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Waste Reduction

principles and practices for a Sustainable Fashion Industry

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Waste Reduction:
principles and practices for a Sustainable Fashion Industry.

Context

The fashion industry is one of the most important economic sectors globally, characterized by a continuous production of clothing, accessories and fabrics. However, this sector is also one of the largest contributors to solid waste and environmental pollution.

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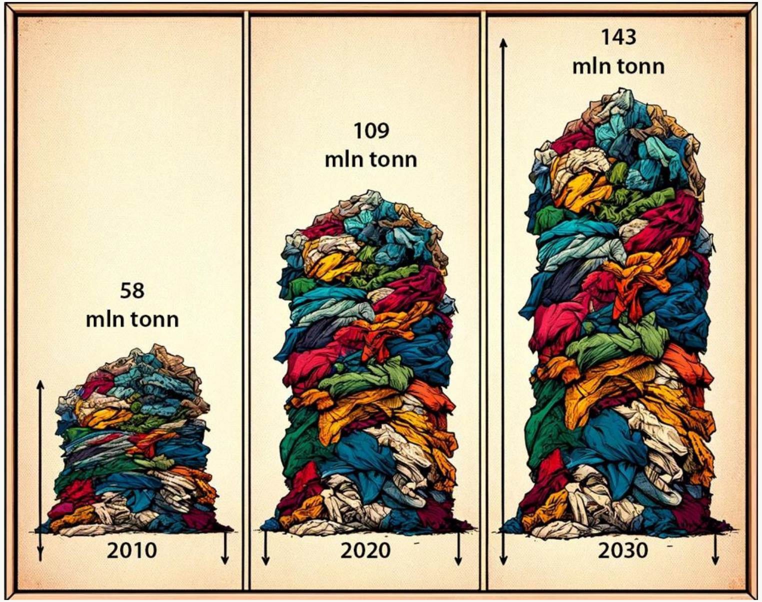
Context

Over the past twenty years, the world has witnessed a veritable explosion in textile production.

We have gone from 58 million tons in 2000 to 109 million in 2020, with forecasts indicating a further increase to 143 million by 2030.



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Context

The current business model of the fashion industry, often referred to as "fast fashion," encourages the rapid and low-cost production of clothing that is only intended to be worn for short periods before being discarded. This model involves a number of environmental and social problems, including:

Waste volume: It is estimated that around 92 million tonnes of textile waste are produced globally each year, with much of it ending up in landfills or being incinerated.

Environmental pollution: Textile waste contributes significantly to soil and water pollution, as synthetic materials take hundreds of years to decompose and release microplastics into the environment.

Waste of resources: Textile production requires huge amounts of water, energy and raw materials, which are often wasted due to the short life cycle of garments.

In response to these issues, it is crucial to adopt sustainable principles and practices to reduce textile waste and minimize the environmental impact of the fashion industry. This presentation will explore current challenges in waste management in fashion and present strategies, techniques and innovations to promote a more sustainable and responsible industry.

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Europe is dealing with a mountain of textile waste that reaches 12.6 million tons every year. (260,000 tons ITA)

Of these, clothing and footwear alone amount to 5.2 million tons.

If we stop to think about the life cycle of these products, we find that each European citizen on average buys almost 26 kg of fabrics per year and throws away about 12 kg.

Most of these garments end up burned or in landfills (87%), and only a small part, less than 1%, is recycled to create new products.

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Context

New strategy expands EPR regimes

The EU is determined to reduce the environmental impact of textile waste, aiming to extend its useful life and increase its recycling. This commitment is part of the broader European strategy to achieve a circular economy by 2050.

On 13 March 2024, the European Parliament set out its negotiating strategy regarding the revision of the Waste Directive, focusing in particular on textiles and food waste.

As far as textiles are concerned, one of the most significant innovations is the introduction of extended responsibility for textile producers, who will be held accountable for the complete life cycle of their products, including the final phase.

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Context

New strategy expands EPR regimes

The reform provides for the expansion of EPR regimes

Extended Producer Responsibility also to textile products.

Manufacturers, including those selling online, will be required to bear the costs associated with the separate collection, sorting and recycling of waste from a wide range of textile products.

This includes clothing, accessories, bed linen, curtains, hats, footwear, mattresses and carpets, without forgetting items made of mixed materials such as leather, rubber or plastic.

The reform will be carried out by the new European Parliament elected between 6 and 9 June 2024.

