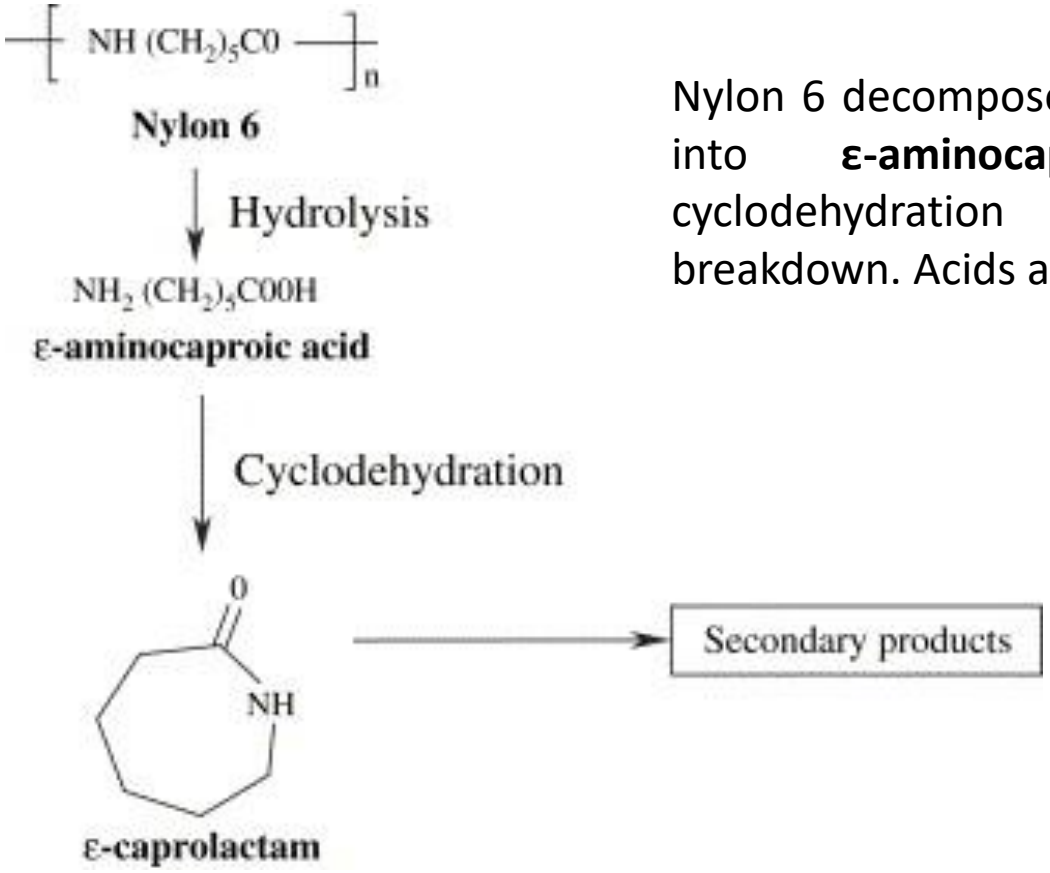
1/Hydrolysis Process

- **Acid Hydrolysis**:
  - The only technique used on a large scale for the depolymerization of **Nylon 6,** to regenerate caprolactam**.**
  - Uses orthophosphoric acid (H_3PO_4) as a catalyst.
  - Yields: 85-97% depending on raw material.

- **Thermal Hydrolysis**:
  - High-temperature water (300-350°) attack on amide group.
  - Yields around 90%, avoids corrosion and by products issues.

- **Alkaline Hydrolysis**:
  - Uses nucleophilic OH^- to break amide bonds.
  - Applied to nylon plastic fibres (**Nylon 66)**, with yields up to 90%.

1/Hydrolysis Process



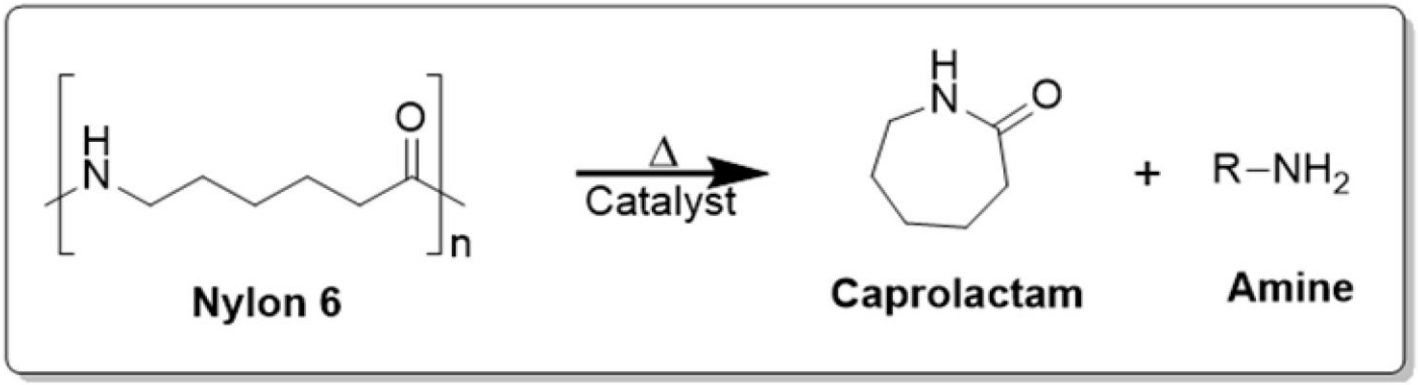
Nylon 6 decomposes at **150–240 °C** and **100–700 psi** into **ε-aminocaproic acid**, followed by cyclodehydration to **ε-caprolactam** or further breakdown. Acids accelerate the reaction

- **Nylon 6,6** depolymerization occurs via acid hydrolysis in HCl, achieving 99.9% depolymerization to hexamethylenediamine (HMD) at 80 °C for 120 min using 6 wt% waste in 5 N HCl.

2/ Pyrolysis Process

- **Pyrolysis of Nylon 6** occurs in an inert atmosphere.

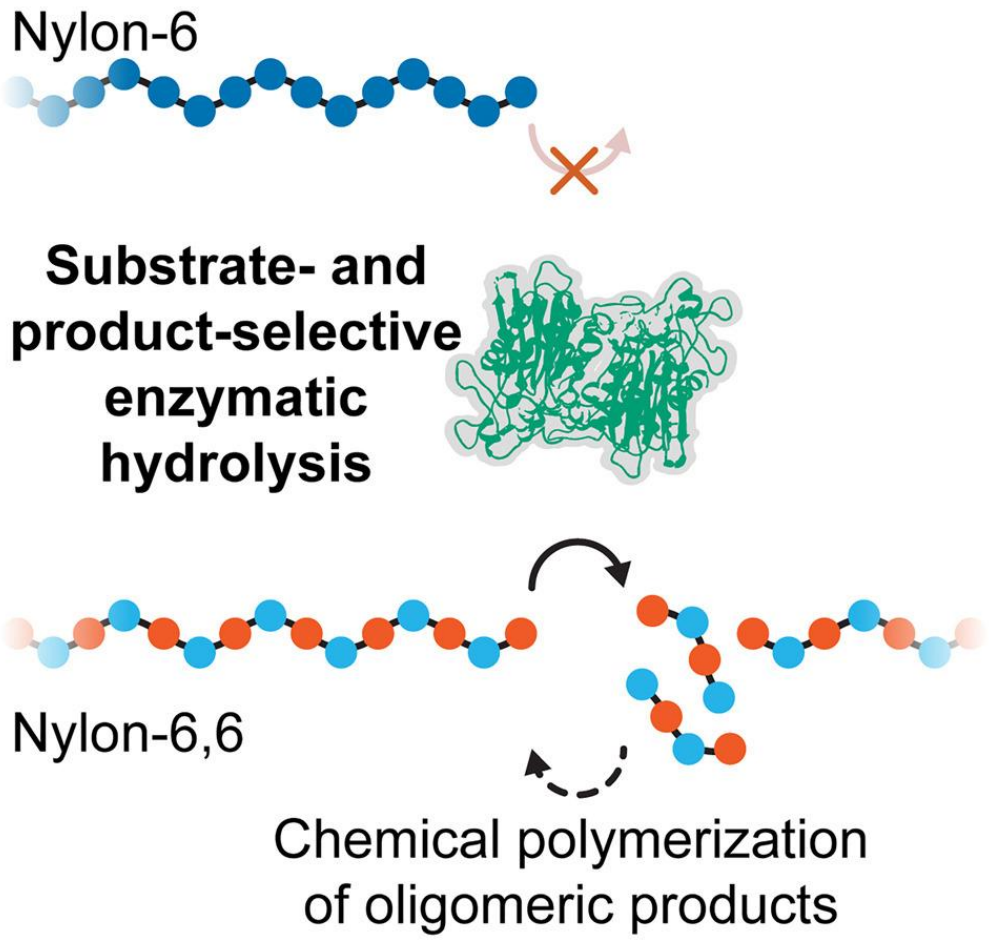
- Intramolecular cyclization occurs at temperatures >300°C in the presence of alkaline hydroxides (KOH on α-Al_2O_3) or carbonates (K_2CO_3).
- Caprolactam monomer was achieved (90% yield) at 250°C, pressure 3 mmHg, for 4 h in the presence of 1 wt % NaOH.
- Not scaled yet.



