45TH IFKT CONGRESS, Ljubljana, Slovenia

Monika Seeger, *Reinhard Helbig, Rolf Arnold, Ulrich Herrmann, Elke Thiele, Jens Mählmann*

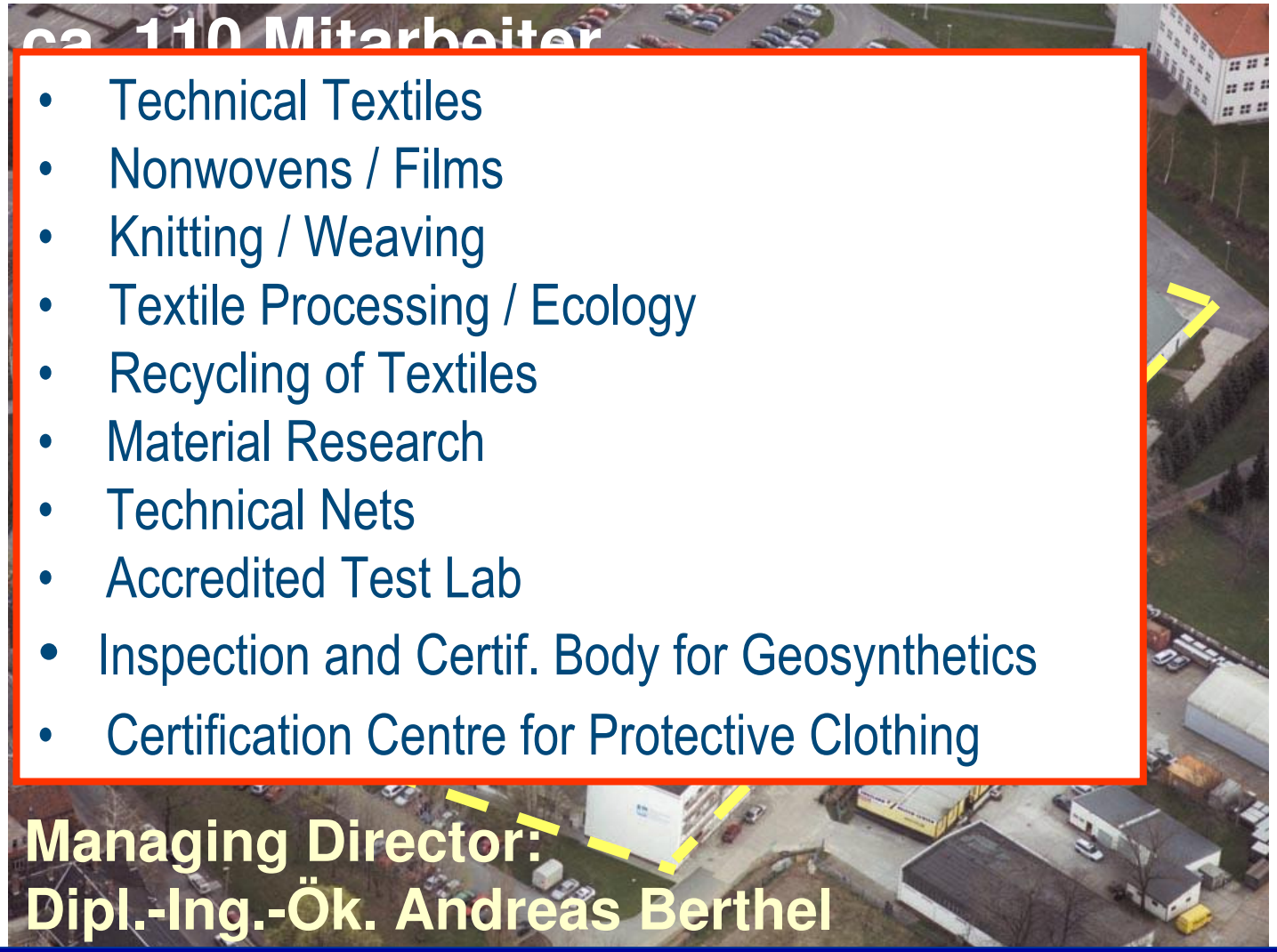
STFI e.V. an der Technischen Universität Chemnitz

Carsten Lies *Fraunhofer Institut IWU, Chemnitz, Germany*

Innovative Technical Textiles – special features, manufacturing, application, research and development

STFI e. V. Chemnitz

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.



ca. 110 Mitarbeiter

- Technical Textiles
- Nonwovens / Films
- Knitting / Weaving
- Textile Processing / Ecology
- Recycling of Textiles
- Material Research
- Technical Nets
- Accredited Test Lab
- Inspection and Certif. Body for Geosynthetics
- Certification Centre for Protective Clothing

Managing Director:
Dipl.-Ing.-Ök. Andreas Berthel

TECHNICAL TEXTILES

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Technical Textiles:

„Fit for the Purpose -

Fit for the Future“

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Technical Textiles – what does it mean ??

