RESEARCH HIGHLIGHTS

DEUTSCHE INSTITUTE FÜR TEXTIL- UND FASERFORSCHUNG DENKENDORF

DITF REPORT

March 2021 – Nr. 1

100 years towards the future

DITF Denkendorf celebrate their 100th anniversary

The German Institutes of Textile and Fiber Research Denkendorf celebrate their 100th anniversary this year. In 1921, the cornerstone was laid with the founding of the German Research Institute for the Textile Industry in Reutlingen. Today, the DITF form the largest textile research center in Europe.

The idea behind the foundation in 1921 was to support the industry through independent research work. A look back shows how excellently this has been achieved. With numerous product innovations and development successes, the research institute quickly developed into an important driving force for the textile industry.

The claim of the founding fathers still characterizes Denkendorf's textile and fiber research today. With product- and technology-oriented innovations and testing services, the DITF support the economy and thus make an important contribution to strengthening the competitiveness and securing the location. With a clear focus on new key technologies and future fields, the DITF today are the innovation engine of the German economy and a provider of ideas for textile innovations.

"With this anniversary, the DITF are celebrating above all the many people who have accompanied 100 years of successful research," emphasizes Professor Dr. Götz T. Gresser, Chairman of the DITF Board of Directors. "First and foremost, of course, I am thinking here of our dedicated employees, their wealth of ideas, their knowledge and their creative energy. Their great collective effort is the basis of our success. But I am also thinking of our numerous industrial and scientific partners, as well as of the political supporters without whom this development would not have been possible.

With their tradition-rich past behind them, the DITF will continue to develop solutions for the challenges of tomorrow, opening up new paths so that textile ideas and technologies reach industry and society quickly and efficiently. This promises a future that we approach with joy and great enthusiasm. Let's celebrate the textile future!

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Textile milestones

What is possible today in many fields of application of fiber-based materials due to modern textile and process technology, was completely unimaginable in 1921. Milestones document the rapid progress and important achievements in textile research from 1921 to the present day. They make us aware of important successes of the past century and show us perspectives for the future.

The DITF anniversary publication "100 Years of Textile and Fiber Research" brings together the milestones from the beginnings to the present day. In a chronicle, it reports on renowned inventors and personalities and presents important inventions and developments that have emerged from it. They range from new flame-retardant polyamide fibers to carbon fibers made from renewable raw materials, from new spinning processes to innovative 3D woven structures, from textile implants to energy-efficient textile polar bear houses.

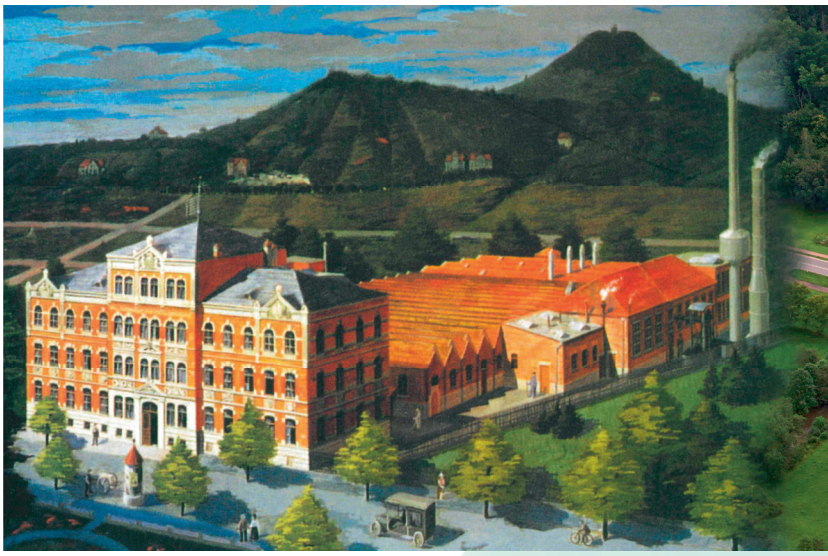
(Download at ditf.de/100-years)

DITF.100

LET'S CELEBRATE THE TEXTILE FUTURE!

The German Research Institute for the Textile Industry was founded in 1921 at what was then Germany's most important textile training institute, the Reutlingen Technical Center for the Textile Industry. Today, the German Institutes of Textile and Fiber Research, as they have been called since moving to Denkendorf in the early 1980s, are the largest textile research center in Europe. The fields of work range from basic chemistry and fundamental textile process technologies to textile testing services and industrial applications. Knowledge management and digital modeling of new products and processes support their implementation in practice. The DITF are a driver for innovations along the entire textile value chain and for textile solutions in key technologies such as medical technology, lightweight construction and mobility.

Then



In order to provide a basis for the upcoming textile industry in the rural Kingdom of Württemberg, a weaving school was founded in Reutlingen in 1855 on the initiative of the Central Office for Trade and Commerce. Within a few years, this developed into an educational institution covering all textile processes. Spinners, weavers, knitters, finishers as well as laboratory and management staff for the textile industry throughout Europe are trained at the Reutlingen Technical School for the Textile Industry.

