

Starting signal for DATIpilot

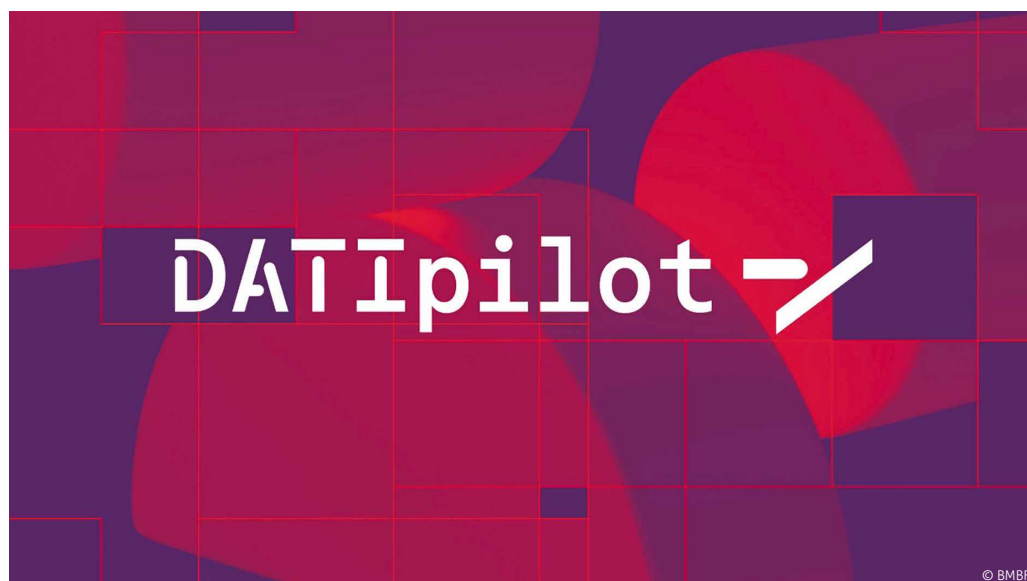
DITF focus on projects in the DATI experimental space

On July 7, 2023, the go-ahead was given for the DATIpilot funding guideline. The BMBF is thus focusing on ideas and research achievements as solutions to social challenges and is driving the transfer of knowledge into application. The new program includes two modules with different focuses: "innovation sprints" with a maximum duration of 18 months promote concrete transfer ideas and the short-term transfer of

creates a learning space for all participants and is used for the conception of the DATI (German Agency for Transfer and Innovation). It goes without saying that the DITF want to be part of this.

The DITF submitted 6 project proposals for the innovation sprints, for which there were a total of 3,000 applications across Germany. Two of them cleared the first hurdle and will be presented at the pitch for

In the application for the innovation communities, the DITF focused on the recycling and circular economy of textiles. Only 1% of all used textiles and textile production waste are recycled back into textiles. 99% is landfilled or incinerated. There is an urgent need for action here, which the project idea of an innovation community Circular Textile Valley addresses with various approaches. For example, cross-cycling



DATIpilot – New BMBF funding guideline focuses on innovation and the transfer of knowledge into application

research results into concrete application possibilities. Over a period of four years, "innovation communities" promote the independent development of an innovation topic and objective and the partnerships required for successful transfer. The DITF participated with great commitment in the tenders for the two modules. The DATIpilot

the final selection in February 2024. They include two textile transfer ideas for important future fields:

- > Transformation of a coating process for the production of electrically conductive natural fibers
- > Bio-inspired, reactive, regulating, resilient – actively cooling electronic textiles

is to be used to recycle textiles and fibers for high-quality components and applications in other industries. Cotton fibers, such as those contained in jeans, could then be reused in the future for fiber-based lightweight components in the automotive industry. Feedback on this application is not expected until 2024.

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Gips-Schüle Special Research Prize

Dr. Antje Ota and the team from the DITF Competence Center for Biopolymer Materials were awarded the Gips-Schüle Special Research Prize at the end of October. The prize, endowed with 15,000 euros, honors their research into the production of cellulose filaments from alternative raw materials. Read more on page 6/7.