Textile materials and products which are mainly produced for their technical function and performance.

Their aesthetic or decorative properties are less or not important.

Overview

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

1. Technical Textiles – General Aspects

1.1 Classification
1.2 Characteristics Features
1.3 Production Technologies, Material

2. Research and Development

Some Examples of Research Work by STFI,
Dep. Technical Textiles, Weaving and Knitting

Head of Dep.:
Reinhard Helbig

2.1 Erosion Protection and Planting of Embankments
2.2 Technical Textiles for Water Purification
2.3 Textile Plant Carriers and Irrigation Mats
2.4 Multifunctional Rope-like Structures
2.5 Textile Reinforced Aluminium Foam
2.6 Example of an International research network

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TECHNICAL TEXTILES

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Classification (Frankfurt Fair FFM)


Mobiltech


Indutech


Protech


Sporttech


Medtech


Clothtech


Hometech


Packtech


Geotech


Oekotech


Agrotech


Buildtech

Quelle: Messe Frankfurt

OVERVIEW

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2.2 Substrates for Water Purification

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EXAMPLE GEOTEXTILES

SÄCHSISCHES

GEOTEXTILES: High growth rate

This market depends closely on the requirements of application as well as on the technological level of the user industry (geotechnics, environment etc.)

Technological level of the user industry = driving force of innovation

EXAMPLE GEOTEXTILES

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

CHARACTERISTIC FEATURES

- Projects for developing the infrastructure etc. are mainly financed by the authorities / public institutions
- Calls for bids
- Strict technical guidelines
- High pressure to competitiveness and cost effectiveness

Sudden drastic and often unpredictable incidences can provoke a total change of conditions:

- Political changes
- Natural desasters (floods, earthquakes) etc.

EXAMPLE GEOTEXTILES

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

General market aspects:

- Quick changes in product development
- Growing market, slightly reduced growth rates
- Long-time development, testing, field tests and certification procedures before market launch
- Global competition
- Multifunctionality: several components integrated in final products
- Tailored solutions

→ **SPECIALISATION, NICHE MARKETS**

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Geosynthetics have to be marked

Example

CE
0991
Textilfilt, Typ A

"CE" abbr. of "Conformité Européene“ ("European Conformity") identification number of notified testing body, type of product

CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation, in practice by many of the so-called Product Directives

GEOTEXTILES

ITT at STFI

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

www.geokunststoffe.com

STFI:
Approval Inspection and Certification Body Geosynthetics

Institut für Technische Textilien GmbH
at Sächsisches Textilforschungsinstitut
Dr.-Ing. Matthias Mägel
Postfach 13 24
D-09072 Chemnitz
Tel. (03 71) 52 74-172, Fax (03 71) 52 74-233
E-Mail: geokunststoffe.itt@stfi.de

INFORMATIONEN INFORMATIONEN

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

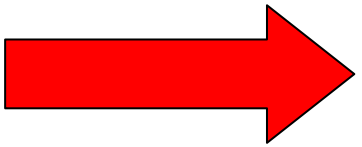
Where to find

Information

Rules and Standards

Guidelines

Instructions etc.



GEOTEXTILES

Standards
Testing bases
Test methods
Application standards
Guidelines

Associations
DGGT
FS "KGeo"