Prof. Dr.-Ing. E.h. Otto Johannsen (1864-1954), head of the Technical School from 1892 to 1932, also pushed ahead with research. In 1894, he habilitated at the Stuttgart Technical University and took on teaching responsibilities at the university as a professor. Before the First World War, a state testing office for textile fabrics was established at the Technical School. The founding of the long-planned research institute was delayed until 1921 due to the war.

Then, however, the Reutlingen Technical School with the testing office and the research institute became the pacemaker for the development of the prospering textile industry for a long time. The range of research tasks also grew, especially in the field of chemistry. In 1936, a separate department for textile chemistry was set up at the Research Institute. Its Head, Prof. Dr. Hermann Rath, was appointed to the newly established Chair of Textile Chemistry at the TH Stuttgart in 1962. The Institute of Textile Chemistry also moved to Stuttgart. There, Prof. Dr. Paul Schlack, inventor of the perlon fiber, took over the Department of Man-Made Fibers, which also became an independent Institute for Man-Made Fibers in 1968.

In keeping with economic developments, the Reutlingen Technical School, now a state engineering school, gradually loses its textile focus. At the end of the 1960s, general mechanical engineering and, shortly thereafter, business administration subjects were introduced as new departments. Finally, in 1971, the Technical School is absorbed into the newly founded University of Applied Sciences for Technology and Economics, now Reutlingen University.

Founded
from the crisis

Think tank for
the textile industry

Competence
in the center

Today

A new era also begins for textile research in the 1970s. Those responsible look for a location where the institutes from Reutlingen and Stuttgart are to be reunited. The choice goes to Denkendorf. Here, in Körschtal, there had been a research institute since 1937, specializing initially in rayon spinning and, after the war, in man-made fiber research in general. And there is room here for new buildings, for which the state parliament approves the funds in 1978. After completion in 1983, textile and fiber chemistry and textile technology are united institutionally and also again spatially under one roof as the German Institutes of Textile and Fiber Research.

What then begins can be called a success story, even if the general conditions are not easy: In the course of globalization, the European textile industry is undergoing a partially painful structural change. Traditional clothing production is migrating to low-wage countries. In order to survive the economic change, new products and innovative processes are required. The Denkendorf institutes are providing crucial support in this process.

Beyond classical textile chemistry and textile technology, new areas of research must be opened up. In particular, textiles for technical applications are coming into focus: fibers and textiles are now being designed as high-performance materials and developed specifically for key technologies such as architecture, mechanical engineering, vehicle construction, aerospace, medicine, environmental technology, etc. In order to cope with this range of tasks, the number of employees has also grown continuously: while about 100 people were employed at the time the research center was founded in Denkendorf, today more than 250 scientific and technical staff work on future textile topics in the overarching research areas of chemistry, process engineering and management research.

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LET'S CELEBRATE THE TEXTILE FUTURE!

In the period of industrialization, the textile industry plays a pioneering role. Artisanal textile production is no longer sufficient to supply the rapidly growing population. In order to develop trade and industry, good skilled personnel are needed. To this end, a weaving school was opened in Reutlingen in 1855. Spinners, weavers, knitters, and soon textile finishers and managers for the textile industry are trained here.

From this school, the Reutlingen ***Technical School for the Textile Industry*** grows until the First World War: a comprehensive textile training center, also for students of the nearby Technical University of Stuttgart. There are also plans for a research institute that is independent of teaching. However, this only became a reality after the war: On January 10, 1921, the ***German Research Institute for the Textile Industry in Reutlingen-Stuttgart*** was officially established as a foundation under public law by resolution of the State Ministry.

Almost at the same time, a state research facility specifically for viscose fibers was established in Denkendorf in the form of ***Zellwolle-Lehrspinnerei GmbH***. Here, scientists worked on establishing this new semi-synthetic fiber made from domestic raw materials in the textile industry. After World War II, activities are expanded to include all modern man-made fibers.

The Technical School for Textile Industry is integrated into the newly established Reutlingen University. The ***Institute for Textile Technology and Process Engineering*** becomes independent and expands its field of work: In addition to classical textile technology, environmental technology, medical textiles, data processing and management become important. At the same time, plans are developed for a comprehensive textile research center and Denkendorf is finally chosen as the new location.

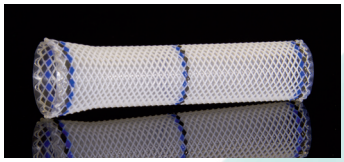
1921 1936 1937 1962 1970 1983

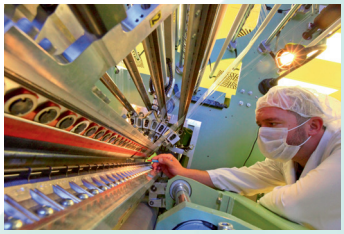
The Research Institute and the Reutlingen Technical School lay the scientific and technical foundations for the burgeoning textile industry. Increasingly, chemical issues also play a role. Since 1936, there has been a separate research department for textile chemistry.

