Sustainable textiles

Baden-Württemberg is known for innovation in textiles and for playing a decisive role in the development of sustainable textiles for the future both in the clothing and the booming technical textile sectors. Companies and research institutes are focused on making the entire textile value chain from raw materials, production and useful life to disposal more sustainable than ever before.

Baden-Württemberg is a land of textiles. In 2017, there were 121 companies with over 20 employees each. The companies had a combined total of more than 11,500 employees and generated revenues of 2,238 million euros.[1] Along with Bavaria and North Rhine Westphalia, Baden-Württemberg is one of the top three states in the German textile industry. Baden-Württemberg also boasts internationally leading research and development facilities. The German Institutes of Textile and Fibre Research (DITF) in the Swabian city of Denkendorf are the largest textile research centre in Europe. Baden-Württemberg is also home to the renowned Hohenstein Institutes in Bönnigheim and numerous research departments in universities and textile companies.

Sustainable textiles are among the most important trends in innovation. They have been declared a priority for product and process development across all departments at the DITF.

It is no longer just an issue relating to the environmental benefits. Sustainable products and processes are also of economic benefit for industry. This can be illustrated with a simple example: If industry stops using toxic chemicals for finishing or treating textile surfaces, there is no longer any need for the costly handling and disposal of toxins. However, this is not the only reaon why research and industry are coming together to work for a sustainable future for textiles. The sustainability strategies of Baden-Württemberg, Germany and the EU also aim at paving the way for a more sustainable textile future on different levels, including by contributing to a change in general public awareness.

Sustainability from the raw material source to disposal

The precursor material and its product: The DITF produces an innovative cellulose fibre from pulp, a wood product.

The sustainability of a textile product is determined by the choice of raw material. The general goal is to use as little as possible raw material sources and reduce our dependency on fossil resources. Using renewable raw materials and cultivating them to save water and energy is just as important as resource-saving production processes. Sustainable production is ideally followed by sustainable use of textile products that have as many life cycles as possible. High-tech solutions from research departments provide valuable approaches that demonstrate how materials can be industrially recycled.

End users can also make a decisive contribution, especially in the area of clothing and home textiles. The useful life of a textile can generally be extended when higher-quality textiles are purchased. However, in the case of outdoor textiles this approach can backfire. High-quality textiles need to be water- and dirt-repellent and breathable. This can be achieved with PTFE membranes (PTFE: polytetrafluoroethylene), but they are produced using environmentally harmful processes. The DITF is therefore working with the Hohenstein Institutes on an alternative made of polypropylene (PP), which is also cheaper to produce. The Hohenstein Institutes are taking a different approach with the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB in Stuttgart. They have joined forces on a "Hydrophobins" project that focuses on making textiles water-repellent with the help of fungal proteins (see article "Textiles: water-repellent thanks to fungal proteins").

Sustainable textiles have many other potential areas of application beyond clothing. Clothing only represents forty percent of the sustainable textile industry. German research and development work primarily focuses on technical textiles. For example, the trend towards lightweight construction has brought textile materials into the spotlight for the construction industry and the automotive and aircraft construction sectors. The focus here is on lightweight and easily mouldable composites. The major research and development centres have been working hard for years to develop environmentally sound and largely reusable products as part of the circular economy.

Biologically degradable “agrotextiles” are in fashion

The polar bear pavilion – a textile membrane construction with a futuristic design points the way to sustainable energy use.

DITF researchers are working intensively on the development of natural biopolymers such as cellulose, hemp and flax, which are also suitable as precursor materials for composites (see article "Natural biopolymers - the sustainable almost-all-rounders"). As far as cellulose is concerned, the researchers are specifically focused on producing biopolymers from pulp, which in turn is produced from wood. Theoretically, of course, cotton can also serve as a source plant for producing biopolymers. However, although cotton is renewable, it requires enormous amounts of water to grow, which has a disturbingly negative affect on the ecobalance. The conventional methods used to convert pulp into cellulose are also an issue for concern as they use solvents that are not very environmentally friendly. Researchers from the DITF have demonstrated that things can be done differently by developing new processes that use “green solvents”.

