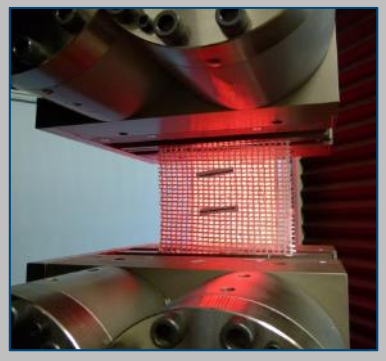
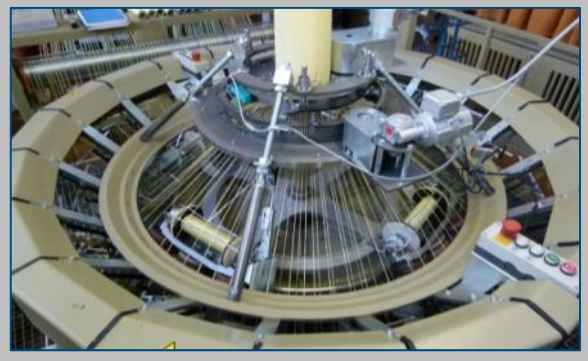
Sächsisches Textilforschungsinstitut e.V. (STFI)

an der Technischen Universität Chemnitz

International Competence in Technical Textiles and Nonwovens





SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

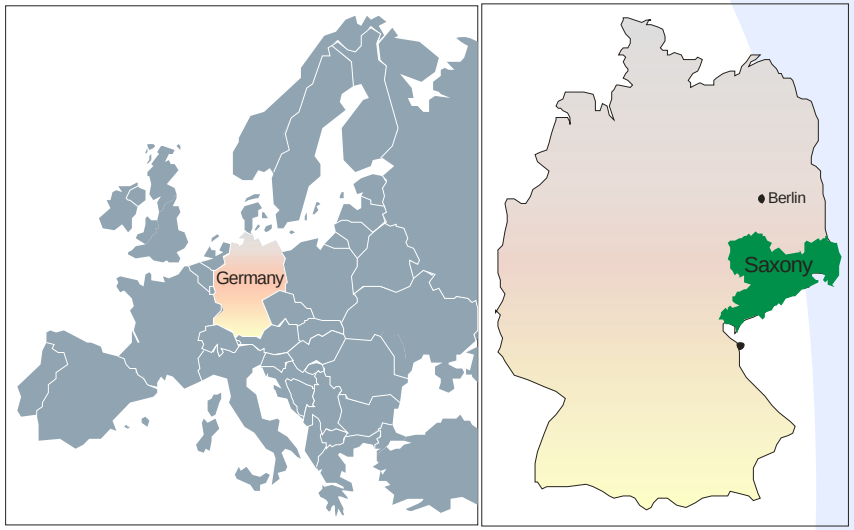
TECHNISCHE UNIVERSITÄT CHEMNITZ

www.stfi.de

STFI - Saxon Textile Research Institute

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

- Non-profit, founded in 1992
- Since 2006 associated to **Chemnitz University of Technology**
- About 140 **employees** (researchers, laboratory assistants and technicians)
- More than 100 **R&D projects** on regional, and national level are carried out each year (BMWi, BMBF, AiF, SMWA, SMWK, …)



The institute is located in Saxony.

- 5 to 10 **patent applications** are submitted per year
- Member of TEXTRANET, EDANA, European Technology Platform, Euro Textile Region, standardisation working groups, etc.

edana
EURO TEXTIL REGION
Textranet
European Technology Platform for the future of textiles and clothing
TECHNISCHE UNIVERSITÄT CHEMNITZ

Profile of STFI - Competencies

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Center of Excellence in Nonwovens

- Fibre Nonwovens
- Spunbonded Nonwovens

KOMPETENZ ZENTRUM VLIESSTOFFE

Center for Textile Lightweight Engineering

- Processing of glass, carbon, aramid, basalt fibres
- Manufacturing of preforms & composites
- Carbon recycling

Innovation Center of Technical Textiles

- Woven, Knitted and Composite Products
- Finishing / Coating / Lamination
- Development of Materials & Testing Methods