A chair for textile chemistry is established at the TH Stuttgart and filled by the head of the ***Institute of Textile Chemistry*** of the Reutlingen Research Institute. The ***Institute for Textile Chemistry*** moved to Stuttgart-Wangen. An Institute for Man-Made Fibers was also established here in 1968.

With the completion of the new buildings in the Körschtal, the largest state textile research center in Europe is created by merging the institutes from Reutlingen and Stuttgart: ***The German Institutes of Textile and Fiber Research Denkendorf*** work on research projects along the entire value chain from raw material to product. In order to support the textile industry in its structural change, the focus is increasingly on technical textiles.

Image sources: Reutlingen City Archive, Stuttgart University Archive, Hubberten (Hundred Years of the Technical Center for the Textile Industry in Reutlingen), Eugen Wendler (original painting owned by Reutlingen University)



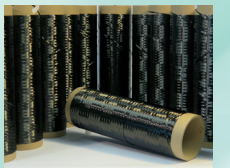


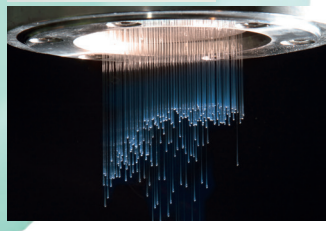
With the spin-off ***ITV Denkendorf Produktservice GmbH*** as a transfer center, the development of medical products became an important mainstay. One year later, the foundation of the ***Center for Management Research*** sets the course for digitalization and Industry 4.0.

With the ***High Performance Fiber Center (HPFC)***, the first public research and development center for high-performance fibers in Germany is opened at the DITF. High-temperature-resistant ceramic fibers and carbon fibers made from natural raw materials are major research areas.

In ***Strategy 2021***, the DITF are bringing the research areas of ***chemistry***, ***process engineering*** and ***management*** even closer together: Six ***competence centers*** for areas with thematic overlaps, four ***technology centers*** for specialized areas and a ***service center*** for testing offers create new synergy effects internally and externally.

2001 **2003** **2014** **2017** **2020** **2021**

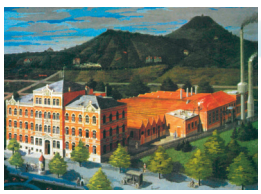




The chemical divisions are combined to form the ***Institute of Textile Chemistry and Man-Made Fibers***. Together, they set new impulses in the field of high-performance materials. The technically complex production of carbon fibers becomes a focus of research.

The DITF present a new marketing concept: Three research institutes – one brand! The new DITF logo stands for the entire research center and represents all institutes to the outside world.

The DITF host the ***ADD-ITC*** for the first time: The ***Aachen-Dresden-Denkendorf – International Textile Conference*** takes place in the Liederhalle Stuttgart congress center. Over 600 participants from 28 countries discuss current topics of the textile world during two days.



100 years of DITF: From the first beginnings in Reutlingen, an internationally recognized research center has developed. More than 250 people are active in all areas of textile and fiber research. The DITF are linked to the University of Stuttgart via three chairs. Much has changed – but basically what was laid down in 1921 in §1 of the statutes still applies: ***"The Research Institute has the task of researching textile fiber and substitute raw materials, the manufacture of textiles and textile machinery in the laboratory as well as in factory operations in close cooperation with the industries involved and to bring the results of its research to the attention of the circles involved in an appropriate manner."***

Heatable compression textiles for training and regeneration

Integration of conductive yarns in highly stretchable textile surfaces

Functional sports textiles promise improved performance. They are now not only used by professionals, but have also found their way into recreational sports. During training and subsequent regeneration, compression and warmth play an important role. As part of a research project, the DITF are developing sports textiles that combine compression with active heat using heatable yarns.

Compression textiles have been shown to stimulate tissue circulation and support lymphatic drainage. As a result, muscles are more effectively supplied and detoxified. After exercise, heat causes rapid regeneration of muscles, tendons and fascia. It increases the feeling of well-being and can even accelerate the healing process if fine tears or inflammations have occurred in the muscle during training.

Stretchable and stable: textile heating demonstrator

Mesh technology manufacturing processes have become established for compression textiles. Heatable compression textiles are developed on flat knitting machines in one piece as a "full garment" part. In this process, sensitive, stretch-resistant, conductive yarns must be integrated into highly stretchable textile surfaces. Sports textiles are exposed to great thermal, chemical and mechanical stresses. The combination of frequent washing, mechanical stress and perspiration place high demands on the material.

The project is therefore primarily investigating the wear of conductive yarns. In order for the textile to stand up to practical use and become marketable, not only the optimum yarn but also a robust textile feed concept that supplies the heating surfaces with energy is being developed. Optimized knitted bindings have the task of preventing short circuits and ensuring that the textile does not heat up locally, i.e. that no so-called "hotspots" are created. In addition to the textiles, the electronics for the energy supply are also being developed in the project. The research project is funded under the Central Innovation Program for SMEs (ZIM). Project partners are warmX from Apolda and Ingenieurbüro Günter from Esslingen.