Recovered caprolactam (b.p.=270°C) can be used in the manufacturing of other materials such as nylon fibres, carpets, and textiles

3/Enzymatic Depolymerization

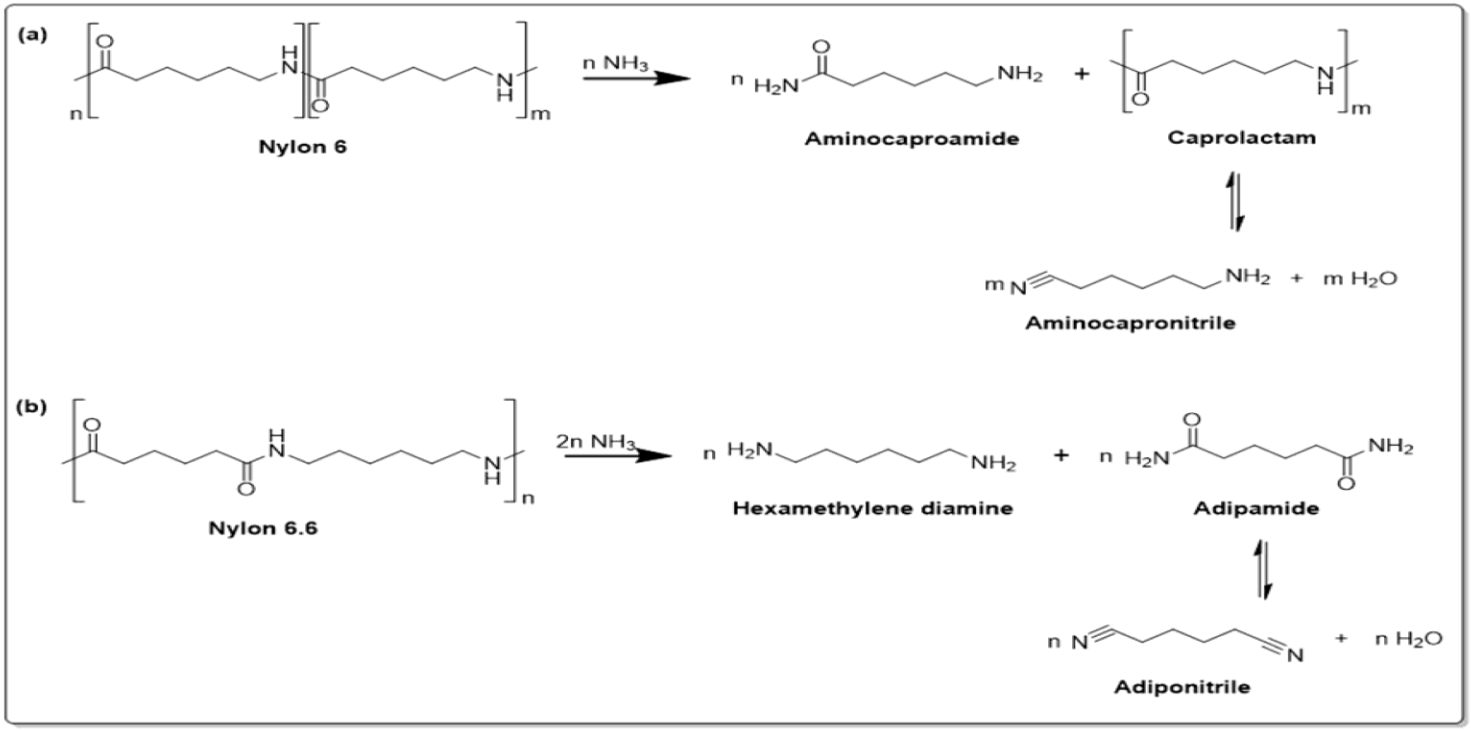
- Nylon Hydrolase enzyme catalyzes the breakdown of nylon.
- Suitable for Nylon 6 (conversion degree: 75%, Nylon 66 is less efficiently degraded).
- Potential for sustainability, not scaled yet.



4/Ammonolysis

•Transamidation reaction with ammonia at high temperatures (280-330°C) under pressure. >90% yield of products if non-converted oligomers are recirculated.

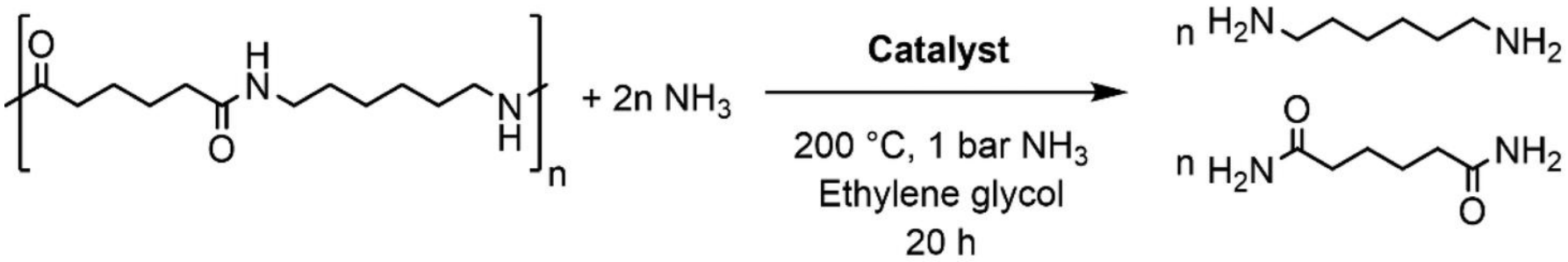
•Patented by DSM for recycling PA6.



The nitriles formed upon dehydration must be hydrogenated to be recycled into nylon again.

4/Ammonolysis

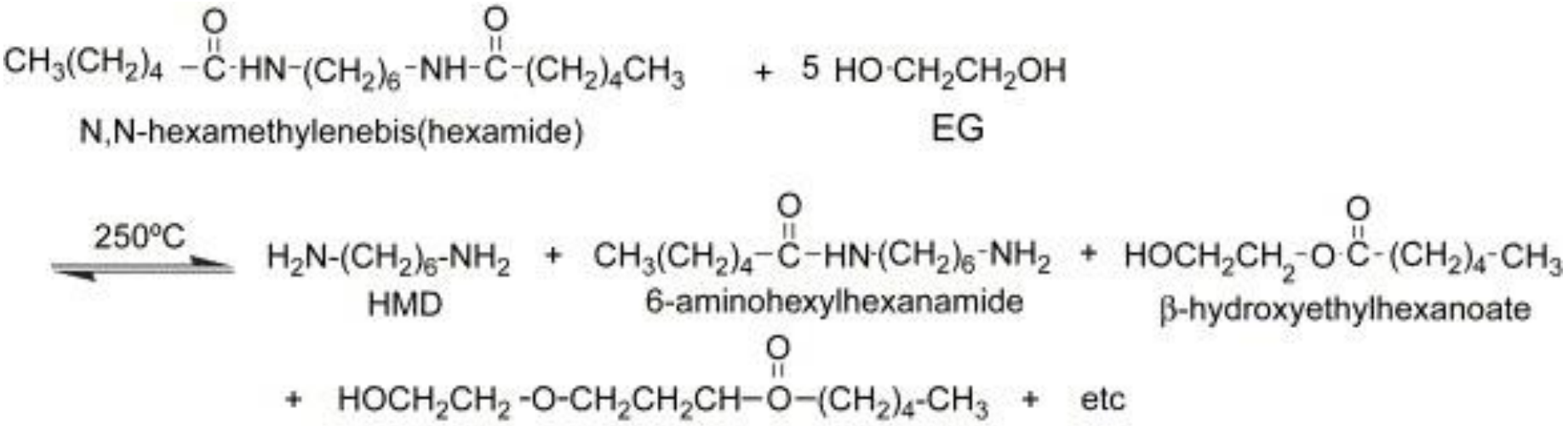
- **Ammonolysis Process** is a primary depolymerisation method of nylon 6,6 carpet waste. It involves using ammonia (NH_3) both as a reactant and catalyst at 200-400°C, under pressure.



- **Aminolysis Process**: Similar to ammonolysis, aminolysis uses amines instead of ammonia, with ammonium phosphate as catalyst.

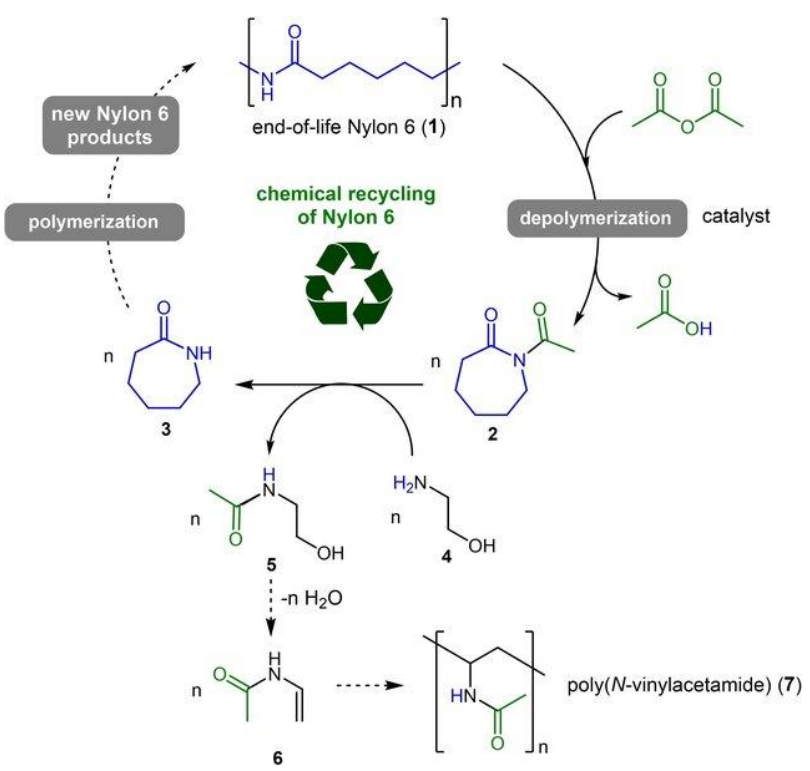
5/Glycolysis Process

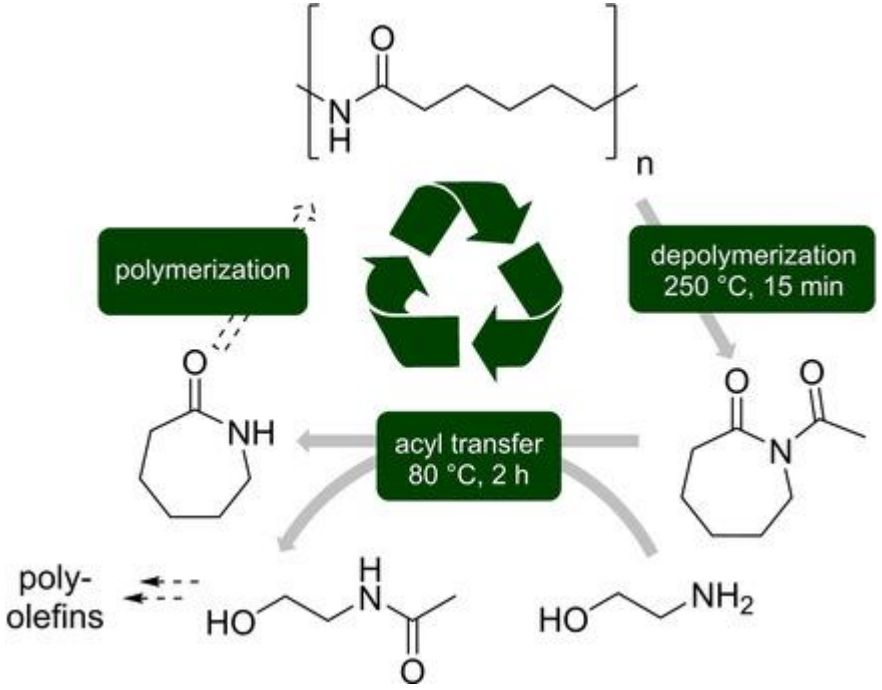
- **Nylon 6 and 6,6**:
  - Hydroxyl groups break amide bonds, forming monomers (sometimes ester forms).
  - Heating the nylon at 250 °C in the presence of acidic catalyst (phosphoric acid).
  - Yields remain low (~37%), not scalable yet.



