

Functionalisation | Chemical Analytics





The STFI is a member of the Verein Deutscher Textilveredlungsfachleute e.V. (VDTF).



Functionalisation I Chemical Analytics

The aim of our basic and application-oriented research activities is the realisation of special functionalities of technical textiles. We mainly achieve this through the alteration or modification of surfaces or through combination of different textiles by coating, finishing, printing or lamination.

To support the textile industry with solutions to future challenges we focus on finding suitable materials and technical processes in order to realise products with certain (surface) properties: We therefore consider the influence of material structure itself as well as the multiple possibilities gained by combining different materials or functionalities. We try to establish energy- and resource-efficient procedures and to find ways to minimise the amounts of harmful substances in products and manufacturing processes.

Through close cooperation with industry, our joint ideas lead to customised product innovations that can be quickly established on the market.

A handwritten signature in blue ink, appearing to read 'F. Siegel'.

Dr.-Ing. Frank Siegel
Manager Functionalisation I
Chemical Analytics



The STFI provides the whole development process: starting from developing formulations for functional dispersions and thermoplastics and their characterisation to small-scale samples and the up-scaling to small-quantity manufacturing on semi-industrial pilot equipment.

Coating and Finishing machine

Working width	40 – 500 mm
Speed	0,1 – 5 m/min
Temperature	25 – 230 °C
Dryer length	1,5 m
Squeezing pressure	max. 6 bar



Double belt press (flatbed) Thermofix®

Width	10 – 800 mm
Speed	0,1 – 20 m/min
Temperature	25 – 235 °C
Pressure (calendering roller)	0 – 7 bar
Heating zone/Cooling zone	per 2 m lenght

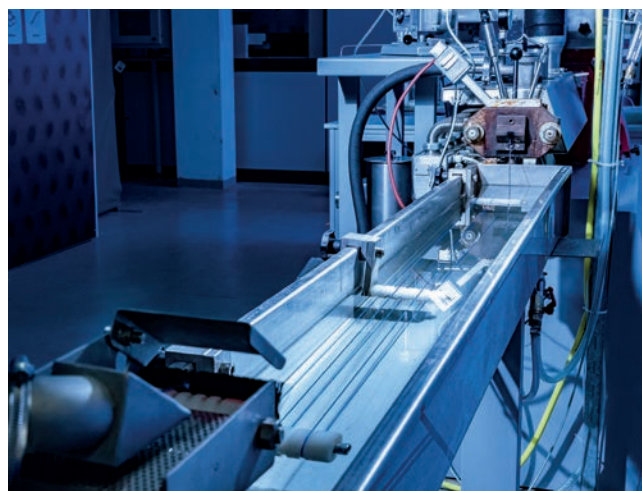
Hotmelt coating and lamination system

Application width	300 – 800 mm
Application speed	0,5 – 20 m/min
Application weight	5 – 350 g/m²
Viscosity	2.000 – 80.000 mPas

- Inline corona pre-treatment
- flat roller and different engraving rollers

Hotmelt Extrusion coating line

Working width	200 – 800 mm
Temperatures	up to 200 °C
Speed at RnD mode	up to 5 m/min



Twin-screw compounder

Screw length	(L/D) 36
Temperature	0 – 300 °C
Throughput	1 – 40 kg/h
Strand cooling by water bath,	3 x solid, 1 x liquid
drying by blower and strand	
pelletiser Venting by vacuum pump possible	

Foam Mixer

Throughput	1,2 – 12 kg/h
Foam densities	50 – 800 g/l
Viscosities	up to 4.000 mPas

3D material application unit 1

Application units for functional printings:

- Filament-Extruder for application of thermoplastic Filaments (Fused Layer Modeling)
- Application head with needle valve for application of thermoplastic polymers (powders, granules)
- Dispensing for application of different coating pastes and inks (water-based dispersions, plastisols, high-solid systems, UV-curable systems)

Print bed size	700 mm x 1.200 mm
Printing height	130 mm
Temperatures	256°C, 220°C, 230°C
UV-LED – Spot	385 nm (Wavelength)



3D material application unit 2

3 different application heads:

Filament up to 350 °C

- 2K-Mixing head for inks
- Jetvalve for inks and reactive systems

Print bed size 650 x 850 x 450 mm³

Heated printing bed up to 100 °C

Heated printing space up to 60 °C

Inkjet printing machine

Print bed size 1.200 x 1.200 mm²

- CMYK water-based Pigment ink (Diamontex P)
- 2 additional printheads for functional inks
- Inline NIR-drying Lambda Physics (NIR-Powerheat PH MF U 5-1, Lambda Technology GmbH, Grafing)