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Honored professorship for Professor Dr. Markus Milwich

The honored professorship recognizes Prof. Dr. Markus Milwich for his special commitment and as an important partner of the Faculty of Textiles & Design at Reutlingen University. The scientist from Denkendorf has been a professor at the Faculty of Textiles & Design at Reutlingen University for the past five years as part of a "shared professorship" that is now coming to an end. Markus Milwich has already been engaged for and at the faculty for more than 20 years, initially as a lecturer. Thanks to his great commitment and his extensive network, he has been able to successfully find research partners and initiate research projects during his "shared professorship". He also forms an important link between the faculty and the DITF, to which he has now fully returned.

Due to the topicality of the subjects and the proximity to research, his lectures in the field of technical textiles are particularly popular with students. Prof. Dr. Milwich has also been involved in the teaching and research center "Interactive Materials" (IMAT) from the very beginning and was active in the study committee of the master's program "Interdisciplinary Product Development".

Prof. Dr.-Ing. Markus Milwich

The faculty, which this year has already successfully set the course for the establishment of the Texoversum, honors Milwich by awarding him the honorary professorship for his special commitment and as a continuing important partner of the faculty.

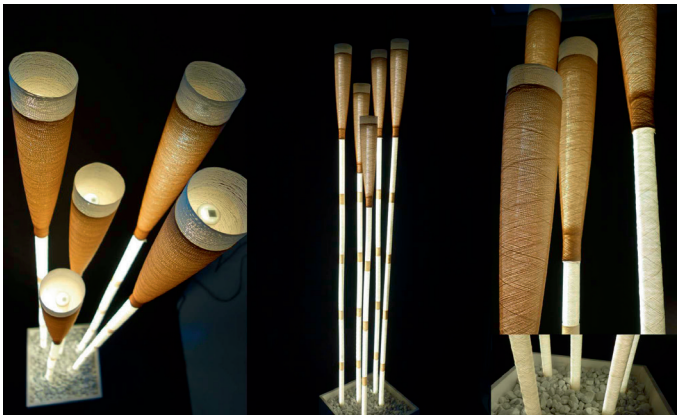
Light experiences light as paper

A feel-good atmosphere with lights made of paper yarn – ecological and sustainable

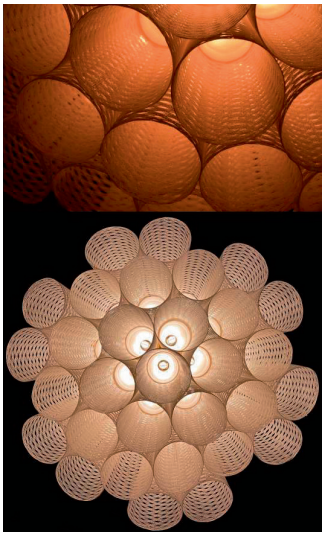
Climate protection and environmental pollution caused by microplastics call for new ideas on how to make sensible use of renewable resources. The renewable resource paper, in the form of waste paper, is also an urban raw material with established recycling processes. Together with project partners, the DITF have processed this natural material in the form of paper yarns and developed beautifully shaped lamps from it. The result of the DBU-funded research project "Paper Light" are sustainable products with an appealing design that can be produced at low cost. The lights are also recyclable.

Scientists at the DITF have processed paper yarn into very lightweight structural bodies using structural winding technology. The manufacturing process is so flexible that many different shapes are possible and the light can be directed differently depending on the application. The corresponding photometric parameters were determined at the DITF. Three-dimensional bodies are produced from the paper yarns using a novel method. The yarns are fixed with an adhesive that also consists of renewable and degradable raw materials. The basic load-bearing metal structure normally used for luminaires can be dispensed with. This has several advantages for the environment: the elimination of wire means that less carbon dioxide is produced during manufacture. In the case of the THIRTY-ONE lamp developed by the DITF, this saves more than two kilograms of CO_2 equivalents – per unit! Without a metal structure, the paper lamps also weigh significantly less and can be transported more easily. After use, the lamps can be returned to the recycling system.

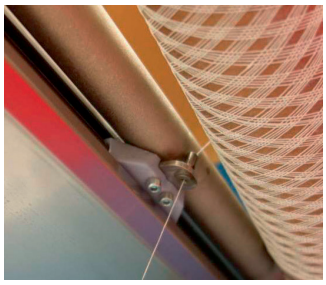
The research team has set up three demonstrator lamps that show the possibilities opened up by different yarn thicknesses, colors and the various spooled structures. In addition, the mechanical characteristic values determined already show great potential for use in other fields of application, such as structural components. Many functional samples are available at the DITF for this purpose.



Demonstrator lamp "FIVE STEMS"



Demonstrator lamp "THIRTY-ONE"



Production of a lampshade: structure winding process

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Stronger out of the crisis: Invest_BW

Sector-open, individual company support program for companies

In order to strengthen the innovative power of small and medium-sized enterprises in the crisis situation caused by the pandemic and to give a strong boost to overall economic demand, the Baden-Württemberg Ministry of Economics, Labor and Housing has launched Invest_BW, the largest open-sector investment and innovation support program for individual companies in the history of Baden-Württemberg. The goal is to keep value creation and jobs in the state. The state is making a total of 300 million euros available for this purpose from the "Future State BW – Stronger out of the Crisis" reserve. Since mid-January, applications can be submitted for the program, which is open to companies of all sizes.