Prize winner Dr. Antje Ota

Bio-based coating for geotextiles

Lignin coating makes geotextiles made from natural fibers durable

Textiles are a matter of course in civil engineering: they stabilize water protection dams, prevent polluted wastewater from flowing away from landfills, facilitate the greening of slopes at risk of erosion and even make asphalt layers of roads thinner. Until now, textiles made of highly resistant synthetic fibers have been used for this purpose, which are very durable. For some applications, however, it would not only be sufficient but even desirable for the auxiliary textile to degrade in the soil once it has done its job. Environmentally friendly natural fibers, on the other hand, often decompose too quickly. The DITF are developing a bio-based protective coating that extends their service life.

Depending on humidity and temperature, natural fiber materials can decompose in the soil in a few months or even



Cellulose-based nonwoven fabric is coated with the melted lignin compound as a protective layer against degradation in the soil

a few days. The DITF are researching a protective coating to significantly extend the degradation time so that natural fiber materials can also be used for geotextiles. Based on lignin, this is itself biodegradable and does not produce microplastics in the soil. At the same time, however, lignin takes a very long time to degrade in nature. Together with cellulose, lignin forms the building materials for wood and is the "glue" in wood that holds this composite material together. In paper production, only the cellulose is generally used, so that lignin is produced in large quantities as waste material. So-called kraft

lignin remains as a meltable substance. Textile production can handle thermoplastic materials well. All in all, this is a good basis for taking a closer look at lignin as a protective coating for geotextiles.

Lignin is naturally brittle. It is therefore necessary to mix the kraft lignin with softer biomaterials. In the research project, these new biopolymer compounds made from brittle kraft lignin and softer biopolymers were applied to yarns and textile surfaces using adapted coating systems. For example, cotton yarns were coated with lignin in different application quantities and evaluated. The

biodegradation test was carried out using soil burial tests both in a climate chamber with temperature and humidity precisely defined according to the standard and outdoors under real environmental conditions. The results were positive: the service life of textiles made from natural fibers can be extended many times over with a lignin coating: The thicker the protective coating, the longer the protection lasts. In the outdoor tests, the lignin coating was still completely intact even after around 160 days of exposure.

Textile materials coated with lignin have an adjustable and sufficiently long service life for certain geotextile applications. They can replace previously used synthetic materials in numerous applications, such as the greening of ditch and stream banks. They therefore have the potential to significantly reduce the CO₂ footprint: They reduce dependence on petroleum-based products and avoid the formation of microplastics in the soil. Further research is needed to establish the existing waste material lignin as a new recyclable material in industrial manufacturing processes in the textile industry.

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Cotton yarns: brown with lignin coating as a protective layer against degradation in the soil and white reference yarn without coating

100 percent recycling of used textiles

The right process for every material to produce high-quality yarn

Sustainability was the main theme of this year's ITMA textile machinery trade fair. And so almost all the companies in Milan showcased new technol-

ogies for textile recycling. However, it is challenging to obtain high-quality yarns from used textiles and process them into equally high-quality products.

The right technological solutions are not yet available for all challenges. Ultimately, it is a question of finding the right processes for each material. The

DITF and the Sächsisches Textilforschungsinstitut e.V. (STFI) have developed a new test routine for this purpose.

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The recycling process begins with mechanical tearing, in which the used textiles are shredded. In most cases, the procedure damages the fibers. Individual fibers end up too short, which makes the subsequent spinning process more difficult. In order to be able to optimally adjust the shredding machines, the fibers must be classified after shredding. The researchers have developed a new test routine for this purpose.

The fiber length is the most important parameter for the further processing of the fibers and for the quality of the finished yarn made from recycled fibers. Pieces of yarn that are still in the torn material are always longer than the fibers themselves and therefore falsify the fiber length measurement. With the help of the new test method, pieces of yarn still present can be opened up with virtually no further shorten-



*Used textiles after the tearing process.
Back: Cotton, front: Aramid*

ing of the fibers. This makes it possible to precisely measure the fiber length distribution of the torn recycled material and the tearing parameters can be better adapted to the material. As a result, the fibers are shortened less during the tearing process. Higher quality yarns can be produced. Based on the characteristics of the optimum recycled material, the suitable recycled product can be found for spinning and the optimum setting and suitable spinning



Yarn and knitted fabric made from 100 percent recycled aramid

components can be found for the spinning process.