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Context

The path of the EU strategy

Over the years, the EU has adopted a number of legislative measures to promote sustainable practices in the textile sector, following a well-defined timeline that highlights a growing commitment to the circular economy.

Let's briefly retrace some significant steps.

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Context

The path of the EU strategy

The first step

In **1992**, the EU introduced the EU Ecolabel, a distinctive mark that manufacturers can place on their environmentally friendly products.

This has helped to highlight less polluting and more environmentally friendly products, encouraging the reduction of harmful substances and the minimization of water and air pollution.

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The path of the EU strategy

The second step

Directive (EU) 2018/850 enters into force, forming part of a comprehensive legislative package focused on waste management, first announced in 2015 as part of the **Circular Economy Action Plan.**

This legislation aims to **drastically reduce waste destined for landfills, with the aim of not exceeding 10%** of municipal waste disposed of in this way by 2035, promoting the recycling and recovery of materials.

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Context

The path of the EU strategy

The third step

As part of the **Circular Economy Action Plan**, as part of the **Green Deal** package of proposals, the European Commission presented a new strategy in March 2022, aimed at countering the accelerated life cycle of textile products typical of fast fashion.

The new vision aims to make fabrics **more durable, repairable and recyclable**, while encouraging the emergence of alternative **business models such as clothing rental.**

The strategy includes initiatives to educate consumers towards more informed choices, the introduction of a **digital passport for products** and the adoption of **ecodesign requirements.**

Furthermore, it stresses the importance of producer responsibility not only for the environmental impact, but also for the social and human rights aspects of textile production;

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Context

The path of the EU strategy

The fourth step

The last piece of this regulatory evolution concerns the new proposals presented by the European Parliament in **March 2024**, which aim to reform the rules on textile waste.

To speed up the pace, Parliament has proposed a tighter timeline than the 30 months proposed by the European Commission for the implementation of these schemes, setting the limit at 18 months after the entry into force of the directive. In addition, it has been established that by 1 January 2025 all Member States will have to **organise a separate collection of textile waste, with the aim of promoting its reuse and recycling.**

These changes, which will be negotiated by the next Parliament elected in June 2024, represent the latest phase of a progressive EU commitment to a more sustainable and circular management of textile waste, in line with the objectives of the Green Deal and the circular economy.

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Definition

The term "*textile waste*" refers to any discarded material that comes from the production, distribution and consumption of textile and clothing products.

This waste includes production waste, fabric scraps, unsold clothing, and used clothing destined for landfill.

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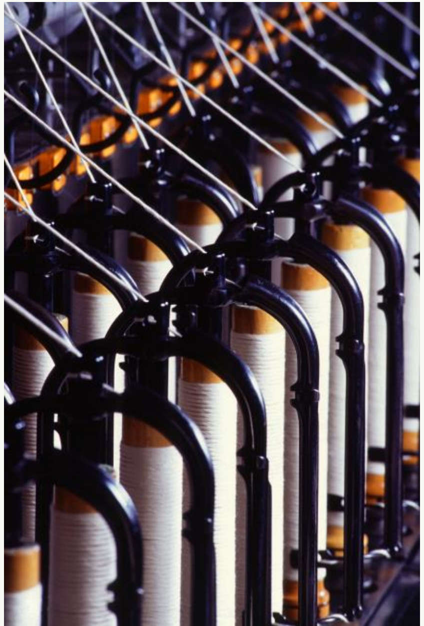
TEXTILE FIBERS / SPINNING

Advanced Spinning Technologies: Use advanced spinning technologies that minimize defects and waste.

In-line Quality Control: Implement in-line quality control systems that continuously monitor fiber production, immediately identifying and correcting any issues to reduce waste.



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TEXTILE FIBERS / SPINNING

Recycling of Production Waste: Implement programs to collect and recycle production waste. Fiber waste can be reused internally or sold to other industries that can turn it into new products.

Upcycling of Waste: Using fiber waste to create valuable new products. For example, cotton fiber waste can be used to make paper or insulation materials.

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TEXTILE FIBERS / SPINNING

Collaboration with Suppliers: Work closely with suppliers to improve the quality of raw materials and reduce waste from the beginning of the supply chain.

Training of Workers: Invest in worker training to increase awareness and skills related to reducing waste and implementing sustainable practices.

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WARPING/WEAVING

Wire Tension Control:

Make sure that the tension of the threads is constant and uniform during the warping process to avoid breakage and rejection.

Use electronic tension control systems to monitor and adjust the tension of the wires in real time.