Under the innovation funding program, research, development and innovation projects, including process innovations or non-technical innovations and service innovations, can be funded with a maximum grant of five million euros. Companies are eligible to apply for the "Invest BW for innovation projects" funding line, in the case of collaborative projects also together with non-profit, non-university research institutions. This is where the DITF enter the game: We would be happy to initiate a joint project with you and support you from the idea through the application phase to implementation. Please contact us!

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Strengthening the Textile 4.0 infrastructure

Digitalization, Industrial IoT and Microfactory in new premises

Digital engineering and digitally networked production are central concepts within the framework of Industry 4.0, which have been developed in recent years at the Center for Management Research for the textile and apparel industry and have also been realized in exemplary fashion at leading trade fairs. The new opportunities this offers are leading to a change in the strategy discussion worldwide with a focus on nearshoring, regional production and digitally networked supply chains.
Thanks to funding from futureTEX in the BMBF's "Twenty20 – Partnership for Innovation" program, a permanent realization of a Textile 4.0 multifunctional laboratory at the DITF is now possible. In addition to the microfactory approach, many research topics related to digitalization will find their place in this modern, flexible laboratory environment.

Funding program futureTEX

In this program, futureTEX is an interdisciplinary competence network of industry and research partners from the textile sector. It supports the transformation of the tradition-rich textile sector in the age of digitalization into a sustainable industrial player – with technical textiles (TechTex) as its basis.
An important element of this strategy is the establishment and expansion of a sustainable research network with leading institutes in the textile industry. To make this possible, the DITF provided approx. 160 m² of laboratory space, which was equipped with a completely new infrastructure as part of an investment project for the new use. Investments of approximately 500,000 euros were made available in this program to secure the Textile 4.0 infrastructure for the focus area "end-to-end digital engineering" at the DITF.

End-to-end digital engineering

The establishment of the multifunctional laboratory and the integration of the five focus areas (see separate box) enable the DITF to work on central research topics of the future together with partners. The DITF's focus on end-to-end digital engineering for individualized products in microfactories and agile manufacturing systems is the result of many years of successful research and development partnerships. This unique position is also reflected in the Mittelstand 4.0 competence center Textil vernetzt outside the futureTEX network, in which research institutes of this network are also involved.

New Textile 4.0 multifunction lab at the DITF

Industry-focused solutions

The new multifunctional laboratory will enable the DITF to work on an even broader range of research and implementation priorities in cooperation with manufacturing companies to meet the increasing demand of consumers for products that can be individually designed. The aim here is to use industry-focused solutions to master the complexity in horizontal and vertical textile value chains, which is determined by short product life cycles, small batch sizes and a simultaneous increase in the number of variants.

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Central research and action fields in the Textile 4.0 Multifunctional Lab @ DITF:

1. End-to-end engineering in "scan-to-factory processes" through
   a. Extension of the manufacturing infrastructure
   b. Connection to service platforms
   c. Automation with the help of object recognition
2. Systems for human-machine interaction for the design, implementation and validation of collaboration systems and safety concepts
3. Computing, sensor and actuator infrastructure in agile lab environment for Big Data approaches and cloud computing for machine learning as well as integration of cloud applications
4. KNX building automation with interface to process automation for close integration of the environment with the building and production processes
5. Digitalization of material characterization and laboratory processes in the environment of end-to-end digital engineering to enable digital twins and thus purely virtual development processes coupled with real production processes.

HEREWEAR Project

Bio-based, local and recyclable textiles

The DITF are partners in the recently launched EU Horizon 2020 project HEREWEAR. Within this innovation project, the DITF as part of a European consortium – coordinated by Centexbel – aim to develop bio-based circular textiles.

The HEREWEAR project aims to create a European circular economy for locally produced textiles and clothing from bio-based resources. This will be realized through a holistic approach covering all necessary levels: on the technical side, new sustainable technologies for wet and melt spinning of cellulose and bio-based polyesters, for yarn and fabric production as well as for coating and dyeing will be developed and tested on a semi-industrial scale. Furthermore, the aim is to significantly reduce microfiber release during washing and wearing through measures along the textile manufacturing process.

In addition, HEREWEAR is testing the maximization of sustainability and recyclability of the produced clothing through regional value-added structures by means of networked production resources in microfactories. Elemental to this is digital consistency and transparency for traceability, as well as a consistent focus on "on demand" production. Additionally, guidelines are provided with which fashion articles can be designed and developed to be recyclable. The focus here is on bio-based materials and reuse/recycling. The participating apparel companies will demonstrate this as an example for streetwear and corporate clothing.

HEREWEAR: Holistic approach to establishing an EU market for locally produced textiles from locally sourced bio-based materials

The DITF are responsible for wet spinning cellulose filaments from bio-based waste streams and marine debris using their patented HighPerCell® technology, and for establishing the textile circular economy based on the DITF Digital Textile Microfactory structure for new local/regional circular value creation. The HEREWEAR consortium is strongly SME-driven and includes 8 SMEs and 1 large company. These are complemented by 6 research institutions. HEREWEAR is co-funded by the European Union.