The recycled materials can be processed into ring and rotor yarns. In practice, ring yarn is best produced using the compact spinning process. This allows the already short recycled fibers to be compacted much better and the yarn gains strength.

Thanks to the new test routine, yarns can be produced from 100 percent recycled aramid fibers without admixture and

then processed into knitted fabrics. As aramid fibers are very expensive, the process reduces costs, saves raw materials and contributes to greater sustainability. In the project, cotton fibers were also spun in a mixture of 80 percent good fibers and 20 percent recycled material. In the meantime, the proportion of recycled cotton has been increased to up to 70 percent.

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Rain-retaining Living Wall

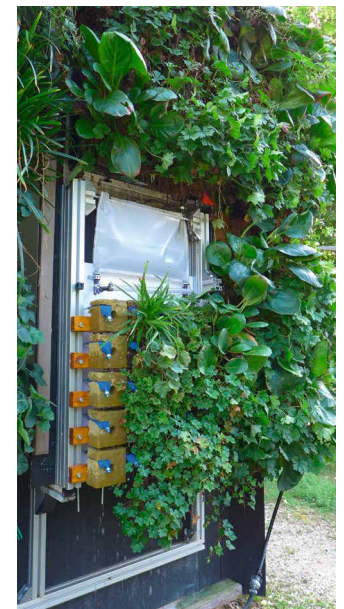
Flood protection through textile storage structures

Climate change is causing temperatures to rise and storms to increase. Summers are becoming a burden for people, especially in city centers. Densification makes use of existing infrastructure and avoids urban sprawl, but at the same time the proportion of sealed surfaces is increasing. This has a negative impact on the environment and climate. Green facades bring more greenery into cities. If textile storage structures are used, they can even actively contribute to flood protection. The DITF have developed a corresponding "Living Wall" in which the plants on the green façades are supplied with water and nutrients via an automatic irrigation system. The "Living

Walls" thus work largely autonomously. Sensory yarns record the water and nutrient content. The care and maintenance requirements are low. The water supply to the "Living Walls" is regulated by innovative hydraulic textile structures. The rock wool plant substrate on which the plants grow has a large volume in a small space thanks to its structure. Depending on the amount of precipitation, the rainwater is stored in a textile structure and later used to irrigate the plants. Before heavy rainfall, the water stored in the rock wool can be actively fed into the drainage system so that more water can be absorbed during the heavy rainfall. In this way, the developed

"Living Walls" help to make efficient use of water resources in densely populated areas.

During development, the cooling capacity of green façades was also scientifically investigated. Modern textile technology supplements the transpiration of the plants. This creates evaporative cooling and lowers the temperatures in the surrounding area. The research team also carried out a cost-benefit analysis and a life cycle analysis. Based on the investigations in the laboratory and outdoors, a "green value" was defined, which can be used to evaluate and compare the effect of building greening as a whole.



Outdoor demonstrator on the ForschungsKUBUS. At the top is the textile water tank with all inputs and outputs and a textile valve for quick emptying. Below this are the substrate blocks with integrated hydraulic textiles

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New test method for cleanroom garments

Determination of the bacterial penetration under realistic conditions

At the DITF, a new biological test method has been added to the range of tests for cleanroom garments: the **Realistic Bacterial Barrier** (ReBa²) test method, which was developed in collaboration with Dastex Reinraumzubehör GmbH & Co. KG. Particularly in the manufacture of sterile pharmaceuticals in cleanrooms, but also in other life science areas, bacteria, skin flakes and fiber particles that can be emitted from people and their clothing pose a risk to the products manufactured in the cleanroom. Cleanroom garments have the task of minimizing this risk. To assess the barrier function of cleanroom garments, the "bacterial penetration" through the cleanroom garment textile is determined, among other things. The test methods used up to now have not been able to convincingly answer the question of realistic test conditions: How many bacteria from the human