Using High-Quality Threads:

Select high-quality wires with proper strength and uniformity to reduce the likelihood of breakage during the process.

Implement strict quality controls on incoming wires to identify and remove defective ones.

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WARPING/WEAVING

Preventive Maintenance:

Perform regular preventative maintenance on looms and weaving machinery to reduce mechanical failures and thread breaks.

Regularly replace worn components to maintain optimal performance of machinery.

MoniReal-Time Quality Control:

Implement real-time monitoring systems that detect defects in the fabric as it is produced.

Use sensors and cameras to spot problems immediately and take action quickly.

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WARPING/WEAVING

Recycling of Production Waste:

- Collect and recycle thread and fabric waste generated during warping and weaving.
- Keeping waste from different productions separate
- The waste can be reused to produce new yarns or filling materials.

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FINISHING

Washing

Water Recycling:

Install water recycling systems to reuse wash water, thus reducing total water consumption and flush volume.

Use advanced filtration technologies to remove contaminants and allow water reuse.

Reduction of the use of Chemicals:

Use biodegradable and less toxic detergents to reduce environmental impact and facilitate wastewater treatment.

Implement automated dosing systems to optimize the use of chemicals.

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FINISHING

Dyeing

Dry dyeing:

Adopt dry dyeing technologies, such as supercritical CO2 dyeing, that do not use water and reduce the use of chemicals.

Optimization of Dye Baths:

Use low bath ratio dyeing techniques to reduce water and dye consumption.

Implement real-time monitoring systems to optimize dye concentration and dyeing cycle duration.

Dyes Recovery:

Install dye recovery systems to reuse dyes not absorbed during the dyeing process.

Use filtration and ultrafiltration technologies to recover and reuse dyes and other chemicals.

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FINISHING

Printing

Digital Printing:

Switch from traditional printing to digital printing to reduce ink and material waste.

Digital printing uses only the necessary amount of ink and can significantly reduce water consumption.

Water-based inks:

Use water-based and less toxic inks to reduce environmental impact and facilitate wastewater treatment.

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FINISHING

Treatments

Eco-friendly finishes:

Adopt finishes with low environmental impact, such as plasma or enzyme treatments, which reduce the use of chemicals.

Use energy-saving technologies, such as low-temperature finishing, to reduce energy consumption.

Process Optimization:

Implement real-time control systems to monitor and optimize chemical and energy consumption during finishing.

Use closed-loop processes to recover and reuse chemicals and solvents.

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QUALITY CONTROL

Automated Inspection:

Use automated inspection systems with sensors and cameras to detect defects in real time, reducing the risk of rejects.

Implement analytics software to improve the accuracy and efficiency of quality control.

Staff Training:

Train staff to recognize and correct defects during the early stages of production, thus reducing waste.

Raise awareness among workers on the importance of waste reduction and prevention techniques.

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FINISHING ETC.

Waste and Waste Management

Process Waste Recycling:

Collect and recycle waste generated during washing, dyeing, printing and finishing.

Partnering with specialized recycling companies to manage textile and chemical waste.

Use of Scraps:

Uuse fabric scraps to create new products, such as accessories or filling materials.

Implement upcycling programs to transform fabric waste into new valuable products.

Waste Management Systems:

Implement waste management systems that include separate collection and treatment of hazardous waste.

Continuously monitor and analyze waste streams to **identify opportunities for improvement and waste reduction.**

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CLOTHING PRODUCTION

Model development

CAD Software for Model Design:

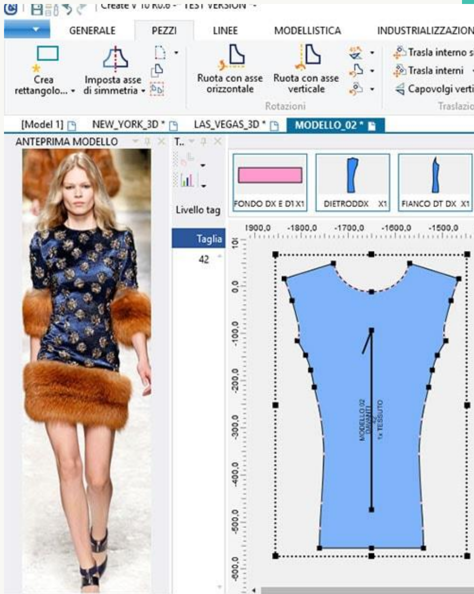
Use computer-aided design (CAD) software to create accurate digital models that minimize errors and material waste.