Testing Bodies
HTW
Inspection- and Certification Body
ITT

EU-Guidelines

Contact
deutsch

Application
Symbols

Functions
Symbols

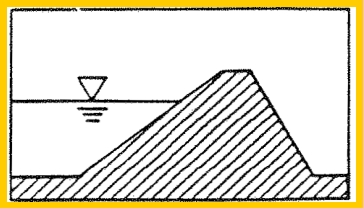
Events
Bautex

Literature
Guidelines

GEOSYNTHETICS

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

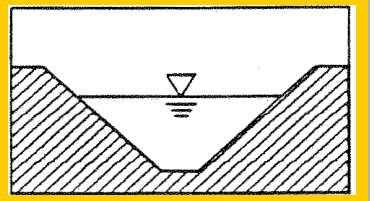
GREAT VARIETY OF APPLICATIONS



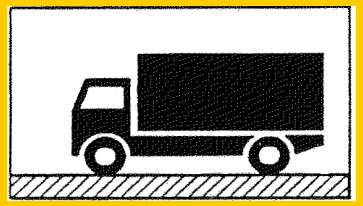
reservoirs, dams

liquid waste

solid waste

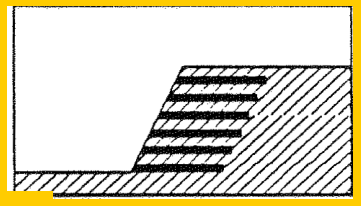


canals

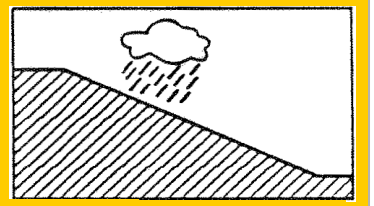


roads

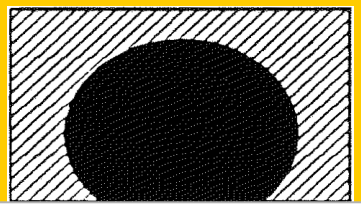
railways



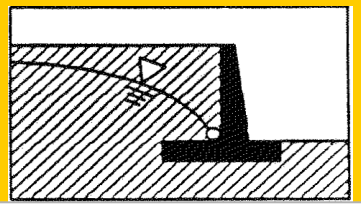
foundations, retaining walls



erosion-control systems



tunnel construction



drainage systems

DIN EN ISO 10318

45TH CONGRESS IFKT 27 - 29 May, Ljubljana, Slovenia

Quelle: Vortrag M. Mägel, M. Hierhammer, K. Lieberenz, Einführung CE-Kennhzeichnungspflicht; Bautex 2002

www.stfi.de

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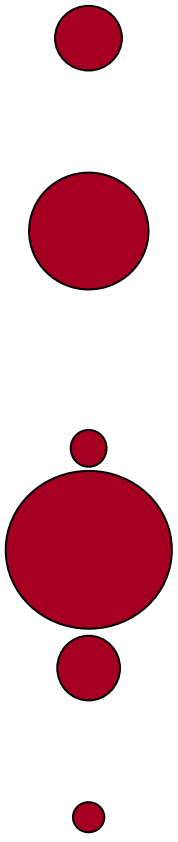
TECHNICAL TEXTILES

Production Technologies

Geo



- Weaving
- Knitting
  - warp knitting
  - weft knitting
  - stitch bonding
- Nonwovens
- Laid scrims
- Braiding
- Rope-making etc.

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

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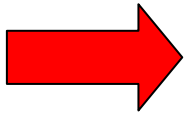
TECHNICAL TEXTILES

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Materials used

Traditional natural and synthetic fibres,

Special technical fibers (basalt, glass, metal wire etc.) and unusual materials adapted to the purpose



Examples STFI

Up to now some used in research and development only, some in real products:
Tubes, packaging tape, velcro tape, hay, straw, seaweed, wood, cuttings, edge strips…

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GEOTEXTILES

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Reinforcing the surface soil of an embankment

Prevention from the loss of soil particles (erosion by water and wind).

Principle: **Roots create a natural mechanical protection effect against erosion**

Problem: **No effect in the beginnings after seeding (period of germination and root development)**

GEOTEXTILES

EROSION CONTROL AND PLANTING OF EMBANKMENTS

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Great variety of products on the market available

coir (coconut fibre), jute, straw, flax etc.

➡ **Mats, compound fabrics made of natural material and synthetic nets, woven fabrics made of natural fibres, nowovens etc.**

in some cases with fertilizer or seeds integrated

INNOVATION: WARP-KNITTED GEOGRIDS

Embankment with warp-knitted geogrids installed (before covering with soil and hydroseeding)

3000 m²

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INNOVATION: WARP-KNITTED GEOGRIDS

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Foto: STFI e.V.