Contact angle measurement

Drop shape analysis with high speed camera
up to 2.300 fps

- Software controlled dosing system
- Determination of free surface energy of solids
- Determination of the surface tension of liquids (pendant drop method)

IR-Lasercutter

Wavelength	10.600 nm (400 W)
Machining surface	1.200 x 1.200 mm ²
Engraving and cutting in greyscale	

UV-LAB-Laser

Wavelength	355 nm (10 W)
Machining surface	120 x120 mm ² (Scanner)

UV-IR-Laser combination

Wavelength 1	355 nm (14 W)
Wavelength 2	10.600 nm (80 W)
Machining source	700 mm
Sheet-to-Sheet, Roll-to-Sheet and Roll-to-Roll	



Technical textiles achieve their tailor-made properties by surface functionalisation like finishing, coating, functional printing or laser structuring as well as joining technologies like lamination.

Developing novel products is always an interaction of material selection, structure engineering and manufacturing process as well as a close look on ecology and chemical analytics.

In cooperation with the STFI research and testing field "Textile Factory of the Future" manufacturing processes are being further developed regarding to the realisation of a complete value chain.

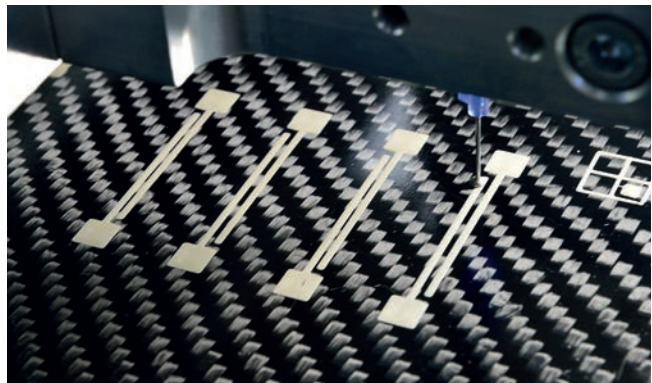
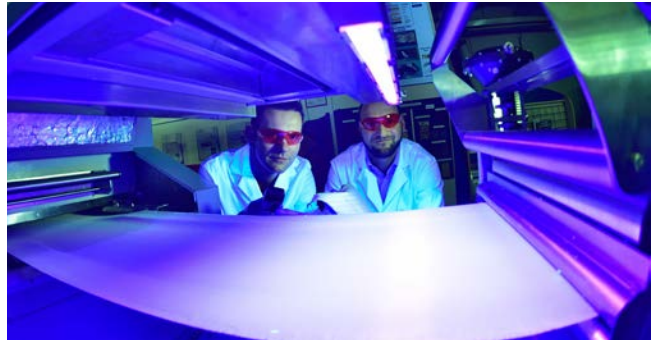


Functional Finishing and Coating

- ▶ Direct and transfer coating (knife-over-air, knife-over-roller)
- ▶ Impregnation by padding
- ▶ Low add-on technologies (reverse roll coating, slot die coating)
- ▶ Foam-coating

Hotmelt and UV-curing

- ▶ Hotmelt compounding
- ▶ Hotmelt roller application (fully and patterned) for lamination and coating
- ▶ Hotmelt extrusion coating (slot die coating)
- ▶ UV-curing (UV-LED emitters at wavelengths 365 nm, 395 nm; Fe-doped Hg medium pressure emitter)

