

HACKTEX VIRTUAL TRAINING MATERIALS

ADVANCED TEXTILES MANUFACTURING INDUSTRY

Learning unit 5: Issues related to the sustainability of functional and smart textiles

Lesson 2

Management of smart textiles wastes. Recycling and challenges

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MANAGEMENT OF SMART TEXTILES WASTES. RECYCLING AND CHALLENGES

LU5.2



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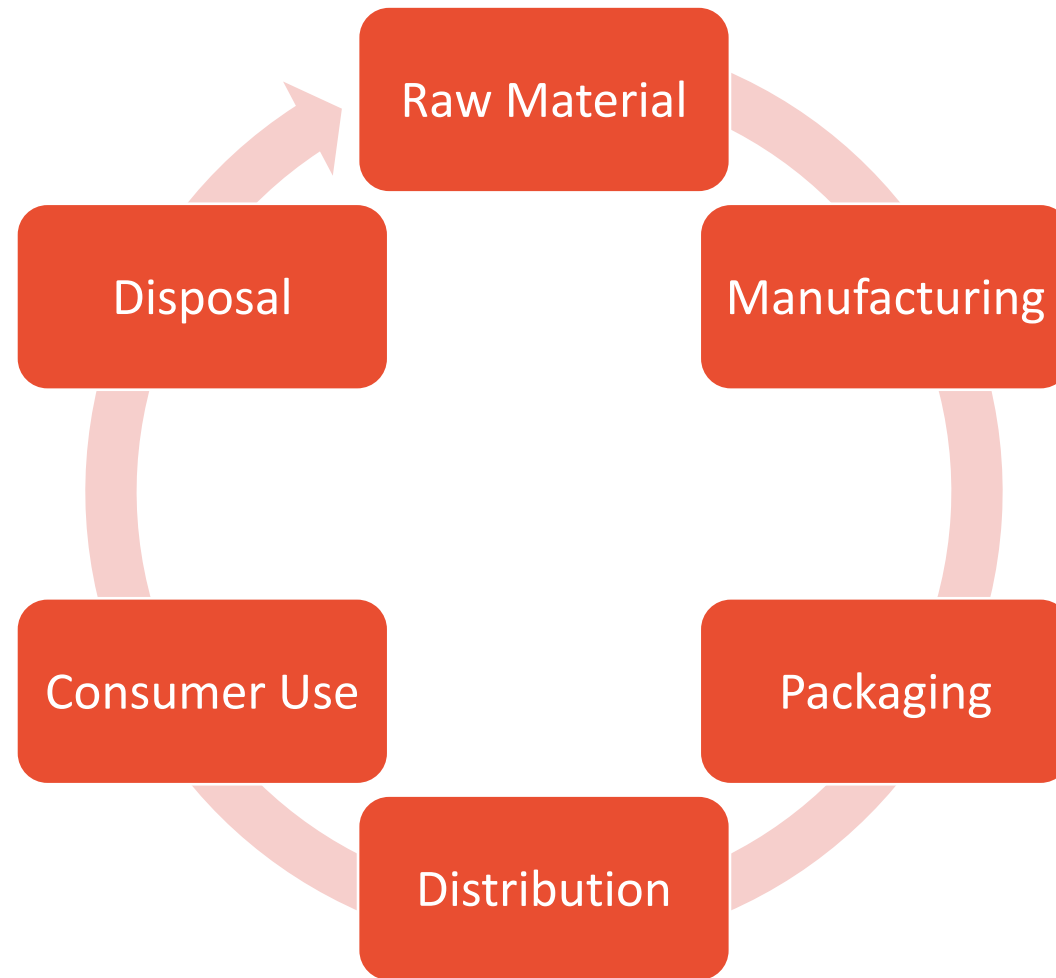
LIFE CYCLE OF SMART TEXTILES