Chemnitz Südverbund

Embankment, 1 year later

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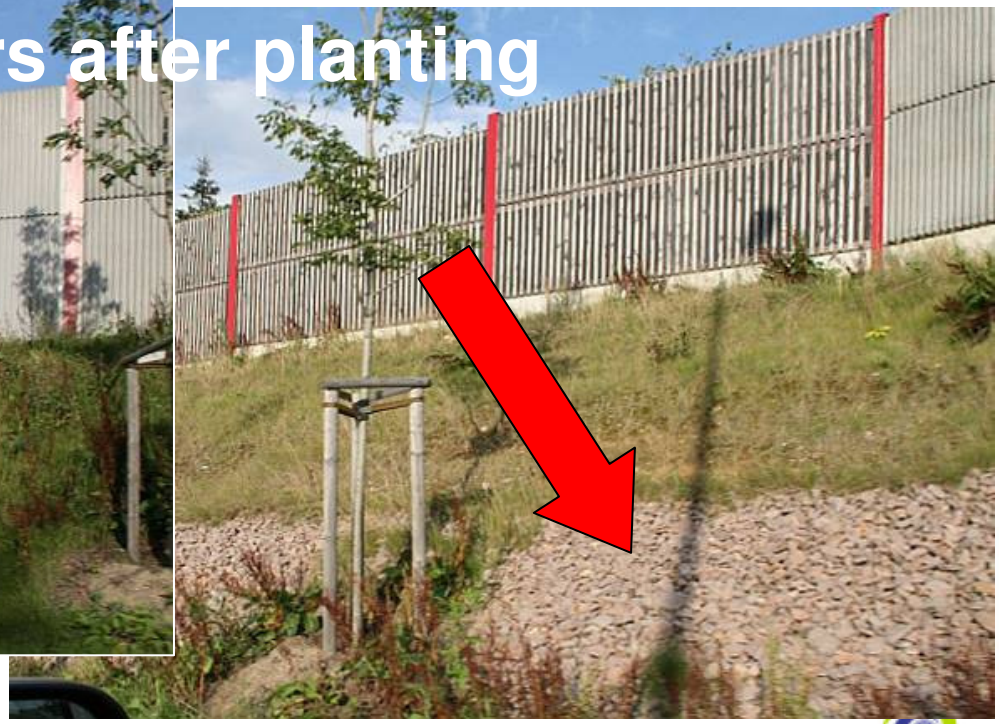
INNOVATIVE COARSE GEOGRIDS

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

EMBANKMENT with coarse grained gravel on the surface

2 years after planting



with STFI geogrids

without STFI geogrids

Foto: STFI e.V.

INNOVATIVE COARSE GEOGRIDS

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Nature reserve

Disused open cast mine

Problems:

- *The coal stratum reaches the surface of the steep embankment*
- *Very sulfurous brown coal*
- *Spontaneous ignition and **seam fires** in summer time because of solar radiation*
- *Heavy smoke emission*
- *Area difficult to reach for fire brigades, particularly for vehicles*
- *Highly cost-intensive*

INNOVATIVE COARSE GEOGRIDS

Brown coal seam

INNOVATIVE COARSE GEOGRIDS

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

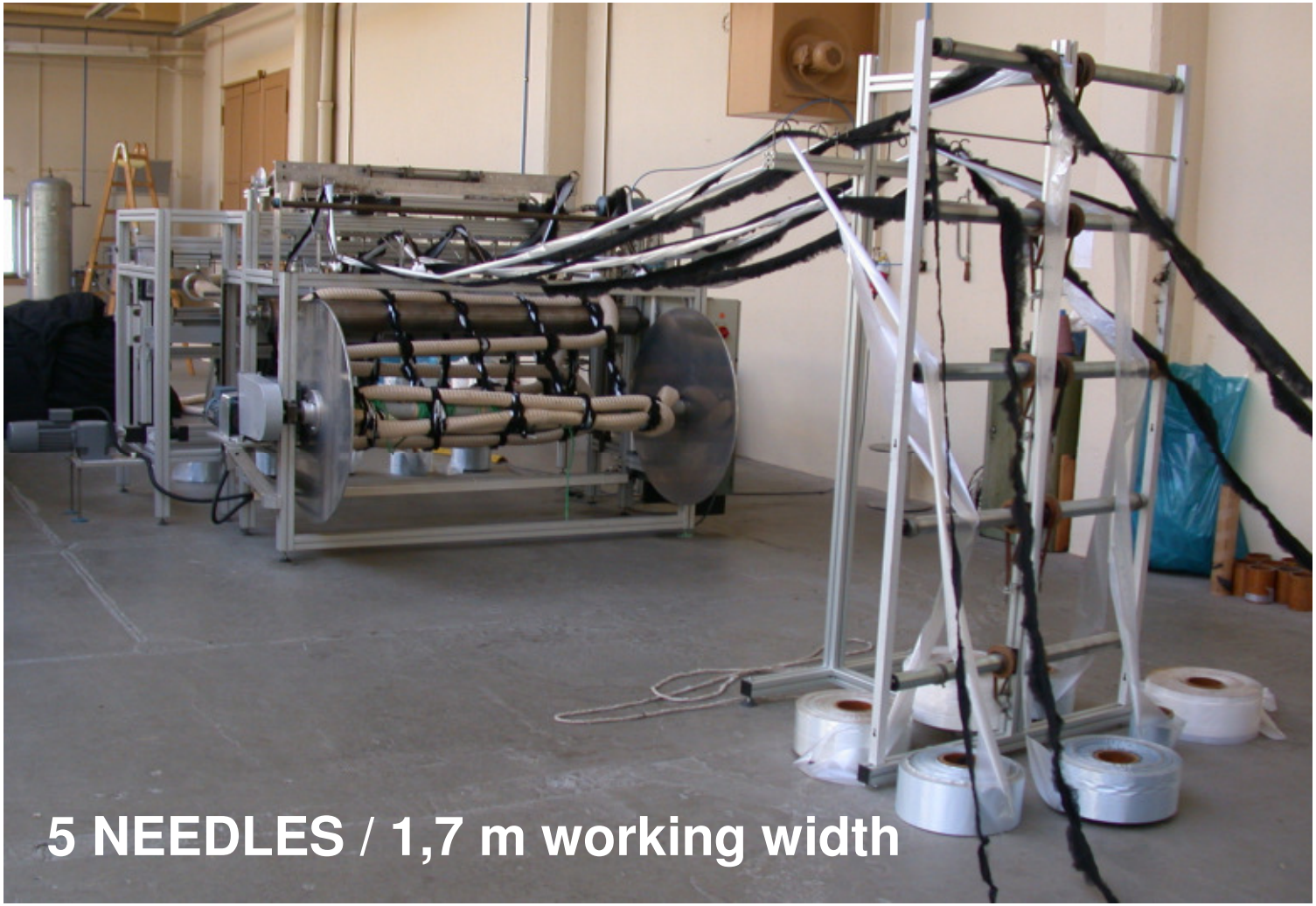
Our solution:

Innovative coarse geogrids

with tubes and temperature sensors inserted

to prevent burning and to start irrigating from the beginning of the growing of the vegetation

EXTRA COARSE WARP-KNITTING MACHINE



5 NEEDLES / 1,7 m working width

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

TECHNISCHE UNIVERSITÄT CHEMNITZ

InnoRegio

Foto: STFI e. V.

Manufacturing KEMAFIL® ropes

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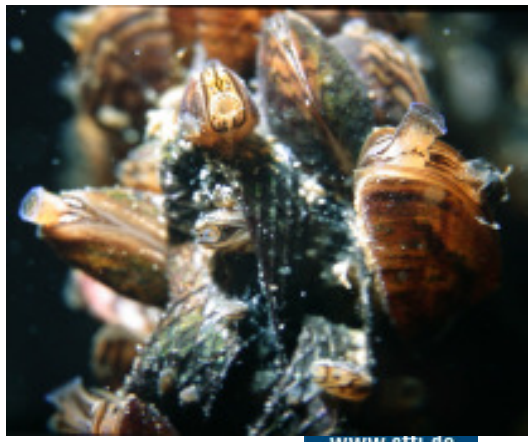
Textile Carriers for Filtering Organisms



~ 1 Mio. mussels/modul; filtration effect (free of particles): 1l/mussel/day

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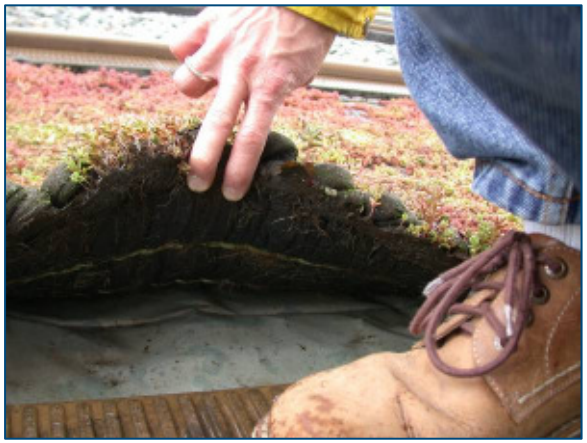
Greening of Railway Tracks

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

ausgezeichnet mit dem Innovationspreis der TECHTEXTIL 2005

Greening/Recultivation

Removable textile plant bedding system for railway trackbeds



SÄCHSISCHES
TEXTIL
FORSCHUNGS
INSTITUT e.V.

Floating Islands

Floating Islands

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Planting / Restoration

Biotope on Recultivated Water Bodies

Floating Islands

Root development

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

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Textiles for Geotechnics, Articulture and Horticulture

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Geotextiles for Irrigation

Geotextiles for Irrigation

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Innovative Machine Design

Special Needle Design

Textilien für Landwirtschaft und Gartenbau

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

ca. 80 percent of the worldwide water consumption is used for artificial irrigation

STFI-development:

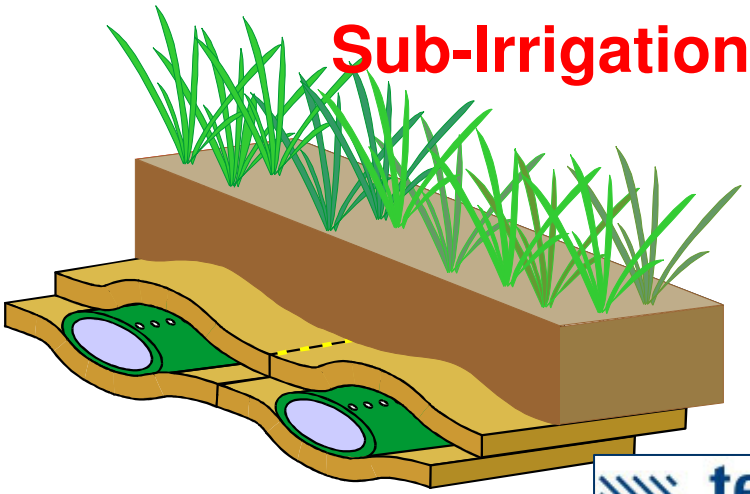
Producer

Textile Irrigation Mat
innovative technology for efficient
Sub-Irrigation of green space

Surface Irrigation means Evaporation

➡ **Pop-up sprinkler have a 50 % higher water consumption**

TEST IN DUBAI (UAE)



techtextil innovationprize.2007 New Products

INNOVATIVE TEXTILE IRRIGATION MAT

- Reduction ofwater consumption and evaporation
- Direct Irrigation in the root area
- Optimised dosing by means of humidity sensors and automatic irrigation systems

Installation of sub soil irrigation mats

Applicaton: large-scale irrigation in arid areas

Installing the irrigation mats

Investigation of root growth In the testing area

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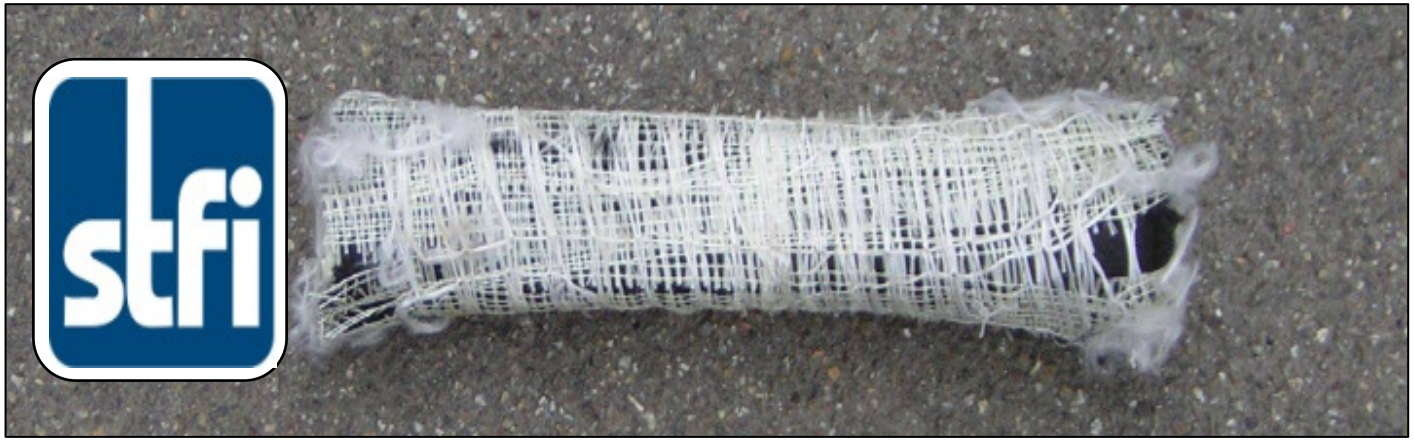
- Textile Wick Drains (vertical drains), STFI development (RIMAX Project)



Further Research on Rope-like Structures

POLYTECT

Integrated Project for SMEs

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Polyfunctional Technical Textiles against Natural Hazards