ReBa² testing device for determining the bacterial penetration of cleanroom garment textiles

skin flora pass through the cleanroom garments to the outside when they are worn? The new ReBa² test method largely reproduces this situation, en-

abling a meaningful determination of the bacterial penetration under realistic conditions. The mechanical stress under movement, with a freely select-

able load duration and with moderate moisture in the test system can be carried out in numerous test scenarios. In addition to the influence of intermediate garments worn under the cleanroom garments, the sweating process or wetting of the cleanroom garments by process media or disinfectants can also be examined. One of the most common bacteria of the skin flora – *Staphylococcus epidermidis* – is used as a test strain with a realistic load (inoculum).

The test is carried out in the Biological Test Laboratory at the DITF Denkendorf and supplements the range of testing and development services for cleanroom textiles.

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Soccer sock with all-round protection

Mechanical absorber structures and protectors protect against injuries

In Germany, most sports accidents happen in soccer. The lower leg and ankle are particularly affected. Current shin guards are limited to protecting the shin. The ankle receives little, if any, protection.

In a ZIM project together with WWS Ideen aus PU GmbH, the DITF have developed a soccer sock that can prevent or significantly mitigate 80 percent of previous injuries in the lower leg area. New mechanical principles are used to effectively dissipate force impulses. Mechanical absorber structures for the shin and calf as well as

protectors to protect the ankle and Achilles tendon have been

integrated into the basic textile structure.



DITF development: soccer sock with mechanical absorber structures for the shin and calf as well as protectors to protect the ankle and Achilles tendon

The integral overall stocking structure is part of the force management system. It is designed in such a way that the specific functional elements do not shift or twist during running and normal ball contact. In this way, the lower leg is optimally protected. The soccer sock is currently being tested in the Regionalliga Südwest.

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Airflow ring: innovation for the operating theater

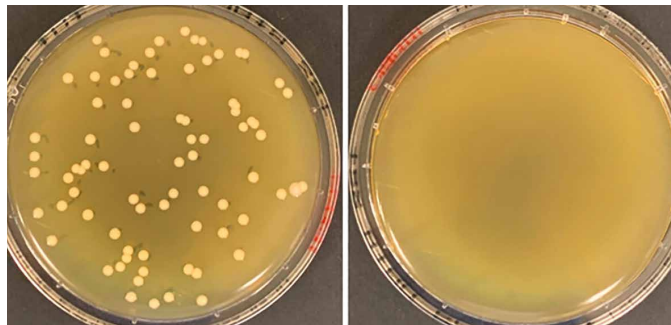
Pleated textile hose for the ventilation of surgical fields

Nosocomial infections, also known as hospital-acquired infections, are caused by microbial contamination of surgical wounds and can lead to serious complications. On behalf of Wandres GmbH micro-cleaning, the Technology Center Bio-medical Engineering at the DITF developed an airflow ring that reduces the risk of contamination. Germ-free air is introduced into the operating field via the ring and pathogenic germs are shielded at the same time.

The tube is knitted from polyester and pleated. This pleating ensures that the circular shape remains stable, but the tube is still flexible. The outside of the tube is coated so that the air is directed into the inner area of the airflow ring. The ring is attached to the skin with a bio-



Airflow ring attached to the skin around the eye



Germination tests with colony-forming germs: left unventilated, right ventilated

compatible adhesive so that it fits tightly even on curved parts of the body such as the face or around joints. The position of the ring can be easily changed. The effectiveness of the Airflow ring has been successfully proven in tests with a high concentration of nebulized colony-forming bacteria. The tests showed that the ring can also withstand significantly worse conditions than in an operating room, for example in doctors' surgeries and in situations with lower hygiene standards.

The DITF presented the Airflow ring at the MEDICA medical technology trade fair in Düsseldorf, at the joint Baden-Württemberg International stand.