6/Ring closing Process

A combination of **acetic anhydride** as depolymerization reagent and catalytic amounts of 4-dimethylaminopyridine allows, under microwave irradiation (15 min) the conversion of Nylon 6 to N-acetylcaprolactam under solvent-less conditions

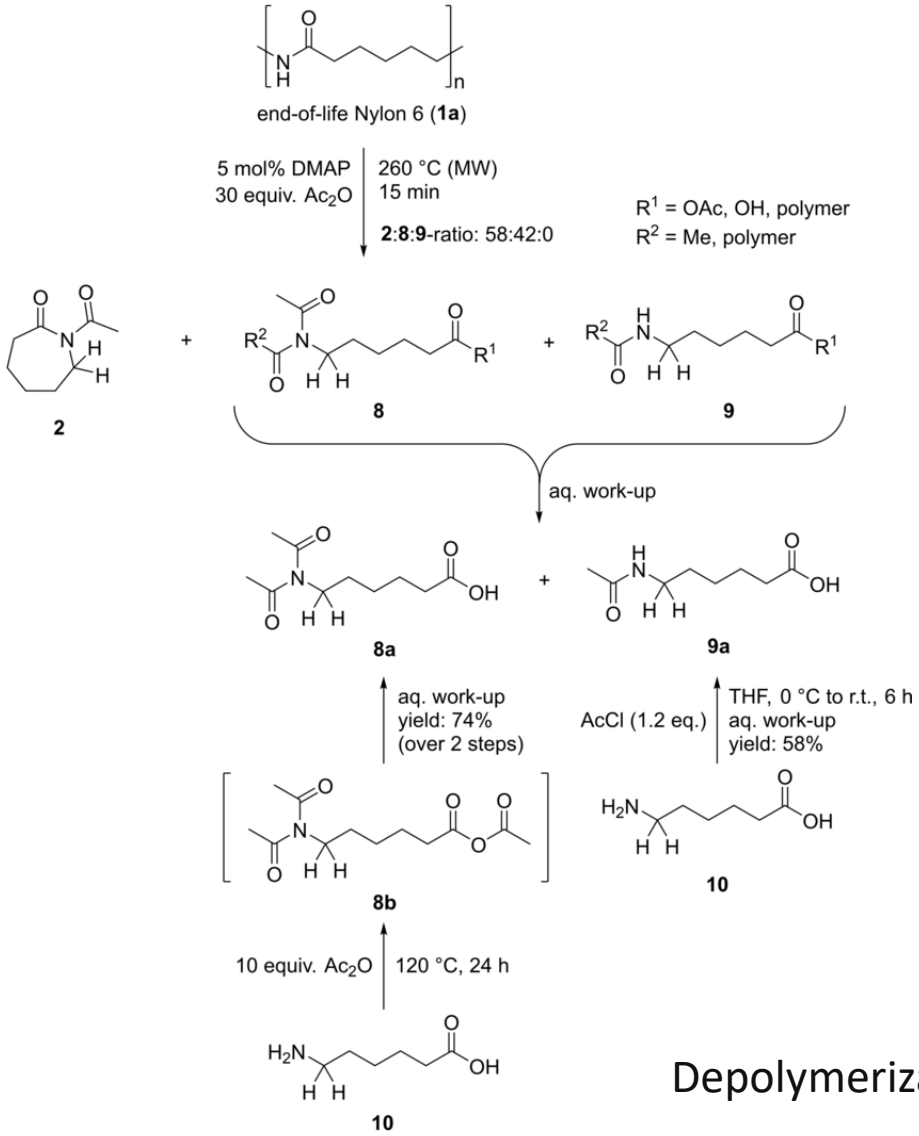




ChemistrySelect 2019, 4, 12638-12642

The depolymerization of end-of-life Nylon 6 is reported. The transformation is based on the ring closing depolymerization in the presence of the catalytic amounts of 4-dimethylaminopyridine to produce *N*-acetylated caprolactam, which is converted to caprolactam the starting material for new Nylon 6 and the acetyl group is transferred to 2-aminoethanol to produce *N*-acetyled 2-aminoethanol a starting material for poly(vinyl amides).

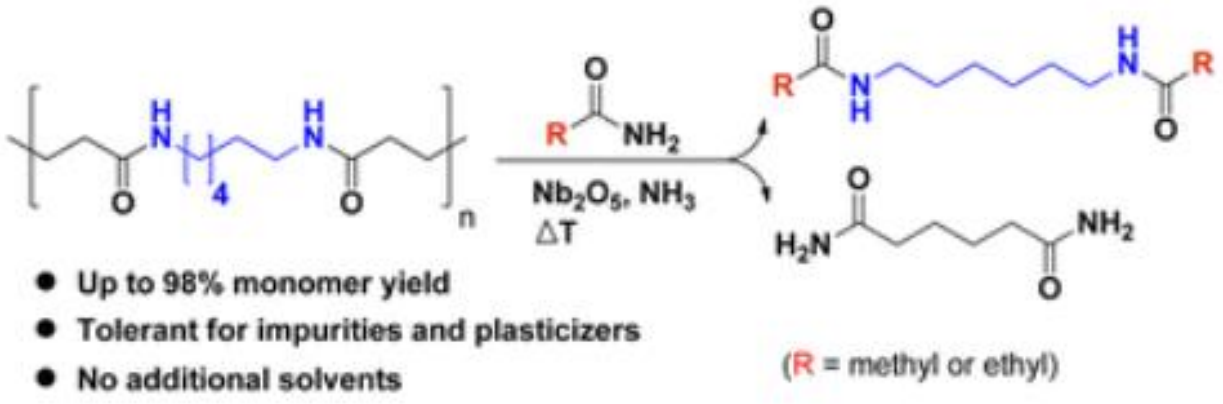
6/Anhydride Process



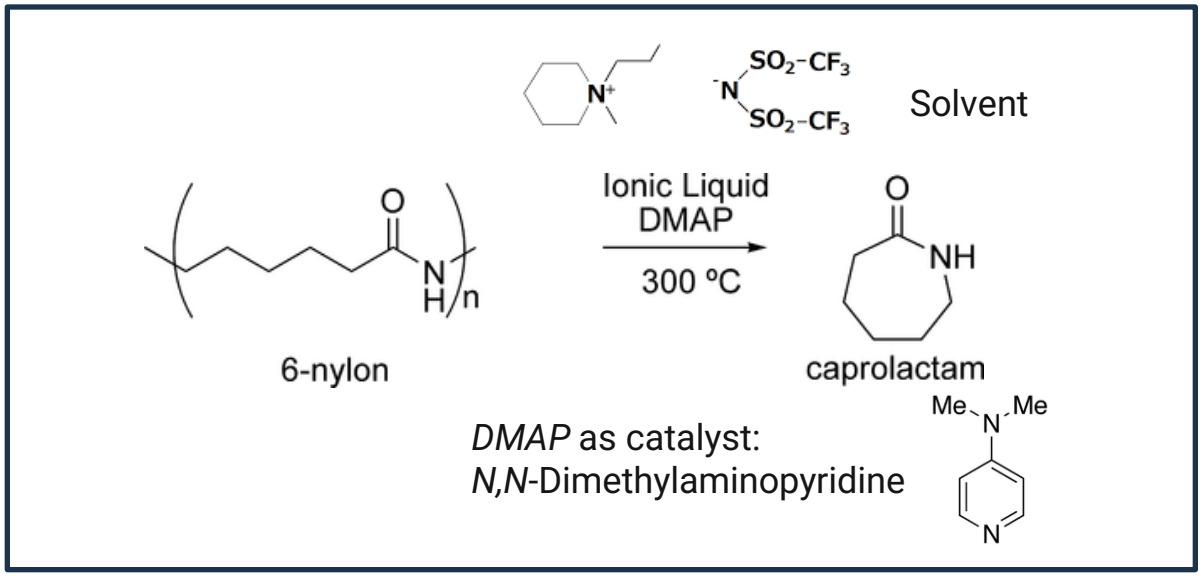
Depolymerization of Nylon 6 with acetic anhydride

7/Solvent-assisted Depolymerization

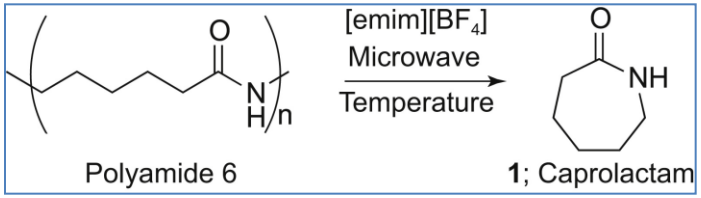
- **Solvent Options**: Supercritical or subcritical solvents for PA6.
  - **With Hydrocarbons**: e.g., n-heptane, toluene. Yields >90%.
  - **With Alcohols**: Secondary/tertiary alcohols (e.g., methanol, ethanol). Yields ~90%.
  - **With Ionic Liquids** facilitate solvolysis at high temperatures (and reduced pressure). Yields ~85%.