EU-Project POLYTECT

Coordinator: D'Appollonia, Italy

POLYTECT

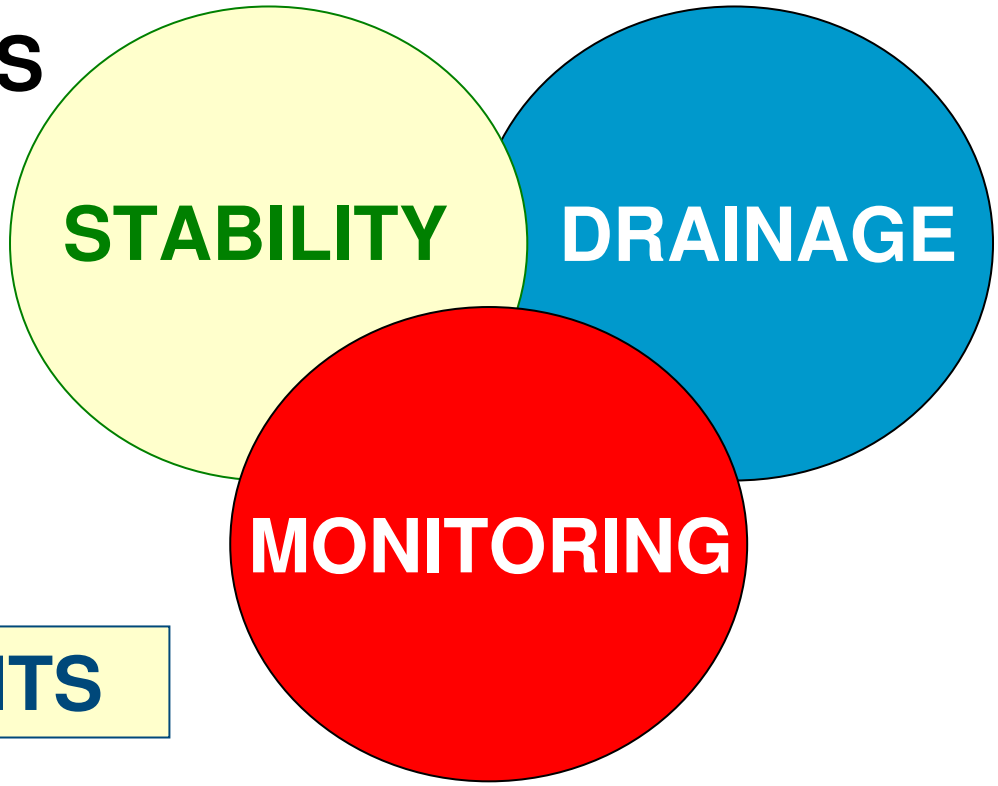
Integrated Project for SMEs

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

From Work Package 5A:

3D ROPE-LIKE STRUCTURES

EMBANKMENTS



REQUIREMENTS

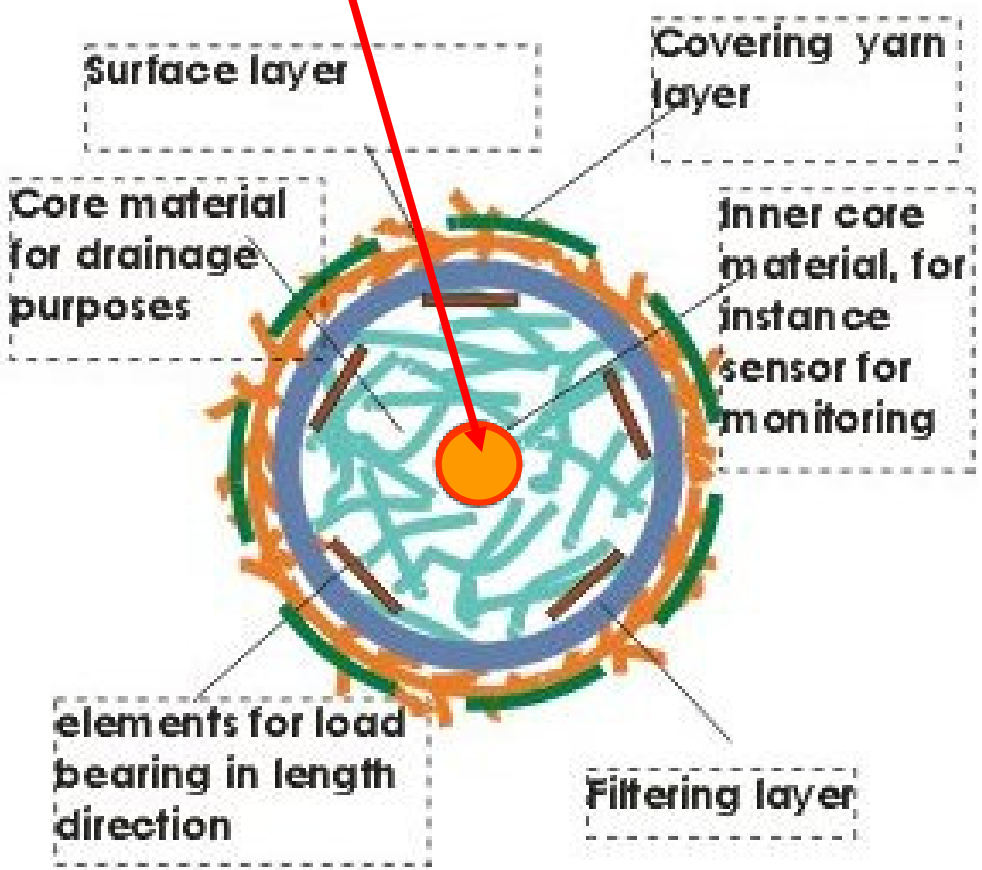
3D ROPE-LIKE STRUCTURES

Vertical drains

Innovation

Multifunctional rope-like structure

Fibre optical sensor



SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

EU-Project

- Reinforced geotextile structures with fibre optical sensors integrated
- Adaption and optimisation of
  - processing technology,
  - machinery and
  - material design

  to guarantee functionality
- Manufacturing trials in laboratory and industrial scales