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AiF project Retrofit

Development of a thread tension sensor for real-time monitoring

As part of the Retrofit Sensor research project, the DITF have developed a new capacitive force sensor for 3D weaving machines in collaboration with Hahn-Schickard. This type of sensor can be used to determine tensile forces on individual yarns in order to draw conclusions about the quality of the processes and gain basic knowledge for digital engineering. The measuring principle of the sensor is based on a three-point support of the yarn. The compact design of the capacitive measuring sensor enables the parallel measurement of a large number of yarns in real time. An AI-based evaluation module performs real-time analysis of the yarn tensions during the production process,

even with electrically conductive fibers. This ensures efficient production to the highest quality standards.

Applications can be found wherever precise quality data is required in real time, for ex-

ample in warp production, 3D fabrics for the aerospace industry, silk fabrics, etc. The retrofit components can be retrofitted into existing systems. The yarn tension sensor was presented to a wide audience for the first

time at the ITMA in Milan and met with great interest in the industry.

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Structure of the thread tension sensor

Chemical protection suit with more comfort

Everything new: material, design, workmanship

Chemical protection suits (CSA) protect people from physical contact with chemical, biological or radioactive substances. CSAs consist of breathing apparatus, head protection, carrying frames and the suit itself. This adds up to a weight of around 25 kilograms. The multi-coated fabric structure makes the CSA rigid and considerably restricts freedom of movement.

In a BMBF joint project together with various companies, institutes and professional fire departments, the DITF worked on completely redesigning both the textile material composite and the hard components and connecting elements between the two. The aim was a so-called "AgiCSA", which offers significantly more comfort for the emergency services due to its lighter and more flexible construction. The DITF sub-project focused on the one hand on the development of a suit that can be individually adjusted to fit the body and on the other hand on the integration of sensors that serve to monitor important bodily functions of the emergency personnel online.

Using a standard CSA suit, the DITF investigated where there was a need for optimization to improve ergonomic wearing comfort. It quickly became clear that it was necessary to move away from the previous concept of using woven fabrics as the basic textile material and think in terms of elastic knitted fabrics. In implementing this idea, the researchers were aided by recent developments in the field of knitted mesh technology in the form of spacer fabrics. By using spacer textiles, many of the requirements placed on the base substrate can be met very well.

Spacer textiles have a voluminous, elastic structure. A 3 mm thick spacer textile made of a polyester pile thread and a flame-retardant fiber blend of aramid and viscose was selected for the new CSA from a wide range of usable fiber types and three-dimensional design features. This textile is coated on both sides with fluorine or butyl rubber. This gives the textile a barrier function that prevents the penetration of toxic liquids and gases. The coating



New chemical protection suit from the "AgiCSA" project

is applied to the finished suit using a newly developed spraying process. The advantage of this process over the conventional coating process is that the desired elasticity of the suit is retained.

Another new feature is the integration of an angled zipper. This makes it easier to put on and take off the protective suit. While this was previously only possible with the help of another person, the new suit

can in principle be put on by the firefighter alone. The new design is based on modern dry suits with a diagonal, gas-tight zipper.

The new AgiCSA also has integrated sensors that allow the transmission and monitoring of the emergency worker's vital and environmental data as well as their location via GPS data. These additional functions significantly support operational safety. For the hard components, i.e. the helmet and the backpack for the compressed air supply, lightweight, carbon fiber-reinforced composite materials from Wings and More GmbH & Co. KG are used.

The first demonstrators are available and can be used by the project partners for testing purposes. The combination of current textile technology, lightweight construction concepts and IT integration in textiles has led to a comprehensive improvement of a highly technologized product in this project.