Optimize cutting layouts digitally to maximize fabric utilization.

Virtual Prototyping:

Implement virtual prototyping techniques to view and edit drawings without having to create physical samples.

Reduce the need for physical prototypes and minimize sample waste.



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CLOTHING PRODUCTION

Cutting

Automated Cutting Technologies:

Use automated cutting machines such as blade, laser, or waterjet cutting machines to improve accuracy and reduce fabric waste.

Implement nesting software to optimize pattern placement on fabric, minimizing waste.

Use of Recycled Fabrics:

Incorporate recycled fabrics into the production process to reduce the demand for virgin raw materials.

Partnering with suppliers who offer sustainable and recycled materials.

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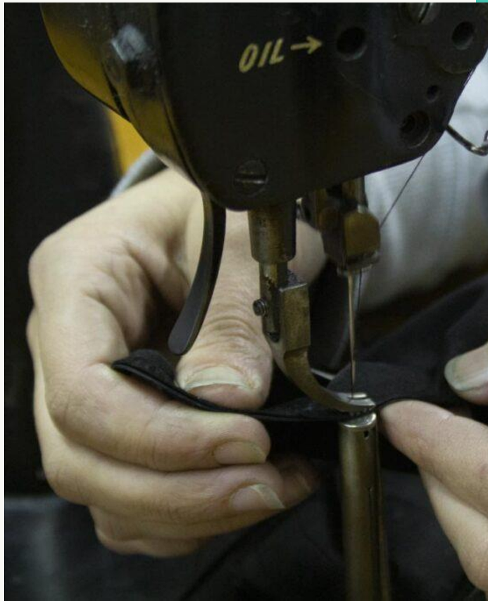
CLOTHING PRODUCTION

Assembly

Efficient Sewing Techniques:

Adopt sewing techniques that minimize thread and fabric waste, such as chain stitching.

Use automated sewing machines that automatically adjust thread tension and sewing speed to avoid errors.



Staff Training:

Train staff to optimize material use and reduce waste during the assembly process.

Raise awareness among workers on the importance of waste reduction and prevention techniques.

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CLOTHING PRODUCTION

Packaging

Sustainable Packaging Materials:

Utilizrecycled and recyclable packaging materials to reduce environmental impact.

Adopt minimalist packaging solutions to reduce the volume of materials used.

Multiuse Packaging :

Design packaging that can be reused by consumers, such as reusable bags or recyclable boxes.

Implement packaging return systems to encourage customers to return used packaging for recycling.

Use your own waste for a possible production of self-managed packaging

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CLOTHING PRODUCTION

Distribution

Logistics Optimization:

Optimize distribution routes to reduce fuel consumption and CO2 emissions.

Use low-emission or electric vehicles to transport products.

Inventory Management:

Implement just-in-time inventory management systems to reduce the accumulation of unsold inventory and minimize waste.

Use sales data and forecasts to optimize production and reduce unsold products and surpluses.

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CLOTHING PRODUCTION

Sustainability strategies and waste reduction

Staff Involvement

Incentives for Waste Reduction:

Offer incentives to employees to reduce waste and improve process efficiency.

Recognize and reward innovative ideas for waste reduction.

Involvement in Sustainability:

Involve staff in corporate sustainability programs and provide ongoing training on sustainable practices.

Promote a corporate culture oriented towards sustainability and waste reduction.

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END CUSTOMER suggestions

Choice of Clothing

Buying with Awareness:

Quality over Quantity:

Choose high-quality garments that will last over time rather than frequently buying low-quality clothes.

Sustainable Materials:

Prefer clothes made from sustainable materials such as organic cotton, linen, hemp or recycled fabrics.

Certifications and Sustainability Brands:

Look for certifications such as GOTS (Global Organic Textile Standard), Fair Trade, or OEKO-TEX Standard 100, which indicate ethical and sustainable production practices.

Second Hand and Vintage:

Consider buying second-hand or vintage clothes to reduce demand for new products and extend the useful life of existing garments.

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END CUSTOMER suggestions

Washing and Maintenance:

Cold Washing: Wash clothes in cold water to save energy and preserve fabrics.

Avoid tumble dryer: Allow clothes to dry in the open air whenever possible to reduce wear and tear and energy consumption.

Eco-friendly detergents: Use low quantity detergents that are biodegradable and free of harsh chemicals.

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END CUSTOMER suggestions

Repair and Maintenance:

Repair: Learn how to make small repairs such as sewing buttons or repairing rips to extend the life of garments.