Services

- Accredited Test Laboratory
- Certification Department for PPE
- Certification Body Geosynthetics

DAkkS Deutsche Akkreditierungsstelle
D-PL-11239-01-00
D-ZE-11239-02-00
D-ZE-11239-03-00

CE 0516

Transfer Center

- Communication and Process Management
- International Cooperation & Research Transfer

Center for Textile Lightweight Engineering

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

- Recycling of dry textile waste
- Processing of glass, carbon, aramid, basalt fibres into nonwovens
- Web forming, web bonding, sliver forming
- Manufacturing of component-specific semi-finished elements
- Manufacturing of fibre compounds and composites
- Integrated testing laboratory

Opening 2016

RESET - 1st Thematic Seminar

RESET
Interreg Europe

European Union
European Regional
Development Fund

“Recycling in textile and waste disposal”

Presentation of Good Practice (GP)

Carbon Fibre Recycling Concept – Re-use of Carbon Fibres in Nonwovens

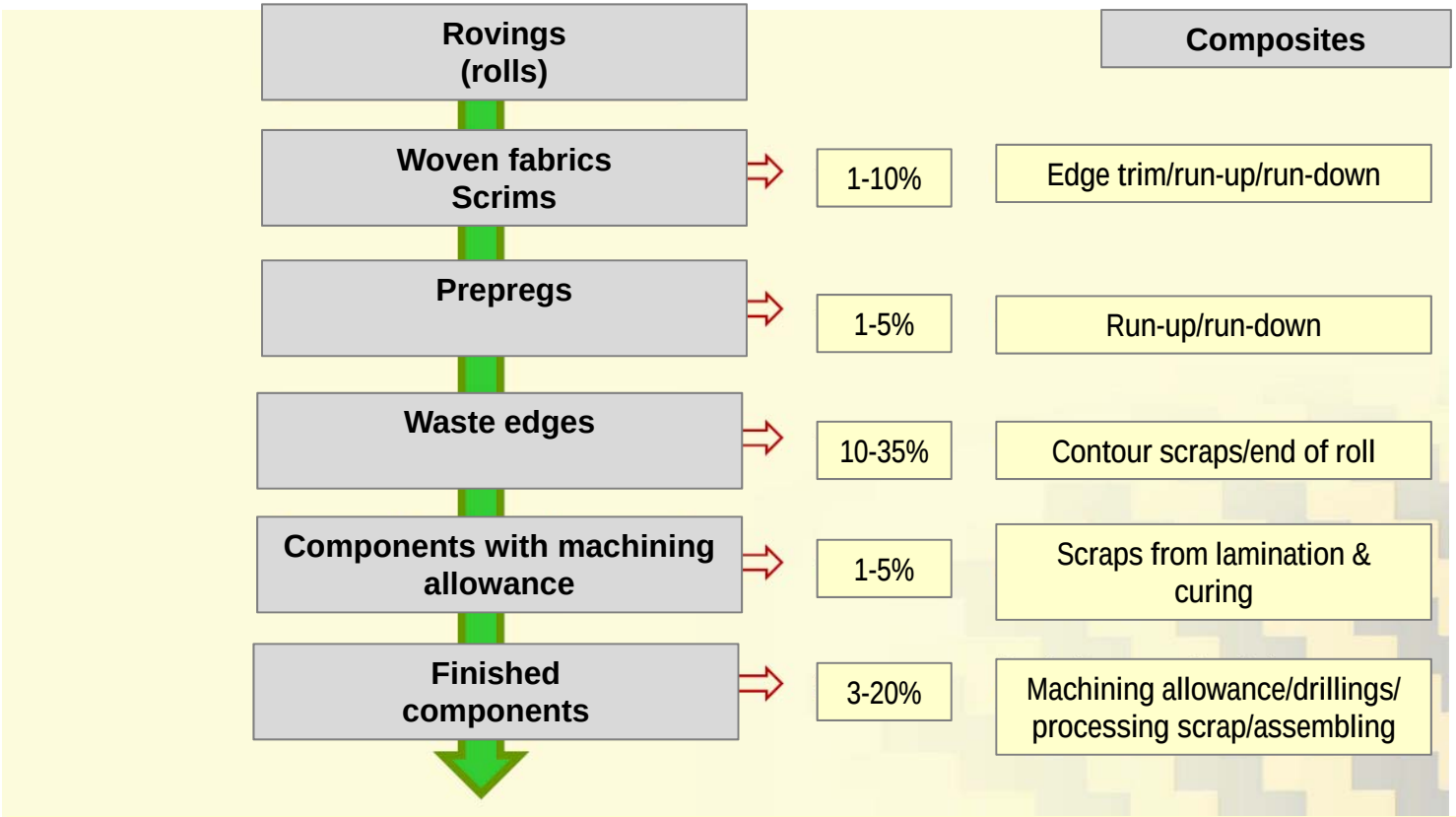
Bernd Gulich / Romy Naumann / Marcel Hofmann (STFI)