Treatment of polyamides in **ionic liquids** at 300 °C resulted in the efficient depolymerization of polyamides to give corresponding monomeric lactam



The MW-assisted update:



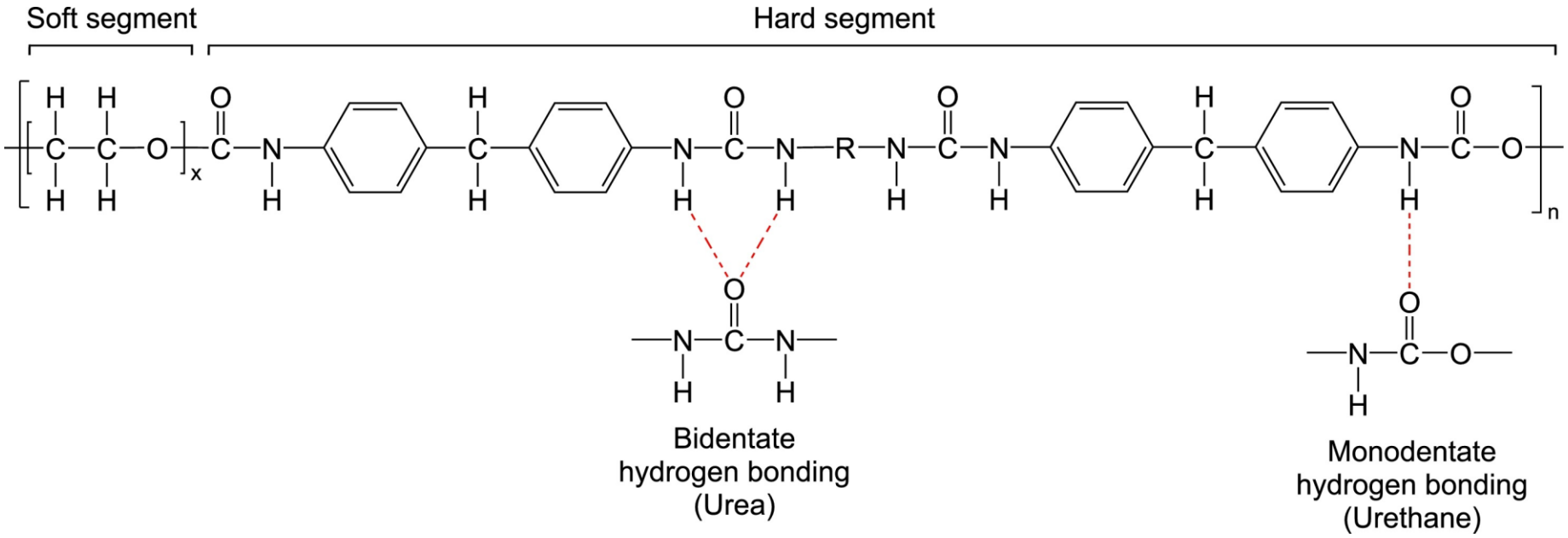
Org. Lett. 2007, 9, 13, 2533–2535

Green Energy & Environment, 2019, 4, 166-170

Recycling of textiles: polyurethanes

Structure:

- Soft chain segments (polyethers/polyesters) provide elasticity.
- Hard chain segments (aromatic structures) ensure strength and stability



Recycling of textiles: polyurethanes

•**Common Names**: Elastane (Europe), Spandex (USA), Lycra. Composed of 85% long-chain polyurethane polymers.

Advantages:
•Stronger, more versatile, and lighter than rubber.
•Can be spun into thin fibers, making it ideal for a variety of textile applications.
Properties:
•High breathability
•Moisture-wicking
•Low heat retention
Elastane Content in Blends:
•Provides high stretchability and shape retention, ideal for blending with polyester, polyamide, and natural fibers. Content ranges from 5% to 85% in blended fabrics.



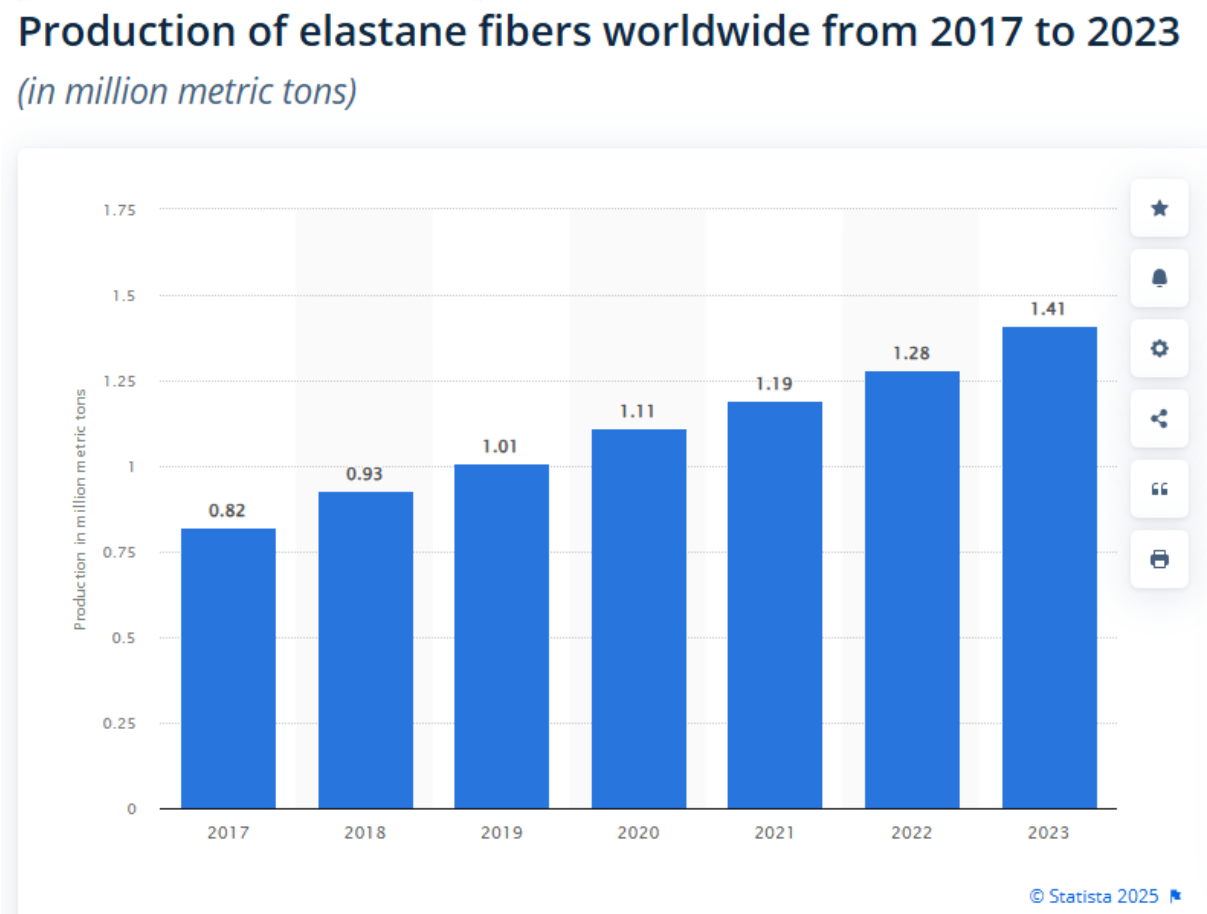


Recycling of textiles: polyurethanes

Spandex	Elastane	Lycra
Spandex means '**Expands**' highlighting its key feature '**Elasticity**'	'**Elastic Polyurethane**' highlighting its chemical makeup	Lycra is a trademark that multi-filament bundle joined together to form a monofilament yarn that stretches and snaps
Invented in 1959 by an American textile chemist called Joseph	Invented 1937 in Nazi Germany	Developed in 1970s by DuPont
Spandex is more widely used in the United states	Except USA, Rest of the world is widely used "Elastane"	All over the world is widely used Lycra and using separate Lycra tag.
Spandex is the generic and brand name of a fiber	Elastane is the generic name of synthetic fiber material.	Lycra is the commercial name of a fiber created by DuPont company
Recovery medium	Recovery medium	Higher recovery and durability
Less price than Lycra	Less price than Lycra	Higher prices

Recycling of textiles: elastan

- Increasingly used in textiles, with 1.3 million tonnes produced in 2022, accounting for 1% of the global fibre market.
- Recycled elastane made up 2.8% of total elastane production in 2022.



Challenges in textiles recycling with elastan

because elastane is so elastic it cannot be handled by shredders used to shred textiles prior to recycling, causing clumping, blockages, and soiling in the machinery.

The main problem is clothing with more than 10% elastane content.

clothing with an elastane content of 2-5% can be mechanically recycled, clothing with an elastane content of 5–10% is typically recycled into items like building insulation and the interiors of automotive seating.

Fiber identification is challenging because precise, automated fiber sorting and pre-processing are not yet widely accessible.

Elastane-containing fabrics may sometimes block filters, necessitating system clean-outs and shutdowns; elastane can occasionally have an impact on companion fiber viability, depending on the particular recycling technique and chemicals being used for purification.

https://www.globaltextiletimes.com/opinions/textile-recycling-faces-challenges-with-elastane-content/

Recycling of textiles: elastan

- **Recycling Challenges**:
  - Elastane is tightly woven or knitted with other fibers, making it difficult to separate without compromising the integrity of the fabric.
  - Elasticity may cause clumping, clogging, and soiling in shredding machinery.

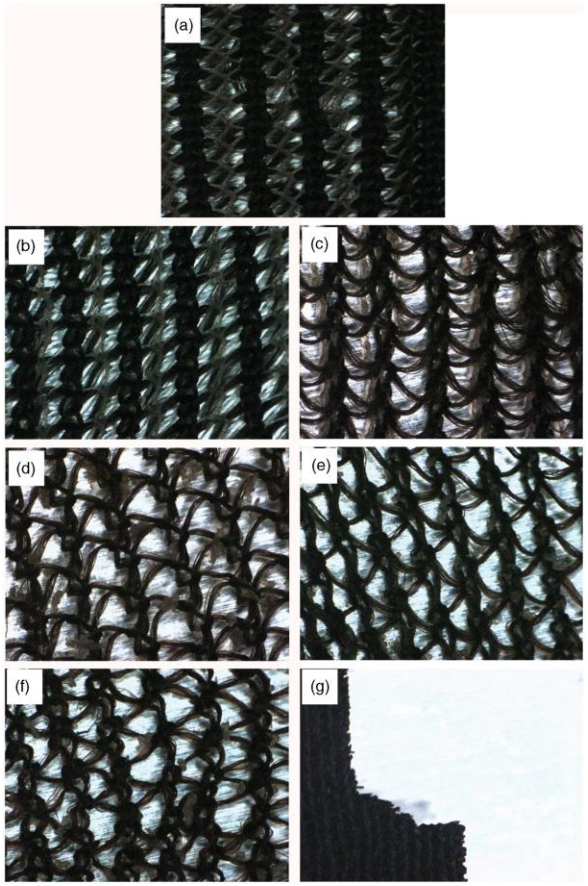
- **Solution**:
  - Elastane can be removed through **selective dissolution** or **selective degradation** via aminolysis or solvolysis.