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DITF receive IFAI Expo Show Stopper Award

Award for UV-curable polymers for use in composite systems

IFAI EXPO is one of the most important leading trade shows for technical textiles and intelligent materials. For almost 100 years, the show has been an important marketplace for renowned manufacturers of specialty textiles for technical applications. The "Industrial Fabrics Association International" is both name giver and organizer of the fair. This year, due to the restrictions caused by the Corona pandemic, the fair was held as a "virtual event" in the form of an online-only event. As part of the event, a "Show Stopper Award" was presented to the best products from various categories. Dr. Reinhold Schneider's research group was successful with the presentation of its newly developed UV-curable polymer systems for fiber composites: the product received the show stopper award in the "Chemicals, Coatings and Compounds" category.

UV-curable polymers are a novelty in the field of fiber-reinforced composites. The use of such matrix materials helps to reduce energy costs and cycle times in production. The low equipment requirements of a UV-fixing unit also make the novel matrix polymers economically attractive for manufacturers of small batches.

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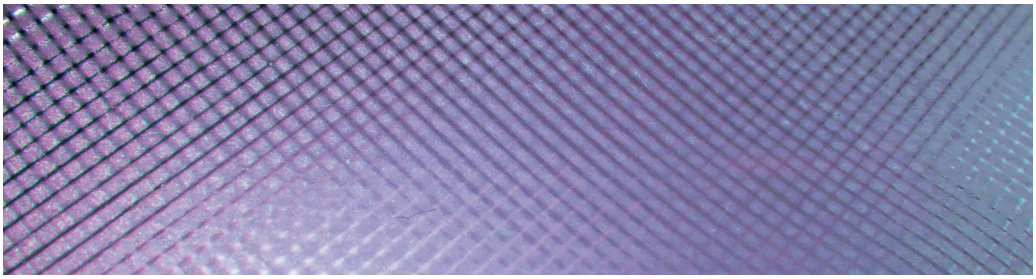
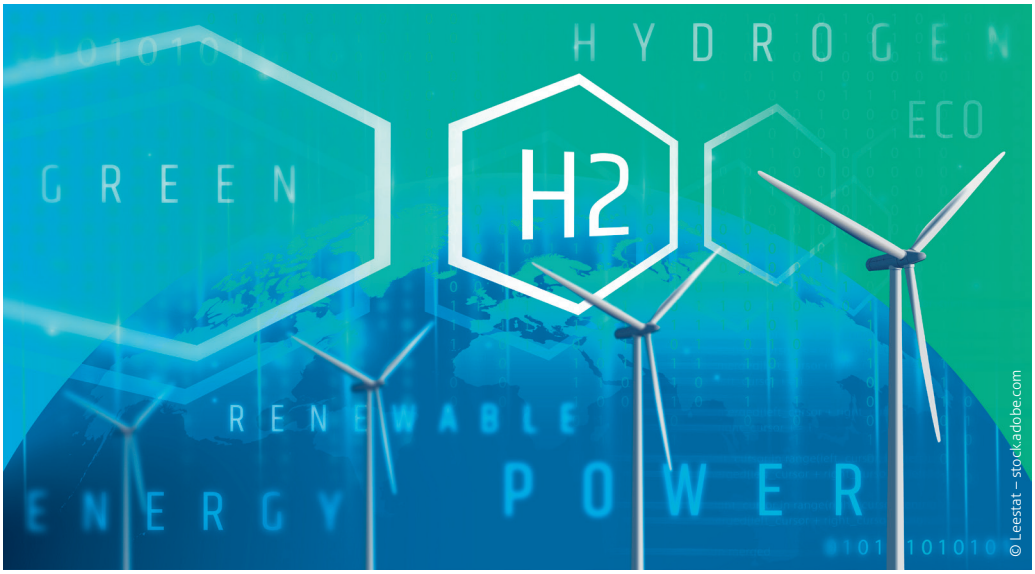


Glass fiber reinforced composite with UV-curable polymers

Electrolysis made in Baden-Württemberg

DITF develop technology for new, reinforced membranes for electrolysers



Solar energy and other renewable energy types are representative of the energy turnaround in Germany. Water electrolysis is a key technology to support the energy turnaround in the storage of generated energy – a known weak point of regenerative energy production. Hydrogen is a secondary energy carrier that enables efficient energy storage due to its high energy density. Therefore, water electrolysis can make a decisive contribution to climate neutrality.

Hydrogen is a clean energy carrier. When converted to electricity in a fuel cell, it is characterized by a very high energy yield. Hydrogen is also transportable and can therefore be used locally by consumers. Hydrogen technology is particularly important for energy-intensive industries such as steel production or in the operation of refineries. But hydrogen is also very popular for modern mobility solutions: as a transportable energy carrier that is also locally emission-free.