20 October 2016 | Alcoy (ES)

Carbon Fibre Recycling Concept

Background for the implementation of the GP

Carbon fibre waste is coming from



In most cases less than 50% of the fibre raw material is finally in the product

Carbon Fibre Recycling Concept

Background for the implementation of the GP

Sorting categories of carbon fibre waste			
„dry“ waste (without matrix)			
	Roving bobbins	Loose fibre bundles	Scrap of semi-finished pr.
„wet“ waste (matrix not cured)			
	Prepreg bobbins	Prepreg rolled goods	Prepreg scrap
„cross-linked“ waste (matrix cured)			
	Production rejects	End-of-life waste	

Carbon Fibre Recycling Concept

Background for the implementation of the GP

- Increasing amount of production waste due to the increased application of carbon fibre reinforced plastics (CFRP) for lightweight and durable products
- High amount of production rejects
- Increase of the amount of end-of-life waste in the near future
- Dumping ban for CFRP materials
- Incineration is problematic due to emissions and cost reasons
- Existing need to establish a closed loop recycling system also due to legal requirements
- Recycled carbon fibres are a less expensive raw material compared to “new” carbon fibres with high functionality (also for the 2nd cycle of use)
- Industrial partners are interested in technical solutions to re-use the high-value waste material
- Our research activities have shown the feasibility of the recycling concept

Carbon Fibre Recycling Concept

Background for the implementation of the GP - Legal framework

- The recycling of carbon fibres is strongly influenced by legal regulations. Landfill of such materials is not allowed and the disposal is regulated by different guidelines.
- Relevant European and national legal regulations are:
  - European Waste Framework Directive (2008/98/EC)
  - Directive 2000/53/EC of the European Parliament and of the Council of 18th September 2000 on end-of life vehicles
  - German Closed Substance Cycle and Waste Management Act (KrW-AbfG) valid since 1996
  - German End-of-Life Vehicles (ELV) Directive valid since 2002
- Further legislation to be taken into consideration is more of technical and safety nature when carbon fibres are processed, such as
  - personal protection (wearing protective suits) to avoid health risks for the workers when getting in contact with the fibres/dust
  - to prevent the transfer of carbon fibres into other facilities when leaving the working area (protection of technical plants against short circuits)

Carbon Fibre Recycling Concept

Background of STFI

- Research and development in carbon fibre nonwovens since 2005
- Investigations in processability of carbon fibres with finite lengths
- First phase: cut fibres from rovings (by means of a chopper)
- Second phase: carbon fibres from recycled fibre composite parts after pyrolysis
- Objective: production of textile semi-finished products from carbon fibres by means of carding

Photos: STFI

Carbon Fibre Recycling Concept

Description of technology

Sorting categories of carbon fibre waste

„dry“ waste (without matrix)	 Roving bobbins	 Loose fibre bundles	 Scrap of semi-finished pr.
„wet“ waste (matrix not cured)	 Prepreg bobbins	 Prepreg rolled goods	 Prepreg scrap
„cross-linked“ waste (matrix cured)	 Production rejects	 End-of-life waste	

Used at STFI

Carbon Fibre Recycling Concept

Description of technology

- The carbon fibres used in composites and reinforced plastics need to be separated from the matrix materials or resins.
- This can be achieved by pyrolysis or solvolysis processes (not available at STFI).
- The dry carbon fibres (free of resin) are further treated with a modified tearing process and are processed into nonwovens by web forming technology. The web forming is possible with 100% carbon fibres or out of blends made of carbon, synthetic and/or natural fibres.