  - Solvents that dissolve elastane can be applied to separate it. Some solvents, like dimethylformamide (DMF) dimethylacetamide (DMA) or dimethyl sulfoxide (DMSO), can dissolve elastane without affecting other fibers.

Recycling of textiles: polyurethanes

Thermal degradation of Spandex

- heat treatment at a temperature of 220°C, just below the nominal melting temperature of nylon 6, was found to have little effect on the nylon fiber but was effective to cause sufficient spandex degradation for the spandex residue to be readily washed off with ethanol

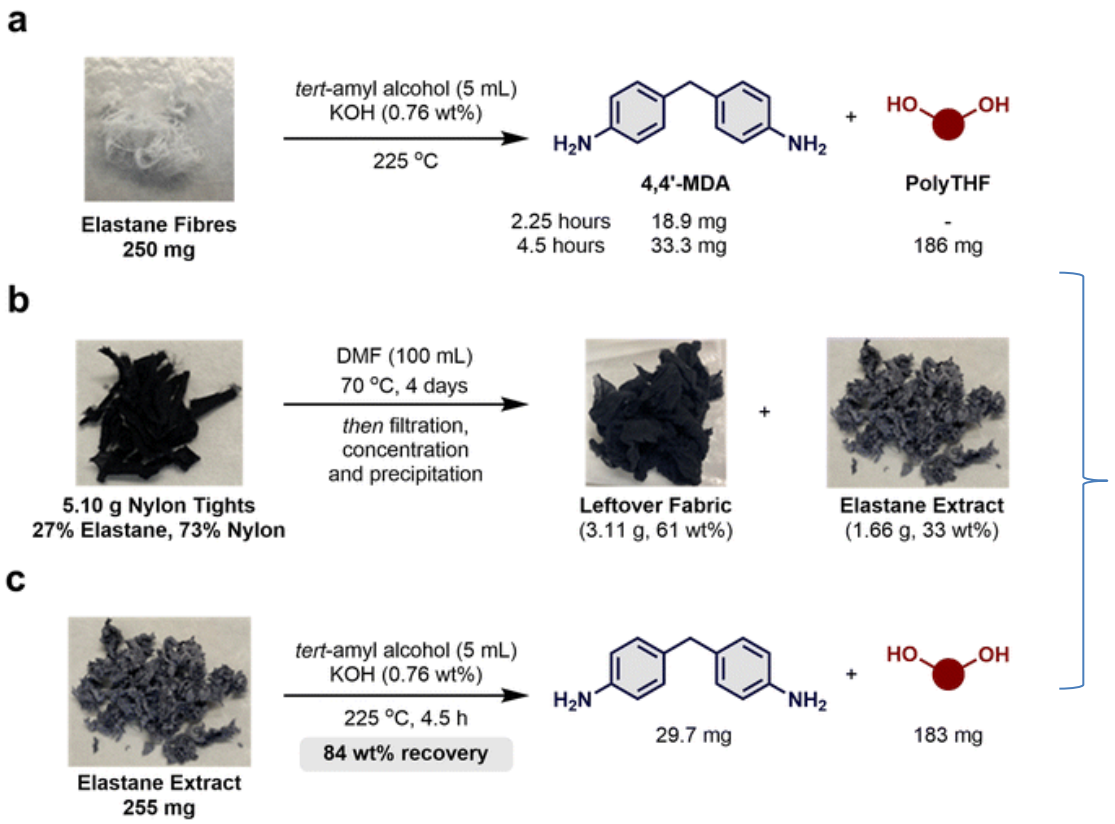


Photographs of nylon/spandex blended fabric heat treated for 2 h at different temperatures: (a) before treatment; (b) 180°C; (c) 190°C; (d) 200°C; (e) 210°C; (f) 220°C; and (g) 230°C.

Yin, Y.; et al. *Text. Res. J.* **2014**, *84*, 16–27

Recycling of textiles: Depolymerization of Elastan

The disassembly of polyurethane-coated polyamide textiles and the depolymerisation of elastane from fabric blends were achieved through solvolysis with tert-amyl alcohol. This two-step process offers a potential method for recycling blended textiles and repolymerising elastane into new fibers.

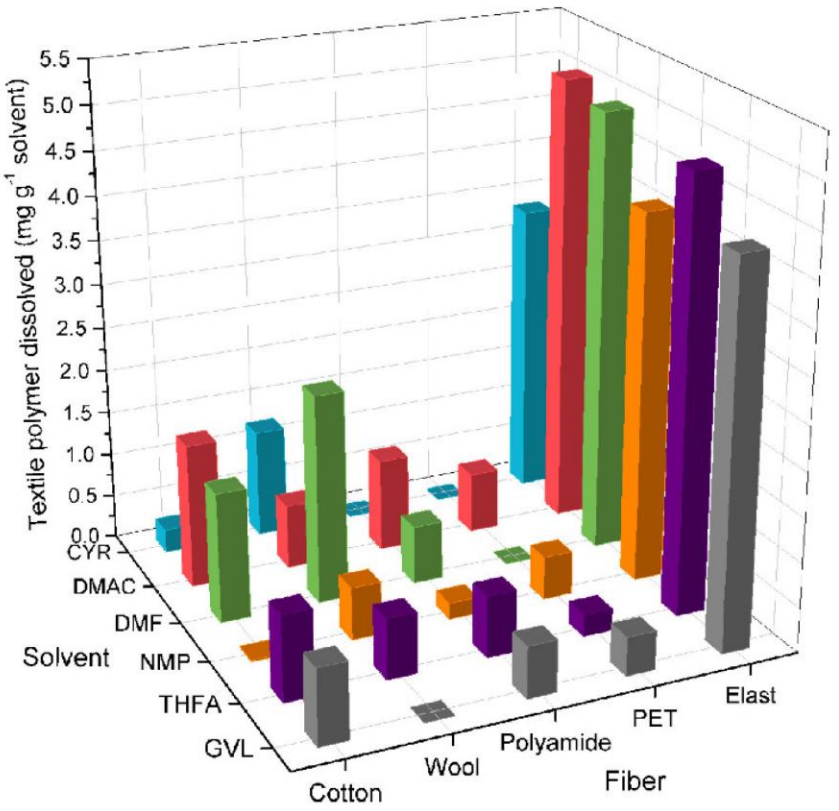


Johansen, M.B. et al. *Green Chem.* 2023, 25, 1622–1629

Selective Dissolution of Elastane / 1

Case 1#
PET/elastane (85/15) and polyamide/elastane (88/12) blends

- tetrahydrofurfuryl alcohol (THFA) and γ-valerolactone (GVL) in 4 hours at 100°C.
- Elastane dissolved into solution, partially depolymerized by breaking carbamate bonds.



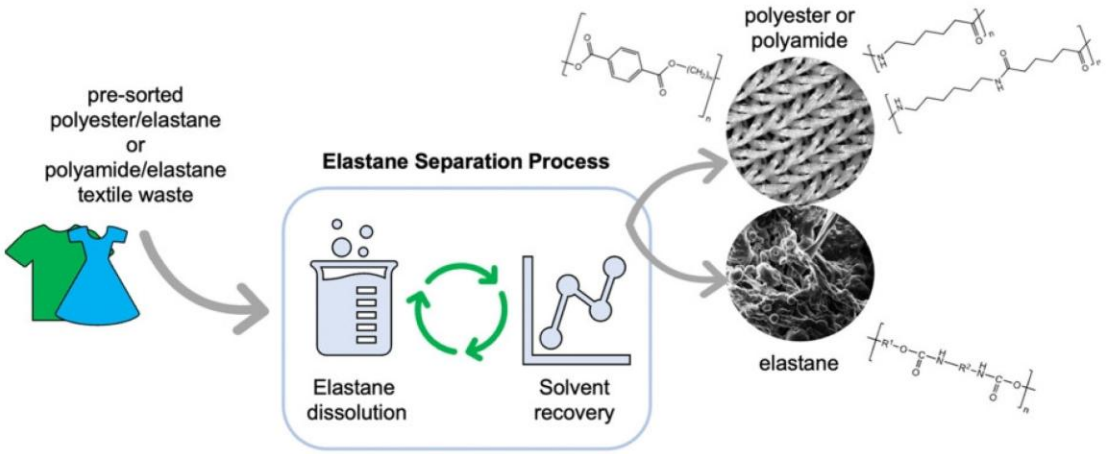
Phan, K. Et al. *Resour. Conserv. Recycl.* 2023, 191, 106903

Case 2#
Polyester/elastane (82% PET/18% EL) and polyamide/elastane (92% PA/8% EL) post-industrial textile

- Tested solvents: Cyrene, DMAc, DMF, DMSO, GVL, NMP.

- DMSO most effective for elastane (+ dyes) dissolution, at 120°C for 30 min, filtered, and washed.

➔ No degradation in polymer matrix, confirmed by TGA.





Boschmeier, E.et al. *Resour. Conserv. Recycl.* 2023, 198, 107215

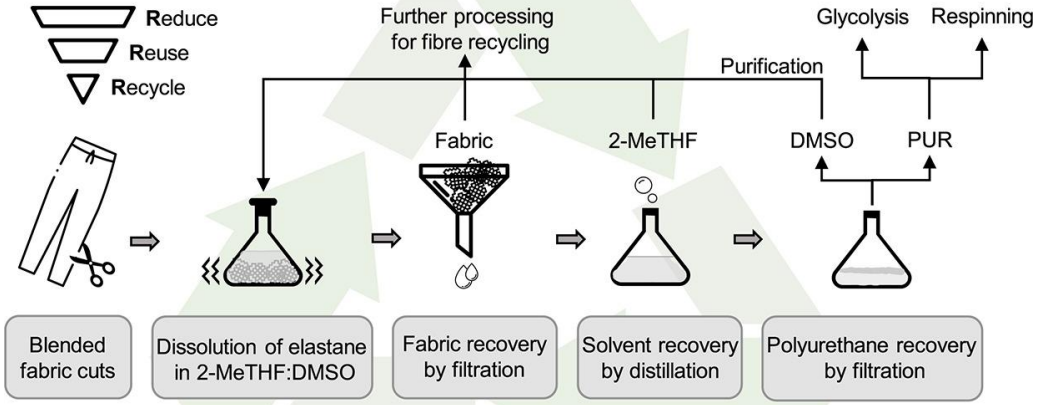
Case 3#

Elastane in mixed polyamide (**Polyamide/Elastane** PA6/elastane blend with 6.3% elastane and PA66/elastane (23%-32%) blends.