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Gips-Schüle Prize awarded to Dr. Antje Ota

Prize-winning production of cellulose filaments from alternative raw materials

Dr. Antje Ota, Deputy Head of the Competence Center Biopolymer Materials at the DITF, received the Gips-Schüle Special Research Prize in October. The prize is endowed with 15,000 euros and recognizes projects with particular social relevance. Dr. Ota and the team from the Biopolymer Materials Competence Centre were awarded the prize for their research into the production of

cellulose filaments from alternative raw materials. Together with the French start-up RBX Créations, Antje Ota investigated the use of hemp residues to produce high-quality textile products. The hemp stalks are used alone or in combination with flax by-products to produce cellulose. Based on a patented ecological process, RBX Créations has developed a hemp pulp with high purity and

excellent properties. The pulp has a lower CO₂ footprint than kraft wood pulp. For the DITF, this pulp is the starting material for the production of cellulose filaments using an innovative, patented process (HighPerCell®). Dr. Ota's team developed this environmentally friendly and novel spinning process based on 20 years of research expertise.

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Dr. Antje Ota is researching the use of hemp for the production of high-quality textile products

It is based on dissolving the starting material in ionic liquids and then spinning it into filaments in a special wet spinning process. The solvent is non-toxic and environmentally friendly. It can be almost completely recovered. This means that no chemicals that are harmful to the environment or health are released during the process. The hemp material used also comes from ecological and sustainable cultivation. The hemp-based cellulose filaments are also interesting for technical applications due to their properties such as high



Winners of the Special Research Award: Dr. Antje Ota (center), Prof. Dr. Michael Buchmeiser (Chairman of the DITF Board of Directors, 5th from left), Dr. Frank Hermanutz (Head of the Competence Center Biopolymer Materials, 7th from left) and the team. Left: Dr. Stefan Hofmann Chairman of the Gips-Schüle Foundation and Supervisory Board member Prof. Dr. Peter Frankenberg.

Gips-Schüle-Stiftung

The Gips-Schüle-Stiftung was founded in 1965 by the descendants of the Schüle family, who had successfully mined gypsum in Stuttgart for over 100 years. The Gips-Schüle Foundation supports research projects at universities and research institutions in Baden-Württemberg with the aim of promoting economic and social progress that contributes to the common good and is sustainable. It also awards the Gips-Schüle Research Prize and the Special Research Prize for Social Innovation every two years.

tensile strength and their elasticity and elongation characteristics. The particular social relevance of the research project arises from the sustainable production of textile products based on natural raw materials. In the long term, the consumption of primary raw materials

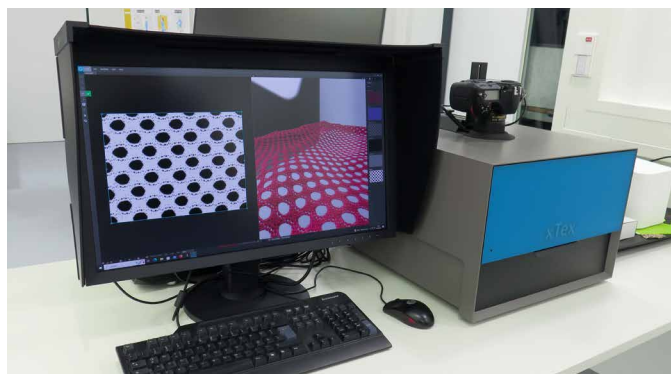
can be reduced and the preservation of forests ensured. In addition, the HighPerCell® technology is recyclable and cellulose materials can be returned to the product cycle.

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Artificial intelligence in image analysis

Digitization workshop at the DITF

A workshop on "AI in image analysis" was held at the DITF in the "Digitalization" area. AI has already been used to solve image analysis problems in many research projects. For example, in the ongoing "TexScan" project, in which a wide range of data is being collected on unknown fabrics in order to optimize automatic process control in textile finishing. This data also includes extensive image analysis information captured by a textile scanner. Another project is dedicated to the quality control of textile knitwear on knitting machines. What is new here is that the use of image analysis means that irregularities in the knitted fabric can be detected during the manufacturing process and not, as was previously the case, in a subsequent quality check. This



Vizoo textile scanner for visualizing textile surfaces

enables the process to be readjusted at an early stage. Other topics at the workshop included the classification of shoe shapes using image analysis, the quantification of shear distortion in glass fiber fabrics and the problems arising from the image analysis of microscopic images in fiber and textile testing. What they all have in com-

mon is that in order to improve product and manufacturing processes using AI, large amounts of data must be collected and linked together. There is a consensus among the workshop participants that material development will increasingly take place virtually in the future and that the laboratory component of development will decline.

