



Ecodesign in the Textile Sector

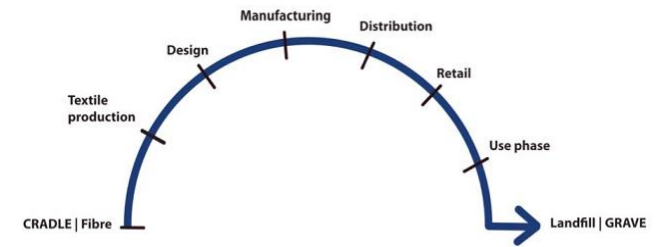
Unit 08: Recycling processes in the textile industry



Introduction

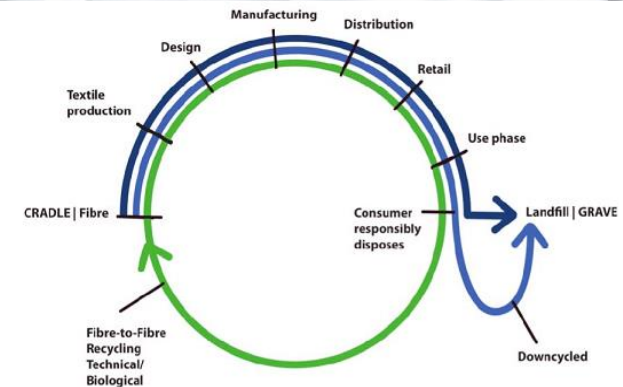
Traditional economy: linear model

"take, produce, discard"



Circular Economy:

a sustainable approach, ideally tending towards the zero impact generated by human activity



Circular Economy

Circular Economy principles

- design in order to avoid waste and pollution
- maintaining products and materials in use
- regenerating natural systems

Examples

optimised product and component design

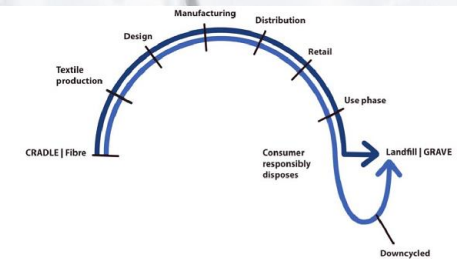
materials designed to support multiple disassembly cycles, re-use of materials and component parts

restoration instead of disposal

Downcycling, Re-use, Upcycling

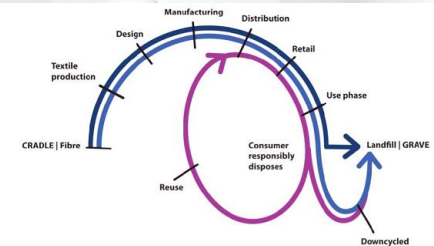
Down cycling:
Lower quality

the textile disposal in the landfill is postponed, the products are recycled and transformed into other materials and / or products of lower value and quality



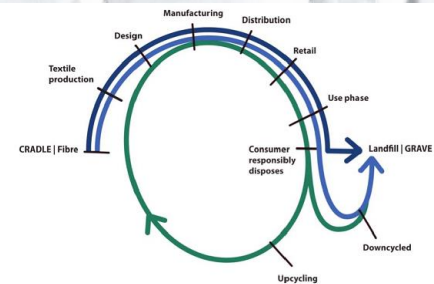
Riuso:
Same value

Products enter in a new life cycle of equal value, potentially returning to a continuous cycle.



Up-cycling:
Increased value or quality

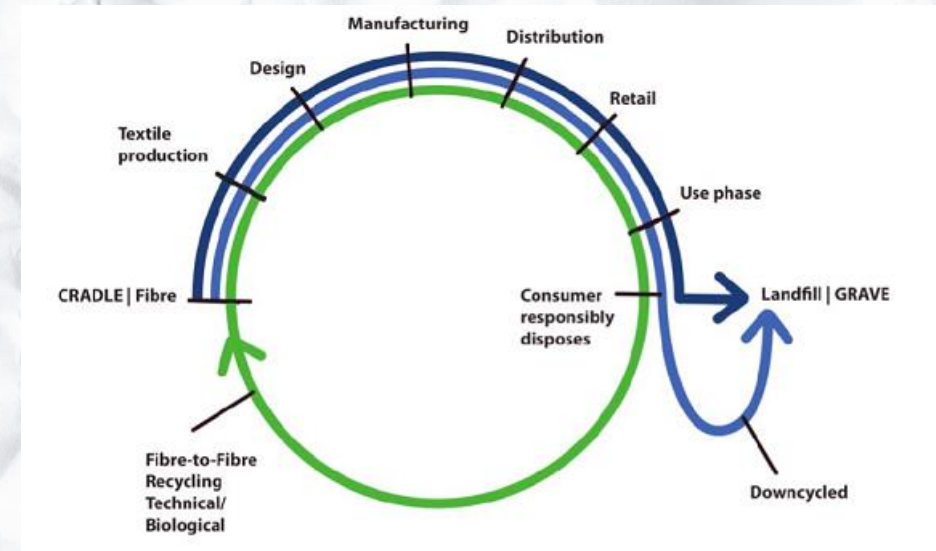
At the end of its life, the product is transformed into a new product with same or higher value, either in terms of product quality or in terms of value perceived by the market.