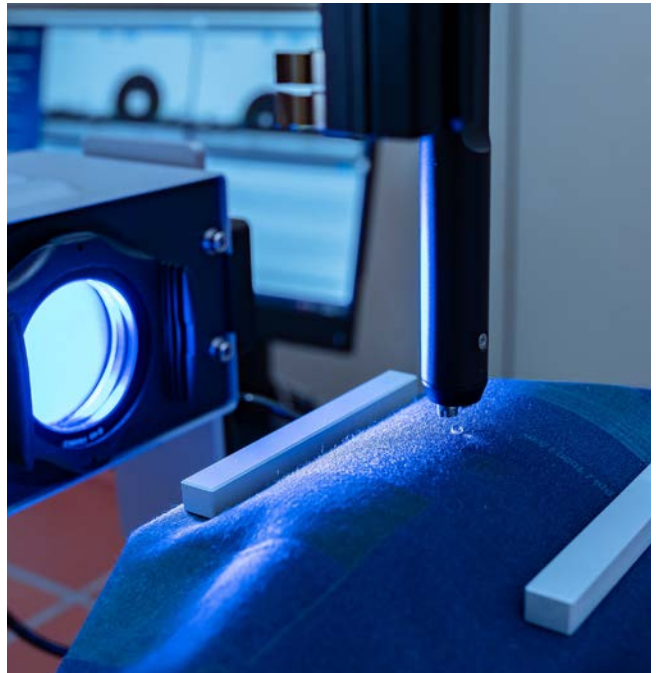
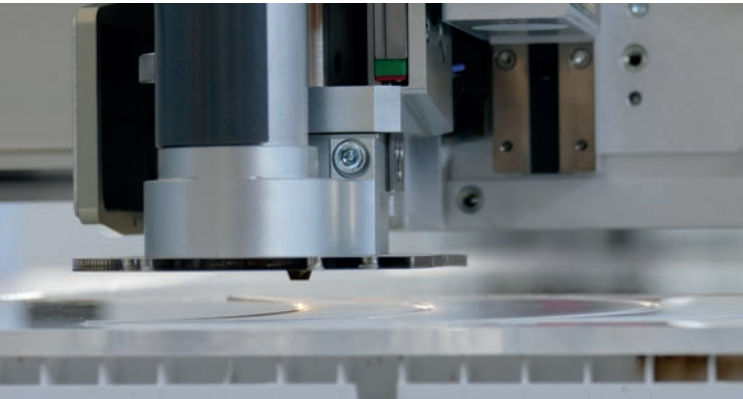


Functional printing

- ▶ Screen printing (flat bed)
- ▶ 3D material application (3D printing, thermoplastic and liquid)
- ▶ Micro valve printing
- ▶ Inkjet printing
- ▶ Engineering, design in 2D and 3D

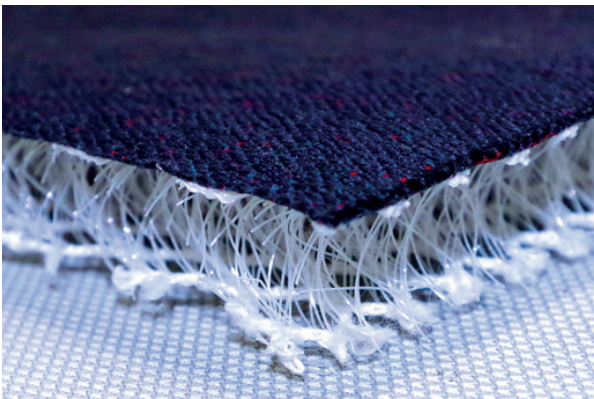
Laser

- ▶ UV-Laser (wavelength 355 nm)
- ▶ IR-Laser (wavelength 10.6000 nm)
- ▶ Cutting, surface patterning, surface cleaning
- ▶ Test procedures for testing textiles against Laser radiation



Textile composites

- ▶ Thermoplastic adhesives
- ▶ Dispersion adhesives
- ▶ Adhesive-free
- ▶ Composite engineering for personal protective equipment (PPE)
- ▶ Artificial leather and decors



Materials and their characterisation

- ▶ Dispersing
- ▶ Hotmelt compounding
- ▶ Chemical-physical material characterisation (Differential scanning calorimetry (DSC), Rheology (Hotmelts, Dispersion), Contact Angle Measurement, dynamic surface tension, drop analysis for Inkjet printing)



Materials

- ▶ Waterborne high viscosity coating systems
- ▶ 100 % coating systems (e.g. thermoplastic, UV-curing)
- ▶ Water-based low viscosity inks and finishes
- ▶ Functional pigments



Textile chemical and human ecological testing

- ▶ Material characterisation by spectroscopical, thermoanalytical and rheological methods
- ▶ Determination of dynamic surface tension of fluids and their contact angles on textiles
- ▶ Analysis of harmful substances (e.g. heavy metals, arylamines, phthalates, solvent residues)
- ▶ Determination of fogging characteristics or odour propagation
- ▶ Quantitative analysis of fibre mixtures
- ▶ Environmental analysis (water, waste water, exhaust air)
- ▶ Protection against chemicals (permeation), cytostatics and pesticides

OEKO-TEX® Test lab

Tested according to OEKO-TEX® STANDARD 100



Contact

Dr. rer. nat. Antje Melzer

Textile chemical and human ecological testing, testing according to OEKO-TEX® STANDARD 100, instrumental pollutant analysis, material characterisation

Phone: +49 371 5274-210

Email: antje.melzer@stfi.de

Dr. rer. nat. Katja Trommler

Textile chemical and human ecological testing, Tests according to OEKO-TEX® STANDARD 100, Material characterisation, permeation and fogging