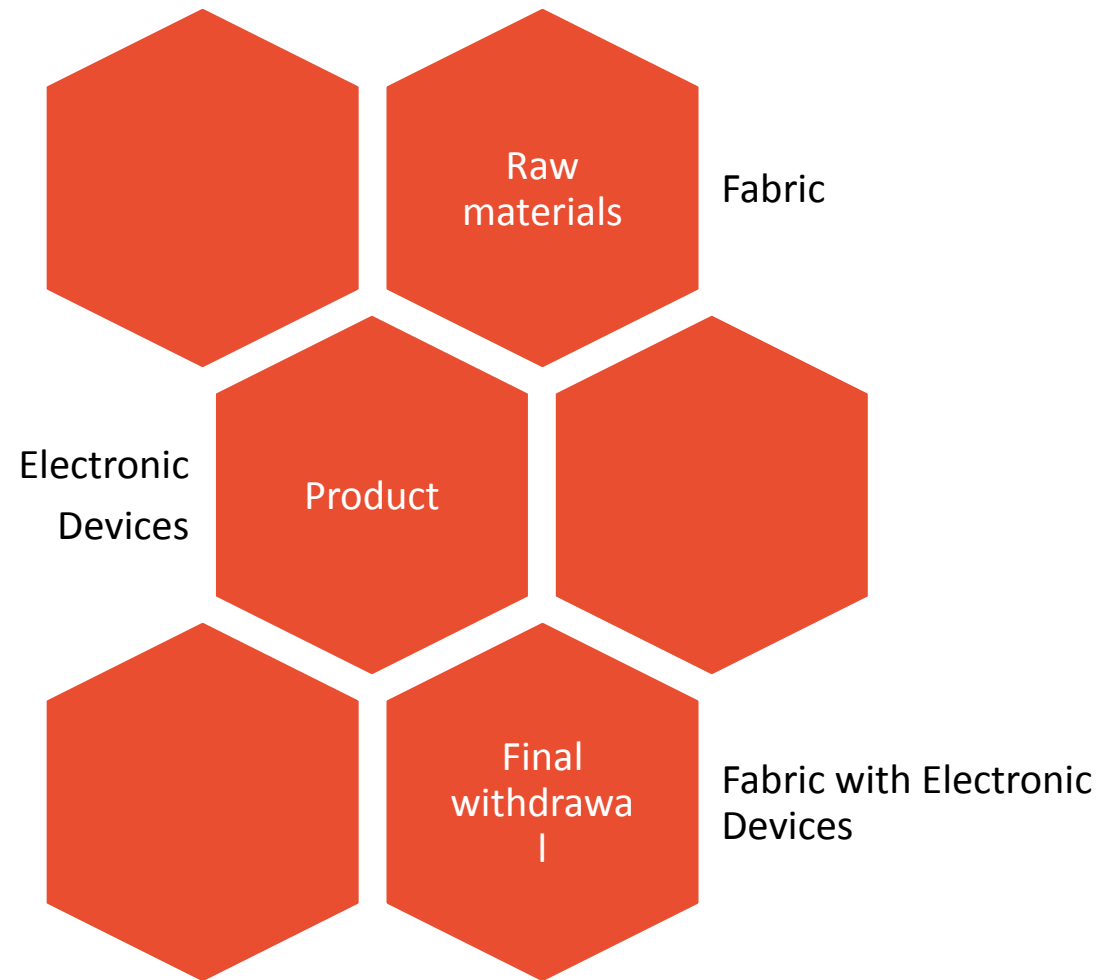
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Cycle of life of a smart textile and its ecological impact



Life cycle of a smart textile



Life Cycle Assessment

The Life Cycle Assessment (LCA) or life cycle analysis is one of the methodologies used for assessing the environmental impacts of a product from raw material extraction through material processing, manufacturing, distribution, use, repair and maintenance, and disposal or recycling. The phases of LCA make it possible to identify the way that an activity affects the environment and the size of its impact on the different environmental compartments beyond the boundaries of the production plant.

The scope of Life Cycle Assessment

The scope of the LCA can be gate-to-gate, which focuses only in one process of production chain, cradle-to-gate way, which is an assessment of a product life cycle from resource extraction (cradle) to the factory gate, cradle to grave, which covers the range from extraction of raw materials from the earth to manufacturing, product use and recycling/disposal at the end, or by cradle-to-cradle, which has the scope closed the loop production.

Ecological impact

Ecological impact, or footprint, of an activity, is an index that aggregates the whole range of environment changes provoked by this activity. This index indicates the quantity of land or sea productive area that is required, in order to produce the resources that are consumed and in order to eliminate the waste produced. It is based on the concept of the carrying capacity of the ecosystems, which is the inherent capacity of the systems to provide material as well as remediate environmental harm.

SUSTAINABLE MANAGEMENT, DEVELOPMENT & CHALLENGES



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Sustainability

- Human sustainability aims to maintain and improve the human capital in society.
- Social sustainability is the high quality of development of the communities.
- An economy is sustainable when ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation.
- Environmental sustainability contributes to protecting and enhancing our natural and developed environment.

Sustainable development

Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.

The challenge of sustainable development is to move forward in such way that every human will be able to enjoy a substantial quality life without being detrimental to natural resources of the planet.

Eco-design

The eco-design is defined the design plan, which it contains:

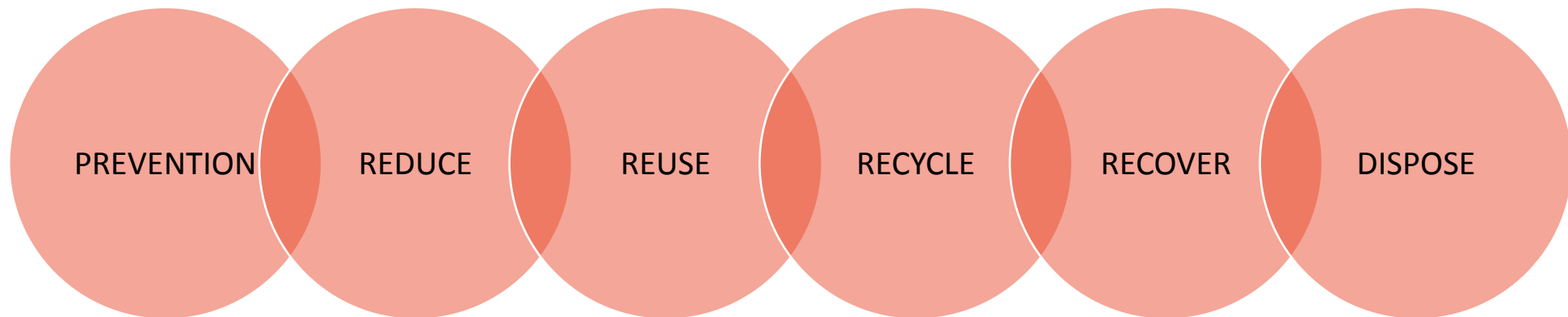
- the design for sustainable sourcing
- the design for environmentally sound and safe product use
- the design for prolonged product use
- the design for recycling