Process:

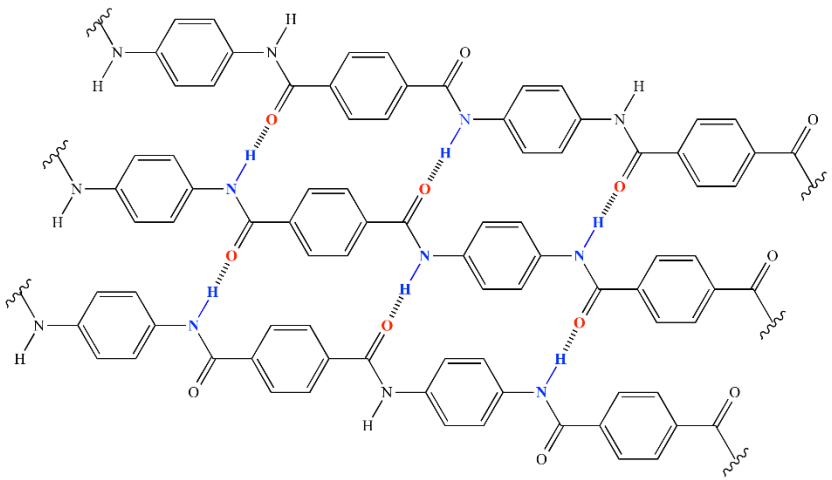
- Sample treated with **70% THF (or 2-MeTHF)/30% DMSO** for 1 hour at room temperature and for 30 min with ethanol and water.
- Elastane precipitated after low-boiling solvent was evaporated under decreased pressure.

Results: Minimal elastane residue on fabric after dissolution.



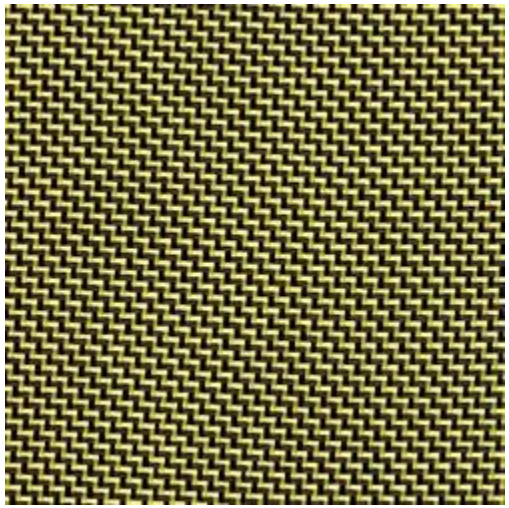
Vonbruel, L. et al. *Resour. Conserv. Recycl.* 2024, 200, 107302

Recycling of textiles: aramid



Kevlar

Created by DuPont™ Kevlar® is a heat-resistant para-aramid synthetic fiber with a molecular structure of many inter-chain bonds that make Kevlar® incredibly strong. Best known for its use in ballistic body armor, Kevlar® also has many other applications because of its high tensile strength-to-weight ratio.





Souce of the figure: http://www.mikecompositi.it/products/1014-tessuto-kevlar-carbonio-210-gm-22-twill-h-1200.aspx

Recycling of textiles: aramid

ACS NANO

www.acsnano.org

Recycling of High-Value-Added Aramid Nanofibers from Waste Aramid Resources via a Feasible and Cost-Effective Approach

Bin Yang,* Weiwei Li, Meiyun Zhang,* Lin Wang, and Xueyao Ding

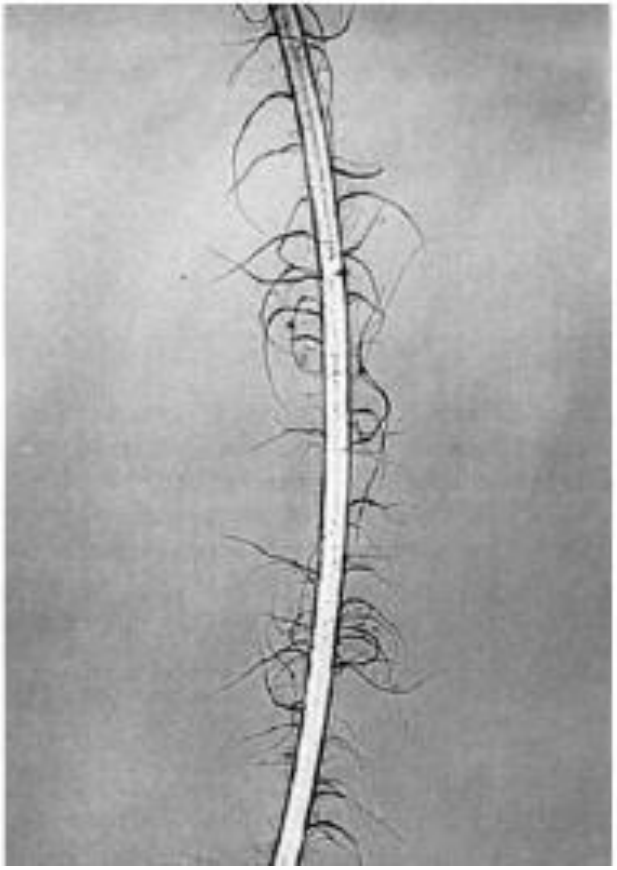
Cite This: *ACS Nano* 2021, 15, 7195–7207 Read Online

- High-performance aramid fibers are extensively applied in the civil and military fields.
- A great deal of waste aramid resources originating from the manufacturing process, spare parts, or end of life cycle are wrongly disposed (i.e., landfill, smash, fibrillation*), causing a waste of valuable resources as well as severe environmental pollution.

- Although aramid nanofibers (ANFs) have recently been recently reported as one of the most promising building blocks due to their excellent properties, they suffer from an extremely high production expenditure, thereby greatly hindering their scaleup application.

Recycling of textiles: fibrillation

Fibrillation *is the process by which the surface of textile fibers undergoes physical and mechanical stress, causing the individual fibrils to break free from the fiber structure and protrude outward. This results in the formation of small, hair-like projections on the surface of the fabric, giving it a rough and uneven appearance.* ***Fibrillation*** *is more common in natural fibers such as cotton, linen, and jute, as they possess a complex structure of fibrils and microfibers.*



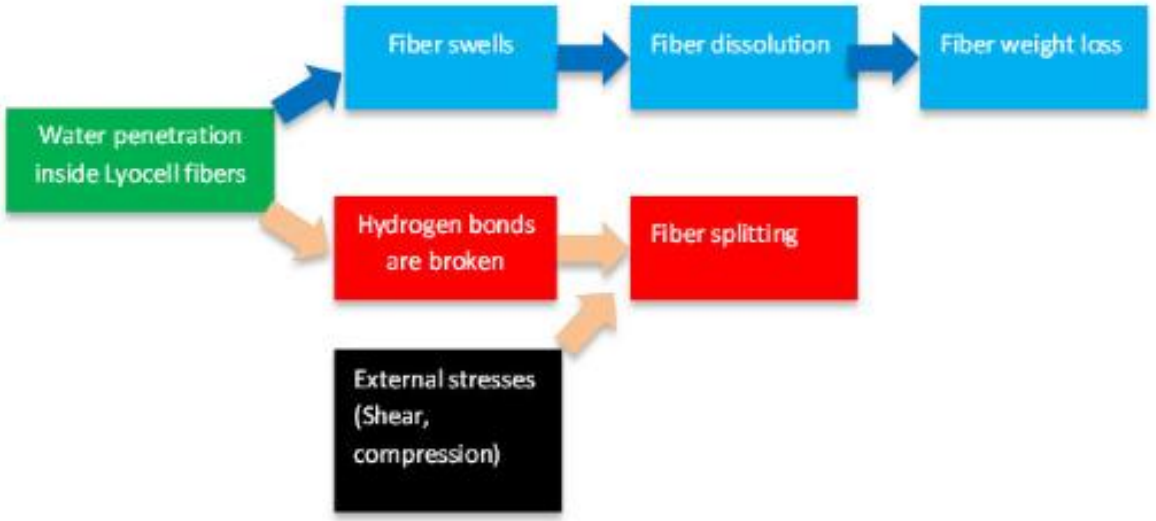


Figure 2: Fibrillation mechanism

Recycling of textiles: fibrillation

Fibrillation Mechanical fibrillation (also called shredding, garnetting, or opening) pulls or tears the textile apart: rotating spiked drums and cutters unravel the yarns and fabric structure into loose fibres. The term is also used for the splitting of a fibre along its axis into finer fibrils, which happens under mechanical stress when the fibre has oriented, weakly bonded microfibrillar domains.

No chemistry needed. It avoids solvents, high temperatures, and depolymerization, so energy use, cost, and environmental burden are low compared with chemical recycling.