Phone: +49 371 5274-173

Email: katja.trommler@stfi.de

Dipl.-Ing. Angela Geu

Tests according to OEKO-TEX® STANDARD 100

Phone: +49 371 5274-174

Email: angela.geu@stfi.de

Ecology & environment

- ▶ Material development (bio-based raw materials)
- ▶ Application of Enzymes and proteins
- ▶ Microplastics origin and containment
- ▶ Environmental analysis (water, waste water, exhaust air)
- ▶ Protection against chemicals (permeation), cytostatics and pesticides
- ▶ Analysis of harmful substances (e.g. heavy metals, arylamines, phthalates, solvent residues)



Exchange of Experiences on Exhaust Air Purification

Innovative and successful developments in the areas of environmental protection, energy efficiency and process management are based to a large extent on the dialogue between all stakeholders involved: plant operators, authorities, researchers and developers and service providers. With our event Exchange of Experiences on Exhaust Air Purification, we would like to offer you a platform on which you can find out about technical innovations and legal changes relating to the topic of "exhaust air purification in the textile industry" and exchange ideas with experts and users.

Main topics of the event:

- ▶ Discussion of challenges from practice
- ▶ Presentation of practical solutions/ description of experiences in the operation of exhaust air cleaning systems
- ▶ Explanation of changed or changing legal framework conditions
- ▶ Teaching of metrological and process engineering basics
- ▶ Presentation of strategies for exhaust air purification and concepts for energetical use or substantial use of exhaust air
- ▶ Presentation of current and future pollutant potential



Contact

Dipl.-Ing. Marco Sallat

Ecology, environmental analysis, microbiological testing

Phone: +49 371 5274-167

Email: marco.sallat@stfi.de



Dipl.-Biol. Jens Mählmann

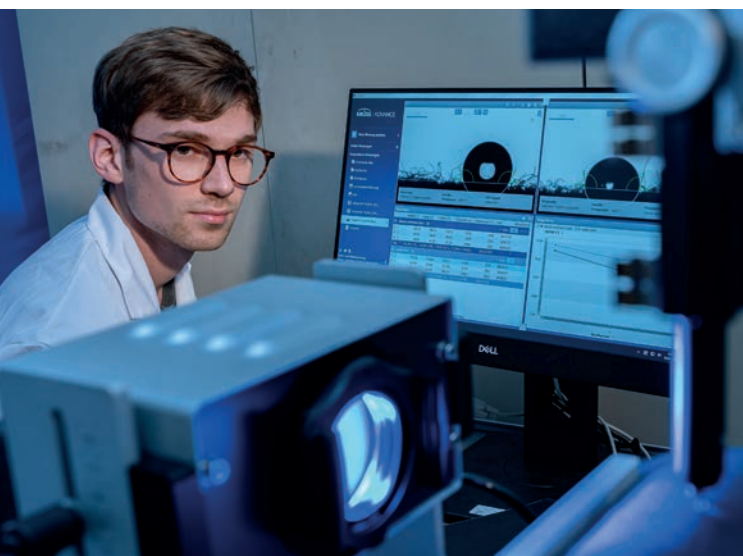
Textiles for water and exhaust air purification, engineering biology and applied hydrobiology, medical textiles, embroidery

Phone: +49 371 5274-240

Email: jens.maehlmann@stfi.de

With our experience we support you in the optimisation of process parameters and formulations as well as the transfer of the ideas in recent technical processes of your company. Depending on material properties and requested effects we select and develop suitable coating, printing and laser structuring processes up to final semi-industrial roll-to-roll processes. We realise your research and development tasks within bilateral contract research or together in publicly funded projects in small or large consortia.

With our semi-industrial equipment, we are able to make samples, prototypes and small pilot productions. Please feel free to get in contact with us.



Workshop "Functional Printing"

Customised production of textiles with extended printed functionalities is made possible by the clever combination of conventional and digital manufacturing principles. In the futureTEX research and test field "Textile factory of the future" at the STFI, we show you possible ways of how such a production can look like.

The workshop "Introduction to the topic and applications" will be held over two half days providing insight into the production of functional functions by printing and conveys theoretical and practical information

in three subject areas:

- From colour to function – Introduction of the processes and their application for the production of functional coatings
- Light as a tool – UV curing and laser structuring
- Functional printing for technical textiles – applications and news from research

On the second day of the event, the workshop will be supplemented by "Tomorrow's Innovations", a lab tour conducted by the Mittelstand 4.0-Kompetenzzentrum Textil vernetzt.