Circular economy: from the cradle to the cradle

Cradle to Cradle concepts

- represents the ideal and reference model of the concept of Circular Economy
- any type of waste can become a "resource" for new life cycles, as happens in nature
- A circular process starts and ends with the fiber
- the approach to circularity is aimed at productive, economic, social and ethical efficiency
- Implies a new design approach



Waste Management Strategies: the "3R" approach

"3R": REUSE, REDUCE, RECYCLE



Strategies with the aim of obtaining the greatest potential benefits of products in order to lengthen their life cycle by avoiding landfilling.

The two macro-areas are divided by type of product treatment: products that do not undergo changes at the end of their life, or products that are brought back to the state of fabric or fiber.

REDUCE

The reduction in the consumption of raw materials, energy and chemicals used is linked to the optimisation of production processes and the development of new technologies.

Reuse, Repair and Renew products

REUSE: Reuse, Repair and Renew products

Reuse is the simplest strategy requiring limited energy consumption

For example, in clothing, the energy used to collect, order and resell used clothes can be 10-20 times less than the energy needed for recycling.

Repairing and refurbishing products is more beneficial than producing new ones, although the savings are less than reuse.

In recent decades, the repair has been negatively affected by: reduction of the cost of products;

- increase in labor costs;
- a strong imbalance of cost;
- rapid change in fashion;
- attitude of consumers towards used or repaired products, seen as an indicator of economic narrowness.

In recent years there has been an increase in interest in re-use, especially by some cultural movements, albeit minor, which have brought back the techniques of:

- restyling,
- redesign of the garment,
- decorations and overprints.

Recycling of textile products

Phase 1: sorting of collected waste

4 main technologies:

- Manual selection: traditional method, small margins;
- Fourier transform infrared spectroscopy (FTIR): selects for color and composition, increased margin, under development;
- RFID (Radio Frequency Identification) label, allows a lowering of costs and a classification on a wide range of criteria;
- 2D barcode: A 2D bar label gives the information necessary to the reader, obtaining the same advantages as RFID labels.

Phase 2: Recycling process

4 main kind:

- primary recycling: recycling of a product in its original form (pre-consumer waste);
- secondary recycling: mechanical treatment of waste, degradation of physical-mechanical and / or chemical properties;
- tertiary recycling: chemical treatment, convert the material into monomer or chemical;
- quaternary recycling: combustion of a solid waste in order to generate heat.

Recycling of textile products

Mechanical recycling

Initial phase of disassembling, cutting and tearing of textiles.

It is then passed through carding machines to separate the individual fibres.

Depending on the quality of the fiber:

- the highest quality fibres are reintroduced into the production chain;
- Mid-level fibres can be used to produce fabrics;
- lower quality fibres will be used as reinforcement, non-woven fabrics, etc.



Knitted fabric made with mechanical recycled yarn of different fibers.

Recycling of textile products

Chemical recycling

Used for synthetic and cellulosic fibres.
More impactful than mechanical recycling.
Some examples:

Polyester: from used textiles and PET bottles (as a substitute for the mechanical process): the articles are reduced into small pieces to form a chip. The chips are depolymerised to form dimethyl terephthalate, then polymerised again and extruded into new polyester fibres and yarns.

Nylon and spandex: Spandex is dissolved to recycle nylon. The process involves a heat treatment to degrade the spandex and then subject the tissue to a washing process using ethanol to remove any residue.

Cotton and polyester blends: the fibres are chemically separated using an agent that dissolves the cellulose; the pulp is filtered and then the polyester is reformed into new fibres, while the dissolved cellulose is used in the common processes of cellulose spinning (viscose and derivatives).

Thank you

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