Alginates, chitin and its chemical relative, chitosan, are readily available renewable precursor materials for producing textiles. Alginates can be produced biotechnologically using bacteria, and are a sustainable raw material for textile wound dressings. In cooperation with industrial partners, the Hohenstein Institutes have developed an innovative process for manufacturing such products (see article "Tailor-made biotech fibres for improved wound dressings”). Another research and development project carried out at the Fraunhofer IGB in cooperation with six partners shows what insect chitin found in the exoskeleton of insects can be used for. The project led to the development of a new biotechnological process to use insect chitin as a sustainable chitin source for use as a functional surface coating for textiles (see article “Insect chitin makes textile production more sustainable”).

The DITF team has also developed carbon fibres made of cellulose, proving that even high-performance fibres used for technical applications can be biobased and sustainable. In an EU project called LIBRE, DITF researchers are working with international partners to develop lignin-based carbon fibre for use in fibre composites. However, the biobased origin alone does not make carbon composites a sustainable part of the circular economy. The DITF researchers are therefore researching technologies that make a second life cycle possible in which the carbon fibres can be used in semi-finished textile products that can be used for tapes or used in composite components.

Polyester textiles sound petrochemical. However, they can also be made from renewable resources other than petroleum. For example, polylactide (PLA) can be obtained from cereals such as corn. However, it is hotly debated as to whether it is sustainable to produce PLA from food. As PLA is bioresorbable, it is well suited for use in medicine, where it can be used as a matrix for tissue regeneration and as suture material. Polyhydroxybutyrate (PHB) can also be used in textile medical and care products, which is made from a different raw material source. Nowadays, PHB can be produced biotechnologically in fermenters where the bacteria are fed with renewable raw materials such as sugar, starch and glycerine.

Sustainable textiles in exotic fields of application

Exotic fields of application also demonstrate how versatile textiles can be. The DITF has developed a three-dimensional textile called "FogHa-TiN" that is designed for use as a fog collector in dry coastal regions for the sustainable production of drinking water. A product called “CloudFisher” that provides people with high-quality drinking water has already been placed on the market. "FogHa-TiN" is also suitable for technical applications such as the separation of harmful aerosols from vapours.

The so-called polar bear pavilion, which was launched by the DITF in 2013 as a visionary future concept for energy-efficient constructions, is another example of how textiles can be used sustainably. Inspired by polar bear skin and its special ability to conduct light and act as thermal insulation, DITF researchers have worked with industrial partners to develop a textile membrane construction that mimics polar bear skin by capturing solar heat and conducting it to energy stores (see article "A warm house thanks to polar bear principle").

Textile moss walls are another interesting field of application in the move towards sustainability. Their purpose is to filter fine dust from the air. In a project called “Moos Tex”, DITF researchers have been working with specialist companies with huge technical experience in botany to develop a moss wall. The moss wall has an active irrigation system that regulates the mosses’ particulate matter requirements. The system demonstrated its effectiveness during the extremely dry summer of 2018 and is now being developed further.

A company from Freiburg called Rhodia Acetow has been working on another aspect of sustainable filtering effects. The company has developed a filter material with degradation values similar to those of pure pulp. It comes in various versions that decompose very quickly under the influence of light or in water or compost. Although such technical textile developments dominate the industrial innovations sector in Baden-Württemberg, many innovative products are also being developed for the clothing sector. For example, Lauffenmühle GmbH in Lauchringen develops recyclable fabrics. The company focuses on the recycling of all materials used in a product without any downcycling. The products are suitable for workwear and protective clothing as well as textiles in the fields of medicine and healthcare.

All these sustainable textiles are extremely diverse, but still only represent a relatively small selection of all developments and innovations. Other players in this sector, including companies from Baden-Württemberg such as VAUD E (founding member) and TRIGEMA, have joined forces in the Alliance for Sustainable Textiles. They work across the entire value chain for sustainable production/fair working conditions, sustainable supply chains and sustainable consumption.

[1] Figures taken from publication "Mit jeder Faser intelligent - Die deutsche Textil- und Modeindustrie in Zahlen" (Gesamtverband textil + mode) www.textil-mode.de/presse/publikationen

References:

Brochure "Textil kann viel“ published by Verband der Südwestdeutschen Textil- und Bekleidungsindustrie

Magazine FIBER PUSH, Werkstoff Faser by AFBW (Allianz Faserbasierter Werkstoffe Baden-Württemberg e.V.)

Brochure "Mit jeder Faser intelligent - Die deutsche Textil- und Modeindustrie in Zahlen" published by Gesamtverband textil + mode

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