WASTE TYPES AND RECYCLING METHOD

Waste management

The management of the waste focuses to prevention, reduce, re-use, recycling, recovery and final disposal.

The process of waste management, for be sustainable, must be approached in an integrate way from the start of the production until the end of the life of the product.



Waste types of textiles

Textile and fashion waste can be classified into different types based on their source of generation, toxicity, disposal and discarding or categorized by their nature (solid or soft) or the phase of the product life cycle that they are produced. Pre and post-consumer wastes are the waste generated at various levels after usage of the finished product by end consumer and could be any clothing or household article, which has been discarded or not in use for any reason like being worn out, damaged or outgrown.

Waste types of textiles

- Soft waste is the waste in which fibers are relatively open structure and can be reused at an earlier feed stage, it's generated from bloom to the ring frame and is reusable for producing a low quality of yarn;
- Hard waste is the waste in which fibers are packed in a closed structure and need additional operations before reusing them with soft waste.

Waste types of textiles

- Hard to treat wastes are wastes characterized by their persistent, resist treatment, or interfere with the operation of waste treatment facilities.
- Hazardous wastes, a subgroup of hard to treat wastes, are the metal, chlorinated solvents, non-degradable surfactants and other non-biodegradable or volatile organic materials.
- Dispersible wastes in textile wet processing are the following: Print paste, lint, coating operation, solvent, waste stream from continuous dyeing, printing, finishing etc.
- High volume wastes are, also, one of the challenges in waste management of the textiles industry.

Recycling methods

Textile recycling is the action of reprocessing pre or post-consumer textile wastes and use it in new textiles or non-textile products.

There are two recycling processes:

- the closed and
- the open loop.

Pre-consumer and post-consumer wastes recycling

- The wastes from pre consumer deposits are production wastes, unfinished or unsold products. In that case, the composition of the textile is homogeneous and known.
- The post-consumer wastes are mixed and heterogeneous, something that makes the recycle process complicated and more difficult.

Recycling methods: Recover the fibers

To recover the fibers, is necessary to separate the textiles by colour and material and to remove the hard and electronic parts from the rest of the clothes, as in coated or laminated textiles. After that, the textile must be cut into little pieces, which enter in a shredding machine with rotating metal pins drums to open the textile and recover the fibers.

Recycling methods: Thermoplastic materials

The thermoplastic materials can be recycling by covert the textile into polymers. That conversion requires a mechanical or a chemical process.

In the mechanical process, the pieces of textiles are melted and spun directly or recycled into granulates. The output is granulates that can be used in the production as raw materials, in an open or close loop process.

Recycling methods: Thermoplastic materials

In chemical dissolution process, the textile pieces are dissolved in a specific solvent, where the fibers are converted from synthetic polymers to cellulosic fibers. The output is a dissolved polymer, which can be spun using a solvent spinning process to recover a fiber of the same nature as the input one.

Recycling methods:

Chemical depolymerizing process

Another recycle way is to convert the synthetic polymers of textile into monomers by a chemical depolymerizing process, where pieces of the textile can be depolymerized in various ways to create output monomers, with the same quality as the virgin ones, that can be used in industry of textiles or plastics in an open or close loop process.

Recycling textile into molecules: Pyrolysis

In recycling textile into molecules there are chemical processes as pyrolysis, composting and fermentation.

In pyrolysis, the pieces of textiles are heated at a very high temperature to be degraded and converted to gas, oil and carbon. The input is any organic carbon-based material, including biomass plastic and textiles and the output are various mixed gases, oils or carbon that can be used as fuel or as feedstock in the production of chemicals.

Recycling textile into molecules: Composting

In the processes of composting and fermentation recycling, microorganisms transform organic material into molecules, thanks to fungi, yeast or bacteria in the presence of oxygen, water and nitrogen. The input could be cellulose rich feedstock and mixed textile wastes and the output is a range of fuel molecules, chemicals and non-cellulosic fibers that can be used as fuel or as input in other industries.

Recycling smart textile

In the sector of the smart textiles is important to understand and approach the textile with its two different natures. In the recycle procedure should be separate the fibers part of the texture from the electronic parts in order to improve the processes that already exist today for the simply textures in one part and the devices in the other.

Summary

- The cycle of life of an e-textile, the types of produced wastes and their recycling methods.
- Definition of sustainable management of the produced wastes during the life of a smart textile.
- Understanding what the sustainable waste management is and confront the challenges of the procedure.

Partners:



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