Construction of a modern electrolyzer

In the joint research project "Electrolysis made in Baden-Württemberg", the DITF are participating in the construction of a state-of-the-art electrolyzer for alkaline water electrolysis, which will serve to transfer technology to industry. The project is coordinated by the Center for Solar Energy and Hydrogen Research (ZSW), which will build the demonstrator with an electrical output of one megawatt. The task of the DITF is to develop and manufacture fleece-reinforced membranes for the electrolysis cell.

Water electrolysis is an electrochemical process with the aim of extracting hydrogen from water. In an electrolysis cell, water is split electrochemically, releasing gaseous hydrogen at a cathode and oxygen at an anode. The anode and cathode are separated by a membrane. The passage of current is not interrupted by the membrane. Depending on the design of the electrolytic cell, the ionic conductivity of the membrane allows the exchange of ions. The membrane is gas-tight and thus prevents the mixing of the gases produced at the anode and cathode.

Membranes of this type are already in widespread use, but they usually have a relatively high ohmic resistance due to their material thickness. A correspondingly higher energy input is required for electrolysis. Thin and highly efficient membranes with better electrochemical properties, on the other hand, have so far not been robust enough, especially when used in larger cells. They are sensitive to mechanical stress and are prone to stress cracking.

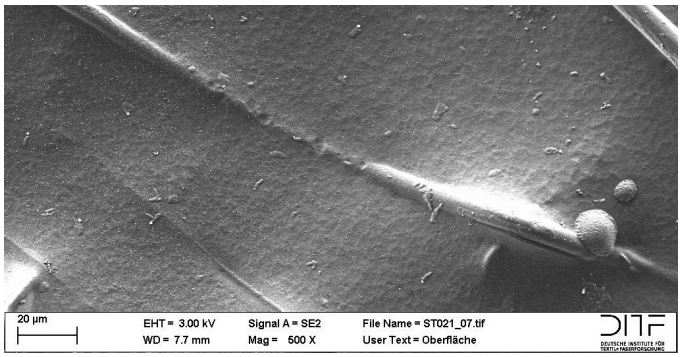
Reinforced membranes from the DITF

As part of the research project, membranes made of polymers are being produced at the DITF that are modified and thus precisely tailored to their task. The membranes exhibit excellent electrochemical properties. They are chemically stable in an alkaline environment, i.e. under the conditions that prevail inside the electrolytic cell. The membranes also exhibit good long-term stability. This means that they work almost faultlessly even under continuous stress. The membranes are inexpensive to manufacture and use.

The mechanical stability of the membrane is a central point in the development. On the one hand, the membrane should be as thin as possible in order to work highly efficiently. On the other hand, it should not fall below a certain thickness in order to ensure mechanical load capacity. The mechanical load cannot be avoided, because during block assembly the membranes are pressed against the mostly porous, structured surfaces of the electrodes in the block.

Project information – at a glance

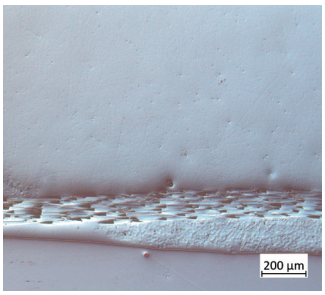
Under the slogan "Electrolysis made in Baden-Württemberg", the Baden-Württemberg Ministry of Economics, Labor and Housing is funding a collaborative research project with five million euros. The project is led by the Center for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW). In addition to the DITF Denkendorf, the German Aerospace Center (DLR) and Hahn-Schickard Society for Applied Research (HS) in Stuttgart are also partners in the project. The aim is to develop a modern, highly efficient water electrolysis plant that will serve as a demonstrator for technology transfer. The technology is intended to help plant engineers and component manufacturers position themselves advantageously in international competition. Specialist companies will be involved in the development project from the outset. The project sees itself as an initiator for state-of-the-art electrolysis production in Baden-Württemberg.



Scanning electron micrograph of the membrane

To mitigate this difficult situation, researchers at the DITF are taking a special approach: The membranes can be mechanically reinforced by using nonwovens made of ultra-fine fibers (fiber diameter 0.2 - 2 µm). The development of suitable nonwovens, their structural design and the choice of their chemical composition are just as great a challenge as the manufacture of the membranes. A specially developed integrated reinforcement frame made of composite materials also absorbs mechanical pressure loads and provides additional protection for the membrane. In addition to pure mechanical stabilization, it will be possible to use the nonwovens to reduce the passage of hydrogen through the membrane. The interface between the membrane and the nonwoven has a special significance in the structure of this composite: the electrical contact resistance must be kept low here in order not to impair the efficiency of the cell. This can be influenced by the choice of material for nonwoven fabrication or by surface treatment of the nonwoven. In this way, the electronic properties but also the fiber-matrix (or fiber-membrane) adhesion, which is crucial for increasing stability, are ensured and further developed.

Bringing together such different materials as an electrochemical membrane and a textile nonwoven is a very challenging undertaking. This makes the first promising laboratory results all the more impressive. The first nonwoven-reinforced membranes are available and are being tested for their practical suitability. The next step will be to optimize the structure of the membranes. At a later date, they will then do their job - for the time being within the demonstrator, which will set the state of the art in this joint project.