Resin-free carbon fibre waste

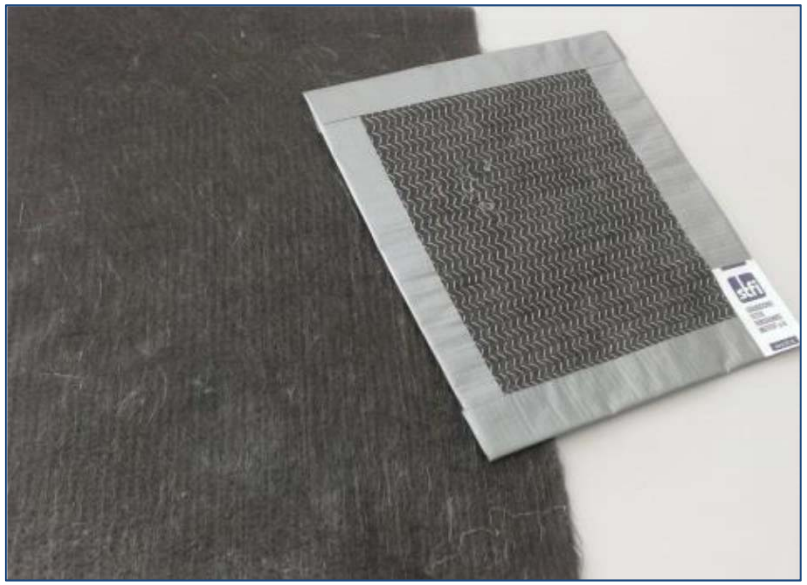
Reclaimed fibres after tearing process

Photos: STFI

Carbon Fibre Recycling Concept

Description of technology

- The web entanglement is achieved in-line through needle-punching or stitch-bonding technology type “Maliwatt”. Feasible technologies are also thermal bonding or spunlacing.
- The received carbon fibre nonwovens can be further processed to intermediates/semi-finished products or composites for structural components in vehicles, aeroplanes, etc.



Photos: STFI

Nonwovens made of 100 % reclaimed carbon fibres

Carbon Fibre Recycling Concept

Description of technology - machinery

Recycling machinery

Carbon fibre plant

Photos: STFI

Photo: Pierret

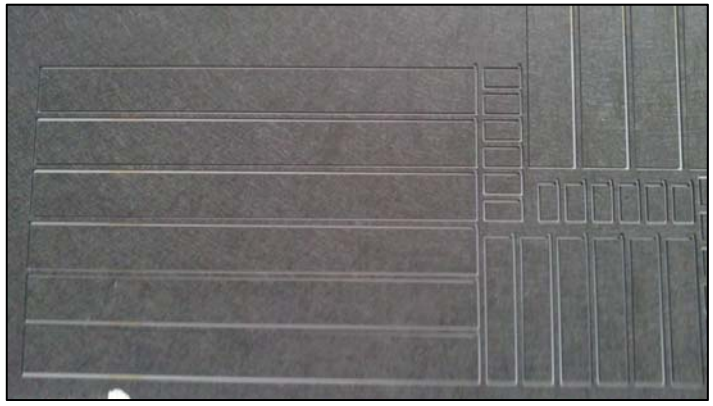
Technological parameters of the carbon fibre plant:

- Working width: 0.6 m – 1.0 m
- Mass per unit area: 40 g/m² - 1500 g/m²
- Processable raw materials:
- up to 100 % carbon fibres
- Blends with glass fibres, natural fibres and aramid fibres as well as thermoplastic fibre material (e.g. PP, PA, PPS…)