EcoCutPro – Development of a flame-retardant ecological cut protection coating and its implementation in an industrial application process

The aim of the ZIM project EcoCutPro was the development of a flame-retardant ecological cut protection coating and its implementation in an industrial application process. The cooperation partner Textildruckerei Heinrich Mayer GmbH (THM), Meßstetten, developed the industrial application process for the efficient and environmentally friendly (water-based) coating of textile substrates and designed the structures with a high degree of coverage while maintaining textile flexibility.

The STFI developed suitable coating formulations and elaborated a technology proposal for the application of ecological ceramic coating systems on corresponding textiles made of high-performance yarns. The aim was to achieve a high adhesion to the carrier material and very good protective and comfort properties as well as high abrasion and contour resistance.



UVfor3D – 3D printing with UV-curable systems for bandages

Bandages are among the aids, i.e. material resources, that are provided by health insurance companies as part of a treatment. They have a compressing and/or function-securing effect on a treated part of the body, e. g. elbow, knee or ankle. In addition to the advantages of medical use, bandages are also used for prevention during sporting activities. Bandages are made of elastic materials or knitted fabrics and are usually supplemented with a molded part that has previously been produced. The molded part is integrated by gluing, welding or sewing processes, which lead to unwanted seams and pressure points. Several time-consuming and costly process steps are therefore necessary for the production of the bandages.

The aim of the research project was the development of a novel process combination of dispenser 3D printing and UV LED curing for the digital partial functionalisation of textiles using the example of bandages for the sports and medical sectors.

digiTEX-PRO – Digitally controlled material application

The digiTEX-PRO research project has succeeded in developing a digitally controllable material application system for the flexible and efficient wet-chemical pretreatment and finishing of textile fabrics. Adapted functional chemicals were successfully printed with the newly developed machine system for the digital material application for the functionalisation of textiles. This laid the foundation for developing new business models.

Digital print head technologies make it possible to deposit very small, defined amounts of liquid from microlitre range to picolitre range on substrate surfaces at very high speeds. The first machine prototype was presented to the general public for the first time at the International Textile Machinery Exhibition (ITMA) 2019 in Barcelona. This was followed by experiments to test different functional inks and the scalability of the process.

Contact



Dr. Ing. Frank Siegel
Manager Functionalisation /
Chemical Analytics
Printing Technologies, Functional
Printing
Phone: +49 371 5274-265
Email: frank.siegel@stfi.de



Dipl.-Ing. Marco Sallat
Ecology, environmental analy-
sis, microbiological testing
Phone: +49 371 5274-167
Email: marco.sallat@stfi.de



Dr. rer. nat. Ralf Lungwitz
Composite production, UV cross-
linking, surface functionalisation,
material characterisation
Phone: +49 371 5274-248
Email: ralf.lungwitz@stfi.de



Dipl.-Ing. Angela Geu
Tests according to OEKO-TEX®
STANDARD 100
Phone: +49 371 5274-174
Email: angela.geu@stfi.de



Dr. rer. nat. Marén Gültner
Textile-based composite structu-
res, surface functionalisation
Phone: +49 371 5274-249
Email: maren.gueltner@stfi.de



Dr. rer. nat. Antje Melzer
Textile chemical and human eco-
logical testing, testing according
to OEKO-TEX® STANDARD 100,
instrumental pollutant analysis,
material characterisation
Phone: +49 371 5274-210
Email: antje.melzer@stfi.de



Tobias Richter M. Sc. (FH)
Functional printing, surface func-
tionalisation, material characteri-
sation
Phone: +49 371 5274-285
Email: tobias.richter@stfi.de



Dr. rer. nat. Katja Trommler
Textile chemical and human eco-
logical testing, Tests according
to OEKO-TEX® STANDARD 100,
Material characterisation, per-
meation and fogging
Phone: +49 371 5274-173
Email: katja.trommler@stfi.de



Dr.-Ing. (FH) Sarah Lysann Zedler
Functional printing, surface functiona-
lisation
Phone: +49 371 5274-266
Email: sarah.lysann.zedler@stfi.de



Dipl.-Ing. (FH) Dirk Wenzel
Textile Laser Applications
Phone: +49 371 5274-238
Email: dirk.wenzel@stfi.de



Sächsisches Textilforschungsinstitut e.V. (STFI)

An-Institut der Technischen Universität Chemnitz
Managing Director: Dr. Heike Illing-Günther
Annaberger Straße 240 | 09125 Chemnitz | Germany
Phone: +49 371 5274-0 | Fax: +49 371 5274-153 | stfi@stfi.de | www.stfi.de
Layout: Dipl.-Des. (FH) Berit Lenk | Photos: STFI, D. Hanus, W. Schmidt, I. Escherich
All rights reserved | © March 2023