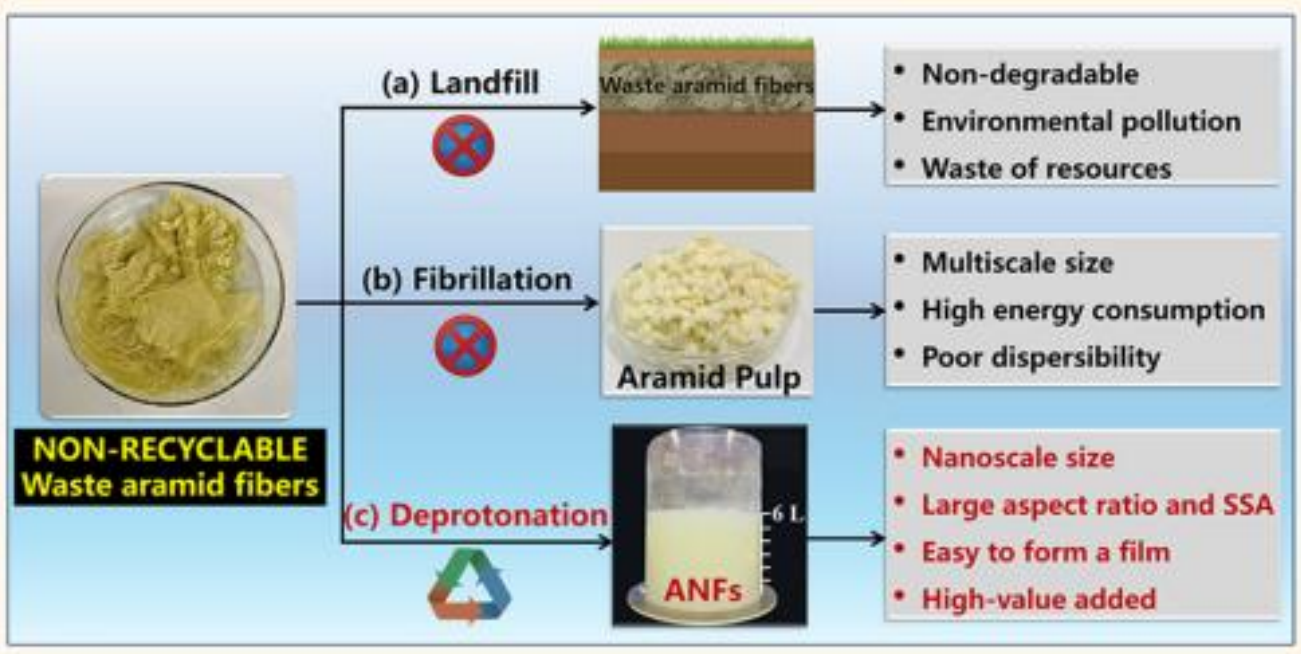
Preserves the polymer. Fibres keep their existing molecular structure (no repolymerization step), which suits natural fibres like cotton and wool that cannot be melt-processed anyway (cellulose degrades before melting).

Works on mixed and difficult feedstock. Post-consumer textiles are often blends, dyed, and carry trims. Mechanical opening is tolerant of this variability, whereas chemical routes need purer streams.

Established, scalable technology. Shoddy and mungo wool, cotton wastes for nonwovens, insulation, and automotive felts have used it for over a century.

Fibre-to-fibre potential. Opened fibres can be blended with virgin fibre and re-spun into yarn, or made into nonwovens.

Recycling of textiles: aramid



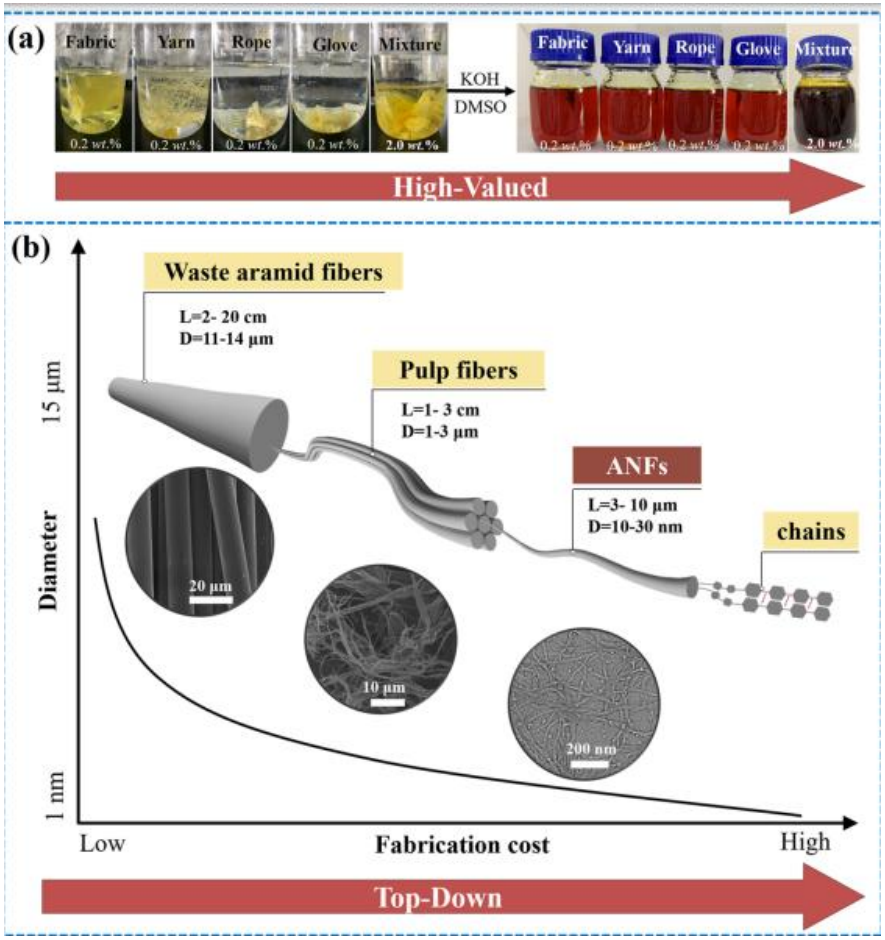
aramid nanofibers (ANFs)

feasible topdown approach to recycle high value-added ANFs with an affordable cost from various waste aramid resources. The results indicate that although the reclaimed ANFs have a molecular weight reduction of 8.1% compared with the recycled aramid fibers, they still exhibit a molecular weight of 43.0 $kg \cdot mol^{-1}$ that represents the highest value compared to other methods. It is noteworthy that the fabrication cost of ANFs is significantly reduced (~7 times) due to the reclamation of waste aramid fibers instead of the expensive virgin aramid fibers. The obtained ANFs show impressive tensile strength (149.2 MPa) and toughness (10.43 $MJ \cdot m^{-3}$), excellent thermal stabilities (Td of 542 °C), and a high specific surface area (65.2 $m^2 \cdot g^{-1}$), to be promising candidates for constructing advanced materials.
Source of text and figure: : ACS Nano 2021, 15, 7195−7207

Recycling of textiles: aramid

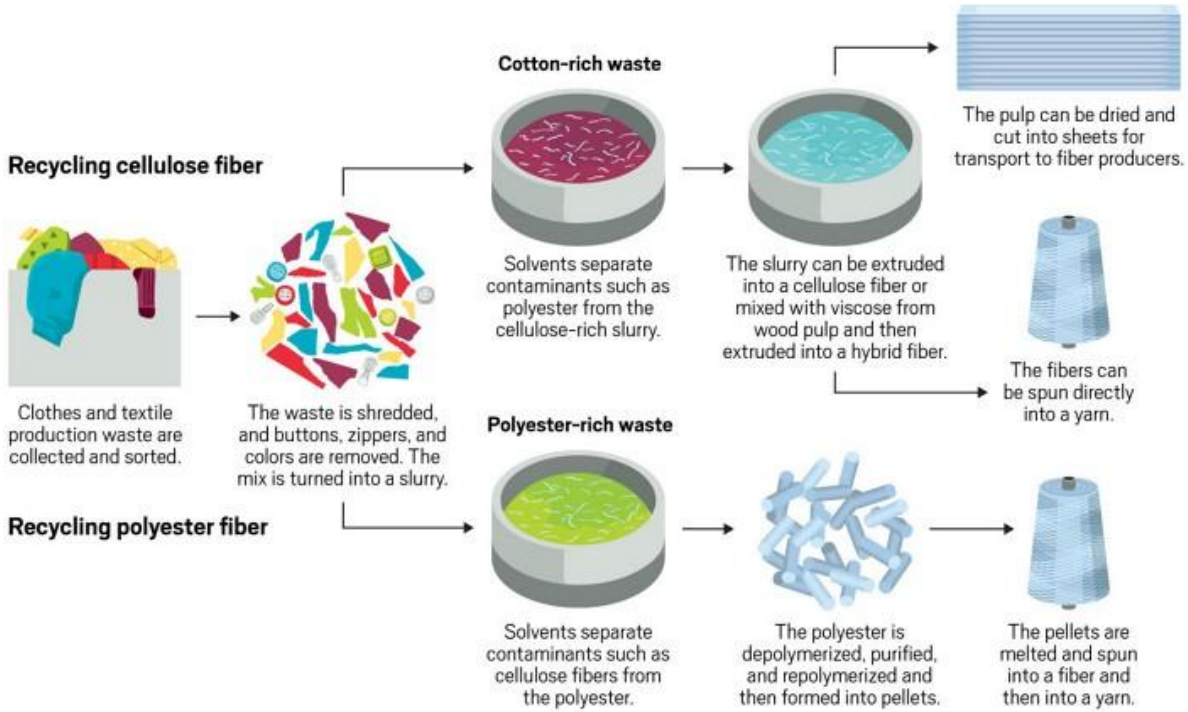
1. all of the waste aramid fibers were rinsed with acetone and DI water to remove the impurities, and then they were dried in a drying oven.
2. the aramid woven fabric selvage was cut into pieces with sizes of 5 × 5 cm, the yarn was cut to a length of 10 cm; the rope and glove were cut to a length of 5 cm, respectively.
3. to fabricate the ANFs, according to our previous report, the waste aramid fibers (1.0 g), KOH (1.5 g), and DI water (20 mL) were added into 500 mL of DMSO.
4. they were magnetically stirred for 5 h to obtain a transparent red-dark ANFs/DMSO solution with a concentration of 0.2 mg·mL−1 , respectively.
5. in order to investigate whether the sources of waste fibers has any influence on the properties of ANFs, four different waste aramid fibers were mixed together to fabricate ANFs. Specifically, 10.0 g of the above-mentioned waste aramid fibers, 15.0 g of KOH, and 20 mL of DI water were added into 500 mL of DMSO. Further, the mixture was magnetically stirred for 9 h to obtain an ANFs/DMSO dispersion.
6. 30.0 g of the recycled aramid fibers mixture was fibrillated by a refiner for 30000 revolutions (4 h) to obtain the aramid pulp as a control sample

Recycling of textiles: aramid



Fabrication of ANFs from the waste aramid fibers. (a) Deprotonation process of the waste aramid fibers in KOH/DMSO system to obtain ANFs/DMSO solutions. (b) Schematic diagram of the formation mechanism of ANFs.
Source of the figure: ACS Nano 2021, 15, 7195−7207

This technology can be used on fibers made of cellulose, polyester, or a combination of the two. Cellulose and polyester are isolated independently for additional processing. After that, cellulose pulp can be used to create new cellulose-based fibers and plastic polymers can be restored to their virgin quality by treating them differently