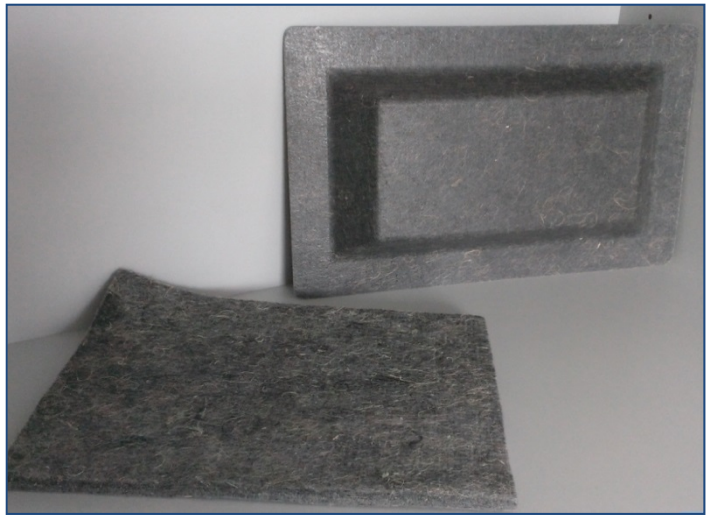
Carbon Fibre Recycling Concept

Description of technology - products

Secondary Roving



Parts for lightweight applications



Photos: STFI

Carbon Fibre Recycling Concept

Transferability of GP

Success factors of the GP

- From a technological point of view, the described Good Practice is transferable to other regions provided the availability of the requested investment for machinery as well as of a sufficient quantity of carbon fibre waste to be recycled
- Development of new products (CFRP made of/with nonwovens from recycled carbon fibres)
- Development of a process with high economic efficiency (material and energy savings) and reduced fibre damage
- Economical and high-quality material recycling of carbon fibre waste

Carbon Fibre Recycling Concept

Transferability of GP

Difficulties encountered and lessons learnt from the practice

Challenges to take into consideration in context of the carbon fibre recycling are:

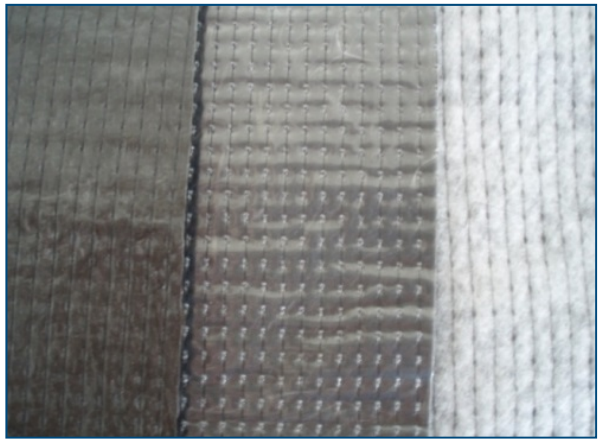
- To bring such processes and products to market (find markets of sufficient size capable of using recovered carbon fibres)
- Questions about waste volumes, provenance, how to maintain a consistent supply of waste
- Development of logistic systems/concepts on regional level to collect, record and sort the waste materials has to be established
- Understanding health and safety requirements for new processes can be time consuming
- To find the investment (investors or funding programmes) for required costs for machinery and equipment

Carbon Fibre Recycling Concept

Transferability of GP – Success story from Germany

Establishment of an industrial plant in the city of Hof in 2015

- Working width: up to 150 cm
- Mass per unit area: 100 – 350 g/m²
- Carding process combined with stitch-bonding technology



TENOWO NONWOVENS

Photos: TENOWO/STFI

→ Further discussions with France and UK are still under progress

Carbon Fibre Recycling Concept

Good Practice value added at regional and transregional (EU) levels

- Gaining expertise in a specialized field
- Establishing innovative recycling systems for high-value materials
- Industrial up-scaling of modified recycling procedures
- Gaining cost-effective materials (compared to “new” materials) with high functionalities
- Saving of material (reduced material consumption reaching the same material parameters as conventional material)
- Energy savings & improved carbon footprint
- Improvement and adaption of machinery and equipment lead to benefits for machinery manufacturers
- Transferability of Good Practices to other regions

Carbon Fibre Recycling Concept

GP Contact

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Thank you!

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