Changes: Consider modifying or updating existing outfits to better suit your needs and style.

Proper storage: Store clothes properly to avoid damage. Use hangers for garments that can deform if folded and keep the garments in a dry and clean environment.

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END CUSTOMER suggestions

End of Life and Disposal

Recycling and Donation

Donation: Donate clothes that are still in good condition directly to people in need or certified charities.

Recycling: Use textile recycling programs offered by many local retailers or services for garments that are no longer wearable.

Swapping: Use the possibility of exchange on equal terms during organized events

Upcycling

Creativity: Transform old garments into new items, such as bags, blankets or rags, to reduce waste.

DIY Projects: Participate in DIY projects that reuse old fabrics in a creative and functional way.

Composting of Natural Fabrics

Composting: If the garments are made from natural materials that are not chemically treated, consider composting as an environmentally friendly method of disposal.

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CLIENTE FINALE suggerimenti

Educazione e Consapevolezza

Informazione:

Tenersi aggiornato sulle pratiche sostenibili nel settore della moda e sui marchi che adottano politiche etiche e sostenibili.

Influenzare Altri:

Condividere le proprie conoscenze con amici e familiari per diffondere la consapevolezza e promuovere pratiche di consumo sostenibile.

Sorting & Recycling Technologies

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Recycling Technologies- SORTING

Advanced Optical Recognition(Optical Recognition)

Technology:

NIR (Near-Infrared) Spectroscopy: It uses near-infrared spectroscopy to identify textile materials based on their chemical composition. This technology can quickly distinguish between cotton, polyester, wool, nylon, and other materials.

Visual Spectroscopy: It uses visible light sensors to recognize the colors and patterns of fabrics, facilitating sorting based on visual characteristics.

Advantages:

- **High accuracy and speed in sorting.**
- **Ability to handle large volumes of tissues.**
- **Minimizes manual intervention.**

Recycling Technologies- SORTING

RFID technology(Radio-Frequency Identification)

Technology:

Tag RFID: RFID tags can be integrated into clothing during production. These tags contain detailed information about the materials, manufacturer, and other features that are useful for sorting.

RFID Scanners: Sorting plants use RFID scanners to identify and catalog garments quickly and accurately.

Advantages:

- **Automated and precise sorting.**
- **Ability to trace the history and composition of garments.**
- **Facilitates recycling and reverse logistics management.**

Recycling Technologies- SORTING

Artificial intelligence(AI) e Machine Learning

Technology:

Machine Learning Algorithms: They use large amounts of data to continuously improve sorting accuracy. Algorithms can be trained to recognize various types of fabrics and garment conditions.

Neural Networks: Applied to analyze images and identify specific characteristics of fabrics, such as damage or stains.

Advantages:

- **Continuous improvement of sorting performance thanks to machine learning.**
- **Ability to adapt to new types of fabrics and styles of clothing.**
- **Reduce operating costs and increase efficiency.**

Recycling Technologies- SORTING

Machine Vision Systems(Computer Vision)

Technology:

High-Resolution Cameras: They use cameras to take high-resolution images of the garments as they pass along the sorting line.

Image Analysis Software: Analyze images to identify material composition, defects, and other characteristics useful for sorting.

Advantages:

- **High sorting speed with precision.**
- **Ability to identify small defects and features not visible to the naked eye.**
- **Integration with other technologies for a more complete sorting process.**

Recycling Technologies- SORTING

Robotic Arms: Used to manipulate and sort garments with precision. Robotic arms can be equipped with sensors and tools to improve sorting efficiency.

Automated Guided Vehicles (AGVs): Automated guided vehicles that transport garments through the sorting plant, optimizing workflow.

Advantages:

- **Increase productivity and reduce human error.**
- **Ability to operate 24/7 without interruption.**
- **Flexibility in dealing with different types of garments.**

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Recycling Technologies- SORTING