Microscopic cross-section of glass fiber reinforced composite after UV curing

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OxiCer – a network around fiber ceramics

ZIM Zentrales Innovationsprogramm Mittelstand
Gefördert durch: Bundesministerium für Wirtschaft und Energie aufgrund eines Beschlusses des Deutschen Bundestages

Development of high-temperature-resistant, fiber-reinforced oxide ceramics

The network "Development of an innovative large-scale technology for fiber-reinforced oxide ceramic composites" (OxiCer) was launched in 2020. Three research facilities, 13 small and medium-sized enterprises and 5 associated network partners have joined forces in this network to jointly advance the development of high-temperature-resistant, fiber-reinforced oxide ceramics. The DITF Denkendorf are also involved:

"By participating in the network, we expect to gain a solid, scientific exchange with other research institutions and companies," explains Dr. Bernd Clauß, who has led ceramic fiber development at the DITF for decades. The common goal of the network, he says, is to smooth the way from basic research to large-scale production and the marketing of technical products. "The possibility of translating our research results into high-quality products is a great motivation for our work," says Dr. Clauß. Efficient and resource-saving manufacturing technologies are intended to create the conditions for production suitable for series production.

The DITF are focusing on the development of oxide ceramic fibers based on mullite and corundum. When further processed into fiber-ceramic components, they provide excellent high-temperature resistance. These special materials are characterized by high fracture strength even under strong mechanical stress and abrupt temperature changes.

The network is funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) as part of the Central Innovation Program for SMEs (ZIM). The network is coordinated by scientists from the Chair of Lightweight Structures and Plastics Processing (SLK) at Chemnitz University of Technology. The project sponsor is VDI/VDE Innovation + Technik GmbH. Currently, the application of the network is in a second phase.

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Burner nozzle made of DITF ceramic fibers "OxCeFi", manufactured by E.C. Pritzkow Spezialkeramik in Filderstadt, Germany

DITF start research projects in hardwood pilot plant

Cooperation agreement signed with Baden-Württemberg Ministry of Agriculture

Baden-Württemberg's Minister for Rural Areas and Consumer Protection, Peter Hauk, signed a cooperation agreement with DITF Denkendorf on February 8, 2021. This marks the start of two research projects that the DITF will work on in the Hardwood Technical Center created by the state. The newly established research center will develop innovative products and processes based on hardwood, loose and lignin fibers for technical applications.

Wood pulp dissolved in ionic liquid

Fiber composites with carbon fibers are used in energy-saving, lightweight vehicles because they are heat-resistant and resilient. Materials reinforced with carbon fibers are becoming increasingly important not only in vehicle construction and aerospace, but also in construction and many other industries. However, carbon fibers are currently still very expensive. To date, these fibers have been produced primarily from polyacrylonitrile. This starting material is based on petroleum, and the production of carbon fibers from this precursor produces toxic by-products that have to be purified at great expense. A switch to cellulose and lignin fibers as feedstock eliminates these disadvantages. Costs are saved and the environment is protected at the same time.

The Hardwood Technical Center links eight research teams from different institutes and serves as an interface to industry. Other research projects deal with the development of new processes for the production of biosurfactants and vegan food proteins based on wood.

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DITF honored with Baden-Württemberg Bioeconomy Innovation Award

The DITF are one of the five winners of the "Bioeconomy Ideas Competition – Innovations for Rural Areas", which was announced for the first time by the Ministry of Agriculture and Consumer Protection Baden-Württemberg. Awards were given for contributions to climate protection, resource efficiency, protection of the environment and biodiversity, and rural development. On November 25, 2020, the prize was presented by Ministerial Director Grit Puchan during the 5th Bioeconomy Day. The DITF received the award for their research on sustainable carbon fibers (see above report on the Hardwood Center).

The pitch presentation of Dr. Frank Hermanutz and Dr. Antje Ota also received the audience award of the event.

AACHEN DRESDEN DENKENDORF
INTERNATIONAL **TEXTILE** CONFERENCE

ADD International Textile Conference 2021

The Aachen-Dresden-Denkendorf International Textile Conference, initially planned for 2020 in Stuttgart, will now take place on November 9-10, 2021. With four parallel lecture sessions, the conference will focus on current research projects and developments of industrial relevance. Experts from the fields of textile chemistry, finishing and functionalization, textile mechanical engineering, processes and composites will speak on products, technologies and processes in the application fields of medical technology, textile construction, mobility, energy and the environment, among others. This year's conference is organized by the DITF.

Anwenderforum
SMART TEXTILES

9th SMART TEXTILES User Forum

The forum will take place as an online event on March 24 and 25, 2021. This year, the topics "Smart clothing and accessories" and "Technologies/smart ideas for automotive" are on the agenda. With 3-hour sessions each over two days, "Innovative Products with Smart Functions" will be presented. Adapted to the online format, film contributions, showroom presentations and product presentations will complement the agenda. In addition, a panel discussion with industry representatives will take place online. In addition to the DITF, the organizers of the forum are the Research Curatorium Textile e.V. and the Textile Research Institute Thuringia Vogtland e.V..

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