STREAMLINED LIFE CYCLE ASSESSMENT

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EXTENDED ABSTRACT: Analysis of environmental aspects along the textile process chain

Key Words: life cycle assessment, LCA, sustainability, carbon footprint

1. Challenges and approach

Ecologically sustainable action plays an increasingly important role in the clothing sector. Along the textile chain many different environmental impacts occur, e.g. high consumption of resources and energy. Depending on the raw materials, high land consumption or the use of numerous chemicals can also have a significant impact.
The method of life cycle assessment (LCA) can be used to identify the need for ecological improvement within the textile industry. By taking a holistic view of the entire product life cycle, a comprehensive evaluation of interlinked environmental aspects and not just the evaluation of individual factors is performed. For this purpose, relevant textile processes along the life cycle of an exemplary product or process have to be defined. The life cycle inventory and the impact assessment parameters can be determined by using modelling software and environmental databases. As a result, environmental impacts of the analyzed system can be discussed on the basis of impact categories, e.g. global warming potential. [1]
Since LCAs involve a considerable amount of work and time, different variations of the classic life cycle assessment have developed. These variations represent a simplified or shortened form of the ISO-certified LCA, e.g. streamlined LCA (sLCA). The aim of these analyses is either to reduce the time and manpower required, the scope of the investigated system or the costs associated with carrying out a life cycle assessment through appropriate measures. The availability of environmental data can also be a criterion for deciding on the level of detailed information required in an LCA and can lead to a decision for a modified form of LCA. [2]

2. sLCA - Using a pair of jeans as an example

The basis of an environmental assessment model is the environmentally relevant data of a product system. In an environmental analysis carried out at the Institut für Textiltechnik (ITA), Aachen, a denim jeans made of 100 % cotton fibers was selected as a reference product. Jeans have been one of the most popular clothing items for decades. It is produced in large quantities of up to 3.6 billion pieces per year. The production chain of jeans is largely based on standardized processes of the textile industry and is sufficiently well known and documented. It is therefore assumed that sufficient data is available to create an environmental assessment model. [3]

2.1 Scope

The aim of the environmental assessment model was to record the actual situation of the environmental impacts along the textile chain of a pair of jeans and to identify environmental hot spots. In particular, the production phase was addressed. The framework of the analysis can be summarized under the three main aspects goal, production system and boundary. The goal of the sLCA is to analyze the status quo of the environmental impacts in the textile process chain. As production system the textile chain of a 100 % CO-denim jeans, used as an everyday garment for two years of use with 52 wash cycles while using is considered. The system boundaries are defined by the Cradle to Cradle approach. This approach includes an analysis of the entire process chain including various recycling scenarios (e.g. second-hand, reuse, recycling and disposal), as shown in Figure 1.

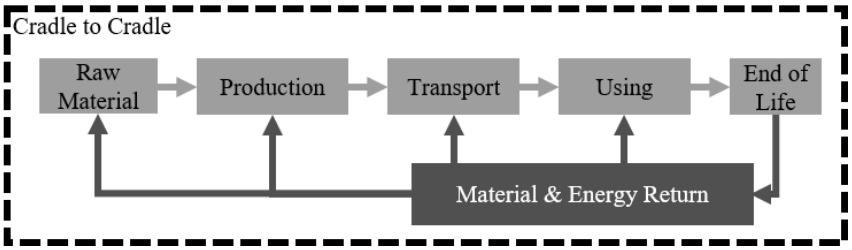

Figure 1. Cradle to Cradle approach

2.2 Results

The standardized ReCiPe 2010 method was chosen as the impact assessment method. By using this method, the total environmental impact can be detected on an "endpoint level" as a weighted value from various impact categories (e.g. global warming potential, fossil or water depletion). Showing the results of the streamlined life cycle assessment the use phase is the determining life cycle phase within the textile chain of a jeans with a share of 44 % of the total environmental impact, followed by the raw material input with a share of 41 %. The production phase holds a share of 15 % on the total environmental impact. The influence of the transport phase and the end of life on the total environmental impact (both < 1 %) are low. The shares of the life cycle phases on the overall environmental impact are shown in Figure 2.

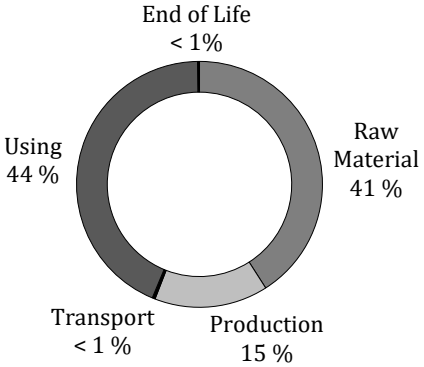

Figure 2. Life cycle phases as a percentage to total environmental impact (according to ReCiPe 2010)

Taking a closer look into the production phase, the spinning, weaving and finishing processes are the key drivers. Their shares on the environmental impact within the production phase are

between 23 % to 28 %, this means that these process steps have shares of the overall environmental impact by 3.5 to 5 %. The shares of the production processes to the environmental impacts of the production phase are shown in Figure 3.

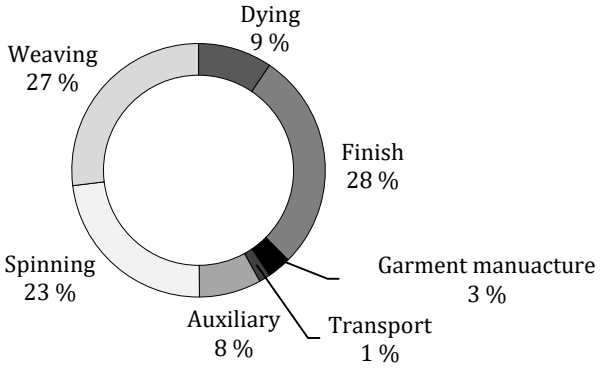

Figure 3. Production processes as a percentage to the environmental impacts of the production phase (according to ReCiPe 2010)

Considering not the entire environmental impact, but the carbon footprint, 54 kg of CO_2-Eq. are emitted over the entire life cycle of a jeans. 73 % of these emissions occur during the use phase, 21 % during production of the jeans.
If recycling options are taken into consideration, CO_2 emissions can be reduced. In the status quo scenario, which takes into account the current status of used textile recycling, a saving potential of 9 kg CO_2-Eq. per jeans is calculated. If 100 % of a pair of jeans is reused, the saving potential is 14.5 kg CO_2-Eq..

2.3 Conclusion

The use phase is the determining life cycle phase of the textile chain of jeans, followed by the raw material and production phases. The transport phase and the end of life have hardly any influence. Comparing the status quo scenario of current used textile recycling with reusing of used textiles the potential to capture CO_2 emissions can be increased by 60 %. Higher savings potentials e.g. of CO_2 emissions should act as an encouragement to optimize textile recycling and promote the implementation of a textile recycling economy.
So far, the focus within an sLCA has been on evaluating the environmental impacts of the textile process chain. In order to evaluate the sustainability of products or processes, however, economic and social aspects have to be included, as these also define the term of sustainability. In order to capture the sustainability of a product holistically, further methods must be developed and tested, such as social LCA or eco-efficiency analysis. [4]

3. REFERENCES

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