

Natural – Local – Circular: A sustainable design strategy using the example of a functional cardigan made of hemp

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Abstract

The ecologically, economically and socially fair production of products already plays a major role in the purchasing decisions of every third consumer, and the trend is rising. The textile industry in particular is criticised for being an environmentally damaging branch of industry, with globally ramified production chains, high environmental pollution, socially difficult production conditions and non-transparent supply chains. While the demand for fibres continues to rise, demands for environmental protection and sustainability are also increasing. The natural fibre cotton in particular is known for its high consumption of water and pesticides. Due to the global distribution of cultivation, processing and textile production, a wide range of logistics activities are necessary, which according to the WEF are responsible for 5.5 % of the world's CO2 emissions.

Regional cultivation with subsequent regional processing is a cornerstone for market efficiency and resource management in the textile chain. 20 % nitrate-polluted arable land is a major problem for NRW agriculture,

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so that relief of arable land is imperative. Hemp plants extract nitrate from the soil and thus make a decisive contribution to improving soil quality and groundwater. The cultivation and processing of hemp into high-quality textiles and technical applications are thus promising technologies for alleviating the current problems of agriculture. The cultivation of hemp varieties with a content of less than 0.2% of the psychoactive substance THC, which has been permitted in Germany since 1996, has led to a steady increase in cultivation areas. Since 2017, the unlimited cultivation of hemp as a winter crop has been permitted and, due to the unique quality of the fibers in terms of fineness and feel from the domestic soil-climate areas, makes it possible to use it for high-quality textiles. The excellent ecological properties and the low water consumption should be emphasised: only 400 litres of water would be used to produce a pair of jeans from hemp, compared to 12,000-15,000 litres for cotton. Aim of the research project HanfKnit (HempKnit) is the design and development of a sustainable cardigan made of 100% hemp. This combines positive physiological properties of hemp, such as good moisture and temperature management, with comfort properties of a knitted garment. The holistic sustainable design concept contains following steps in a local textile chain from fiber to product:

1. Selection of hemp fiber types with sustainable preparation, for different processes and product applications from local sources.
2. Spinning process > production of yarn blends from natural hemp and Lyohemp[®], a regenerated fiber made from harvest waste > hemp straw (target > monomateriality)
3. Design of an ergonomic function concept for a cardigan (body mapping concept).
4. Development of a construction model according to different targeted functionalities in the fabric / the product (based on different knitting constructions)
5. Knitting tests on flat knitting machines > yarns in different blends and combinations, using f.e. plating technique with pure Lyohemp[®], to test effect on the physical properties.
6. Analytic tests (performance and optical appearance)
7. Evaluation of all results > selection of patterns and constructions.
8. Converting the selected patterns into a zero-waste knitting programme (fully fashioned or seamless) for a first prototype.

Cutting of individual parts, material loss and time-consuming finishing processes are eliminated. Via a body mapping concept, ergonomically placed functional zones and their properties are to be developed and integrated into the knitting construction, adapted to the various requirements for leisure, work and outdoor use. Plating technique offers another option to optimize function and comfort of the jacket. Due to its

monomateriality, the resulting prototype also fulfils the most important requirement for recycling at the end of the product's life and thus for the circular economy.

Improving the processing of hemp fibers into attractive, sustainable natural products with a regional production chain in Germany thus promotes small and medium-sized companies with high innovation potential in the long term. In addition, increased hemp cultivation (with low THC content) promotes biodiversity and relieves nitrate-polluted soils.

Overall, the project supports the goals of establishing the circular economy, the "National Research Strategy Bioeconomy 2030" and the EU's Green Deal.

This project is funded as part of the European Union's response to the COVID-19 pandemic, REACT-EU project (EFRE-0802061).

Keywords: design for sustainability / recyclability , local production, zero-waste knitwear, hemp, monomaterial.

DOI: 10.57649/GFC.978-989-54263

ISBN: 978-989-54263-3-1

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