Chemical Treatment and Analysis

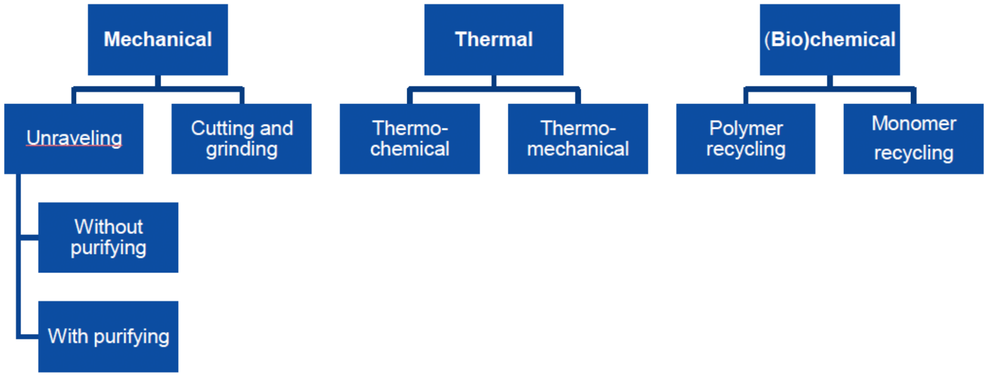
Technology:

Enzyme treatments: Used to pre-treat tissues and facilitate their separation based on chemical composition.

Chemical analysis: Technologies that analyze the chemical composition of textiles to identify specific materials that can be recycled efficiently.

Advantages:

- **Precise sorting based on chemical composition.**
- **Reduction of contamination in recycling streams.**
- **Improvement of the quality of recycled materials.**


Mechanical
Unraveling
Cutting and grinding
Without purifying
With purifying
Thermal
Thermo-chemical
Thermo-mechanical
(Bio)chemical
Polymer recycling
Monomer recycling

Recycling Technologies

Mechanical Recycling

Definition:

Mechanical recycling uses physical forces to recover textile fibers from waste, without altering the chemical structure of the material. It is often used as a pre-treatment for other recycling technologies.

Input:
Pre- and post-consumer fabrics (wool, cashmere, cotton, polyester, polyamide, etc.) - Industrial textile waste

Processes:
Collection and Selection: Textile waste is collected and sorted to remove non-textile materials.
Shredding: Textiles are shredded into smaller fragments. (wet treatment)
Fraying: The fragments are further processed to separate the fibers.
Carding: The fibers are aligned and prepared for spinning.

Output:
Recycled fibers that can be spun into new yarns – Fiber to Fiber
Filling materials or composites

Advantages:
Proven and available technology
Low-cost and relatively simple process

Disadvantages:
Reduced fiber quality compared to virgin fibers
Limitations in the treatment of complex or heavily contaminated tissues

Development:**TRL 9, widely used in regions such as Prato, Italy**
Future developments aim to improve the quality of recycled fibres and increase production capacity.

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Recycling Technologies

Thermal Recycling

Definition:

Thermal recycling uses heat to treat textile waste, which can be turned into gases, oils, or basic chemicals.

Thermo-Mechanical Processes:

Input: **Polyester, Polyamide**
Processes:
Fusion: **fibers are melted.**
Extrusion: **The molten material is extruded into pellets.**
Output: **Pellet**

Thermo-chemical processes:
Input: **Polyester, polyester-cotton blends**
Processes:
Depolymerization: **The fibers are broken down into chemical monomers.**
Output: **Ethylene terephthalate (TPA), ethylene glycol, cellulose**

Advantages:
Ability to handle complex and contaminated tissues
Production of high-quality materials, similar to virgin materials
Disadvantages:
Energy-intensive processes
Need to manage chemical by-products
Development:
Mature technologies with some industrial plants already operational
Future developments aim to improve energy efficiency and by-product management.

Recycling Technologies

Chemical Recycling

Definition: **Chemical recycling uses chemical reactions to break down textile fibers into their basic chemical constituents, which can be reconstructed into new fibers.**

System:

Polymerization: **Cotton through pulp processes.**
Input: **Cellulose fibres (cotton)**
Processes: **Production of cellulose pulp by chemical dissolution.**
Output: **Regenerated cellulose fibers (e.g. viscose, lyocell)**
Monomerization: **Polyamide 6 (PA6) and polyethylene terephthalate (PET)**
Input: **PA6, PET**
Processes: **Depolymerization into monomers such as caprolactam, TPA, MEG.**
Output: **Monomers for new polymer fibers**
Recycling polyester-cotton blends:
Input: **Polyester-cotton blends**
Processes: **Selective dissolution and recovery of components (cotton, PET)**
Output: **Cellulose pulp, PET fibres, glucose**

Advantages:
Ability to recover high-quality materials from textile waste
Flexibility in the treatment of different types of fibers
Disadvantages:
High costs and process complexity
Use of potentially hazardous chemicals
Development:
Technologies under development and industrial scalability
Expectations for improvements in the purity of recovered materials and energy efficiency

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transitions