In order to drive forward the expansion of AI in as many DITF research fields as possible, it is necessary to provide data on the manufacture of textile products and their preliminary stages as well as measurement data from the laboratories. Clearly described processes and measurement parameters in the research fields make it possible to create a broadly usable and correlatable database. Training AI models requires large amounts of data, which are traditionally collected in DITF research projects. The DITF are thus laying the foundation for AI-based material and product development and process optimization in the future.

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25th anniversary of service for Dr. Jamal Sarsour

On October 1, 2023, Dr.-Ing. Jamal Sarsour, Head of Environmental Technology at the Competence Center Textile Chemistry, Environment & Energy, celebrated his 25th anniversary at the DITF. He studied pro-

cess engineering, specializing in environmental engineering and food technology, and received his doctorate in 2004 with a thesis on the treatment of wastewater from textile finishing. Sarsour has focused on processes for operational environmental protection as

well as on the development of textiles for environmental protection, energy generation and recovery, drinking water production and water treatment.

He was inspired by natural models for the technical solutions, e.g. for the polar bear

house and the fog catcher. He passes on this methodological knowledge to students as part of the lecture series "Bionics – Selected examples of the implementation of biologically inspired developments in technology" at the University of Stuttgart.



drupa 2024

At drupa in Düsseldorf, the world's leading trade fair for printing technologies, the DITF and international partners will be presenting the Digital Textile Micro Factory, in which virtual design, 3D garment simulation

and digital production processes will be demonstrated. The presentation at touchpoint textile at the end of May 2024 will focus on material transport and material handling with a high degree of automation in digital textile printing and

automated cutting. Shirts for the sports sector will be produced with a focus on sustainability.

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Re-election of

Dr.-Ing. Thomas Stegmaier

Thomas Stegmaier, member of the DITF Executive Board and Head of the Competence Center Textile Chemistry, Environment & Energy, has been re-elected as President of the Board of Directors of the International Society of Bionic Engineering (ISBE). This was announced at the 7th International Confer-

ence of Bionic Engineering – ICBE 2023 in Wuhan, China. The ISBE is a non-profit, non-political organization founded in 2010 to promote the exchange of information on research, development and application in the field of bionic engineering. Thomas Stegmaier has held the position since 2019, having previously been Vice President of the association.

Show Stopper Award

At the Advanced Textile EXPO in Orlando, Bastian Baesch re-

ceived the Show Stopper Award in the "Devices and Tools" category. With this award, the trade fair honored the development of the new CRC sensor principle. With the new CRS sensor principle, it will be possible for SMEs to directly detect faults in the production process with regard to the electrical properties of SmartTextiles and to sort out faulty parts early on in the process chain without additional effort. This will significantly improve quality and reduce the cost of manufacturing smart textiles.



Fairs & Events

- January 31** Forum Functionalization, Hohenstein – Hohenstein in cooperation with AFBW and DITF
- February 27 – 28** SMART TEXTILES User Forum, Berlin – TITV in cooperation with DITF and FKT
- March 05 – 07** JEC World Paris – DITF booth
- March 20** DITF Innovation Day 2024, Denkendorf
- March/April** ESMA Academy – Digital Printing on Textiles, Denkendorf – DITF
- April 23 – 26** Techtextil Frankfurt a.M. – DITF booth
- April 25** Girls' Day, Denkendorf
- May 16** CRC1333 Minisymposium on "Catalysis under Confinement", Stuttgart – University of Stuttgart
- May 28 – June 07** drupa, Düsseldorf – DITF booth
- June 05 – 06** Week of the Environment, Berlin – DITF exhibition
- June 08** Science Day, University of Stuttgart – DITF booth
- June 18 – 20** MedtecLIVE with T4M, Stuttgart – DITF booth
- July 13** Open Day – DITF Denkendorf



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