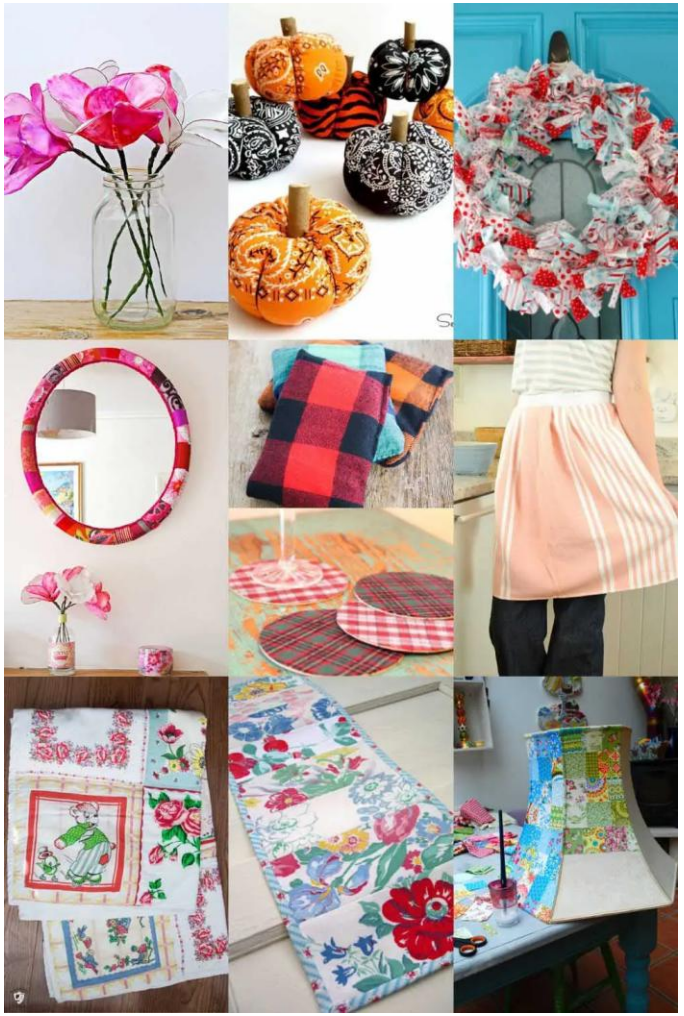
➔Degradation may cause the recovered polymers to have shorter chain length

https://cen.acs.org/environment/green-chemistry/Transforming-textiles/100/i11

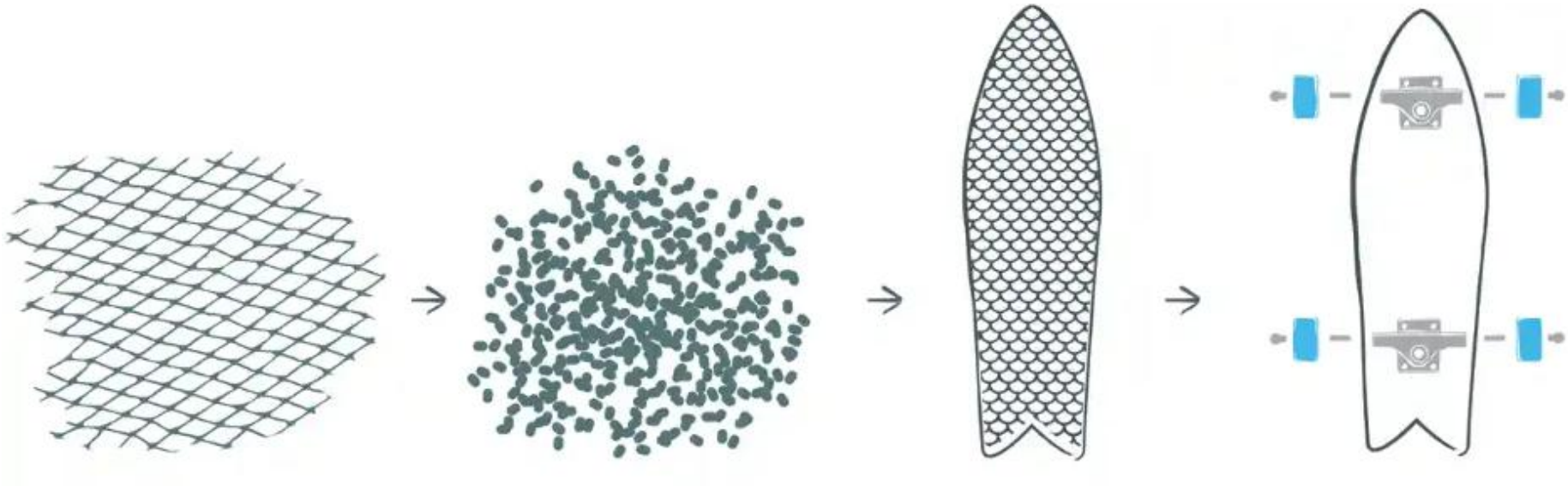
Repurposing textiles

Textiles from the post- and pre-consumer markets can also be used as a raw material for filler products, including flocking, insulation, and nonwovens as well as shoddy fibers for recycled yarns





Repurposing of textiles: Nylon 6



How Bureo converts nylon fishing nets to skateboards. Photograph: Bureo

Source of the figure: https://www.theguardian.com/sustainable-business/2016/may/18/recycling-nylon-bureo-patagonia-sustainable-clothing

Repurposing of textiles: Nylon 6

- Italian manufacturer Aquafil (https://www.aquafil.com/the-group/) began in 20027 developing a machine that can churn through most kinds of nylons, producing new threads ready to be repurposed.

- Nylon waste – such as abandoned fishing nets or textile production scraps – is recovered and converted into new yarn, which has the same qualitative characteristics as traditional nylon.

- Aquafil now sells these threads, called Econyl (https://www.econyl.com/about-us/)





Repurpousing textiles

Acoustic Felt Made From Recycled Polyester

- made from 100% traceable textile offcuts, the product upcycles surplus polyester materials in the pursuit of functional sound absorption solutions (acoustic sound absorbers)
- BAUX Acoustic Felt is made from either upcycled and 100% traceable post-production textiles, or certified Recycled PET bottles sourced from recycling entities across Europe
- set in social areas or around noise sources that need to be walled off (e.g. desk dividers, free standing partitions or linings to walls)
- useful for retrofitting buildings with sustainable materials
- no glue or hardware is used, highlighting that each tile has been designed with the intention to be repurposed and reused, with the guarantee that no panel requires treatment before recycling

Repurposing textiles



BAUX's Acoustic Felt is made from 100% traceable textile offcuts
Source of the figure: https://www.forbes.com/sites/amynguyen/2021/06/18/from-textile-waste-to-sound-insulation--the-acoustic-felt-made-from-recycled-polyester/?sh=2dd1c80346e1

The Acoustic Felt panels use naturally variegated colour
Source of the figure: https://www.forbes.com/sites/amynguyen/2021/06/18/from-textile-waste-to-sound-insulation--the-acoustic-felt-made-from-recycled-polyester/?sh=2dd1c80346e1



Repurposing textiles



https://www.culocamicia.com/

Repurposing textiles

HOW WE ARE 10

EACH BOXER IS UNIQUE AS EACH SHIRT IS DIFFERENT.

To avoid uncesseary stock our boxers are made when ordered.
We personally handpick up all the second hand shirts we use for our underwear - because you know, we care about quality - we cut and sew them "a little" and we turn them into unique boxers. We mean unique for real, as every shirt we use is a single piece.
As our boxers are upcycled the composition, materials and motifs of the article may vary. Which makes every piece even more special.



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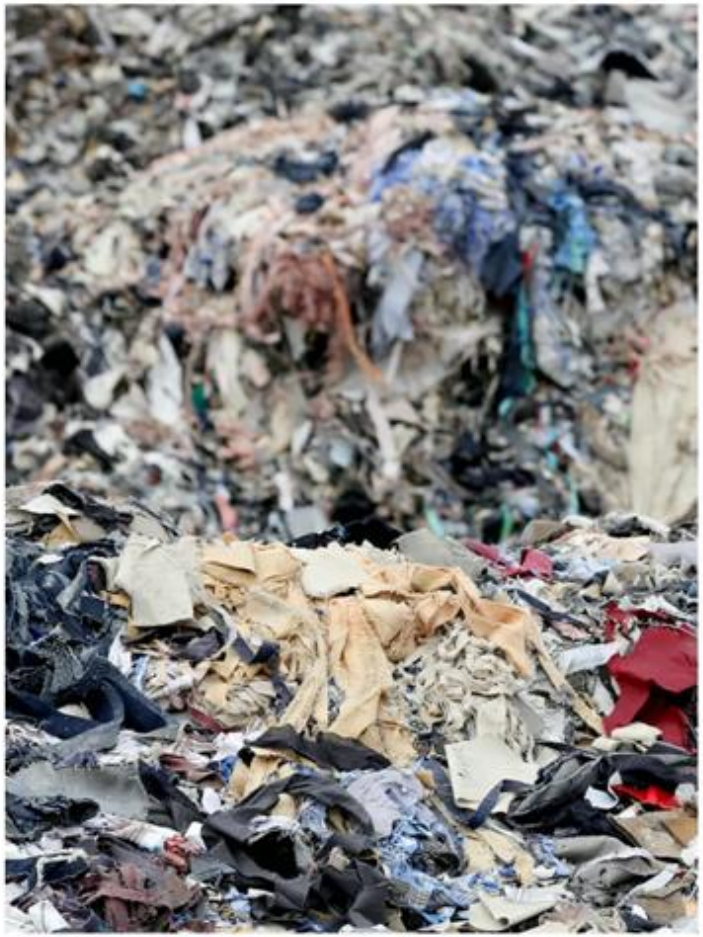
https://www.culocamicia.com/

Repurposing textiles

WHY WE ARE

TRASHION IS THE NEW FASHION.

Second to oil, the clothing and textile industry is the largest polluter in the world.
Shirts are one of the many products people don't know what to do with once they got tired of wearing and we want to be there when that happens giving people's shirts another chance as a new product.



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Repurposing textiles

OUR PACKAGING IS AS IMPORTANT AS THE BOXER .

Our packaging is made out of the rest of the shirt.
We use the sleeve of the shirts used to make the boxer
to put together our reusable packaging.





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