POLYTECT

Integrated Project for SMEs

Test on the building site „Chemnitz, Hilbersdorfer Kurve“

BAM

UNIKASSEL VERSITÄT

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

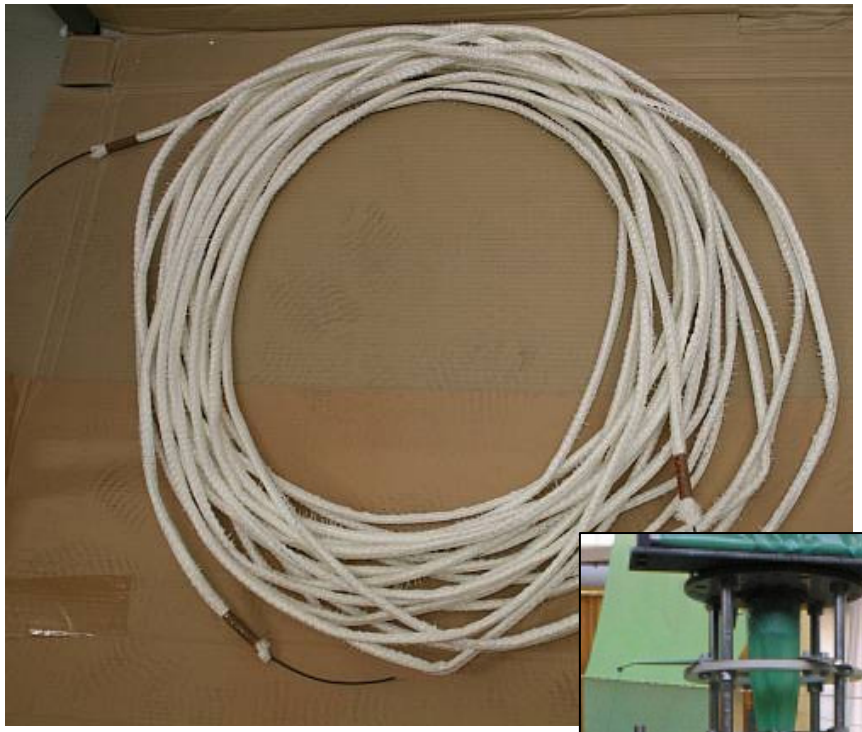
Extreme Materials S.r.l.

Reconstruction of a railway dam

Start: Summer 2007

Example of samples manufactured

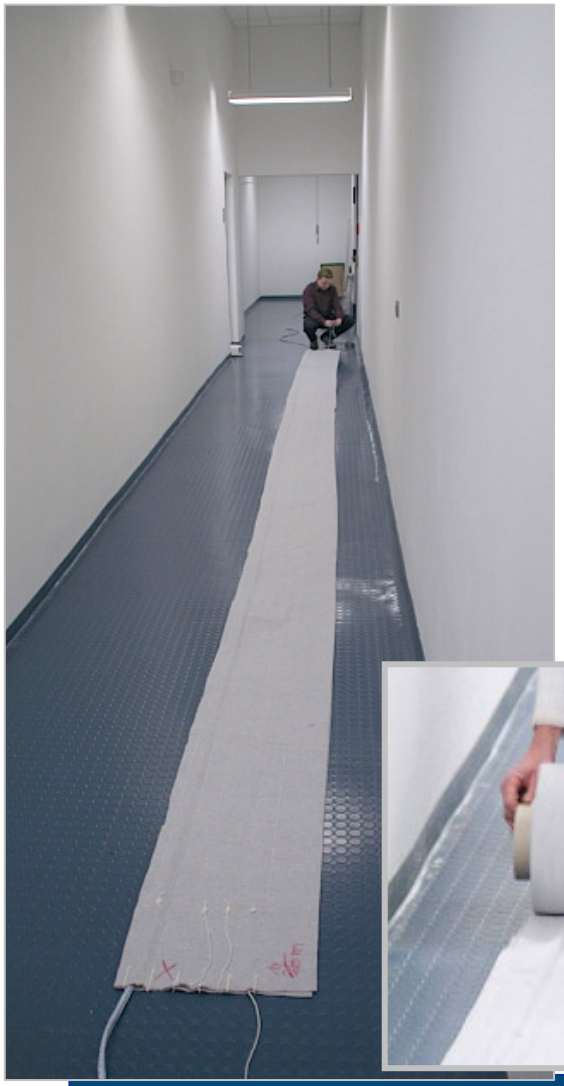
- 3D ropes

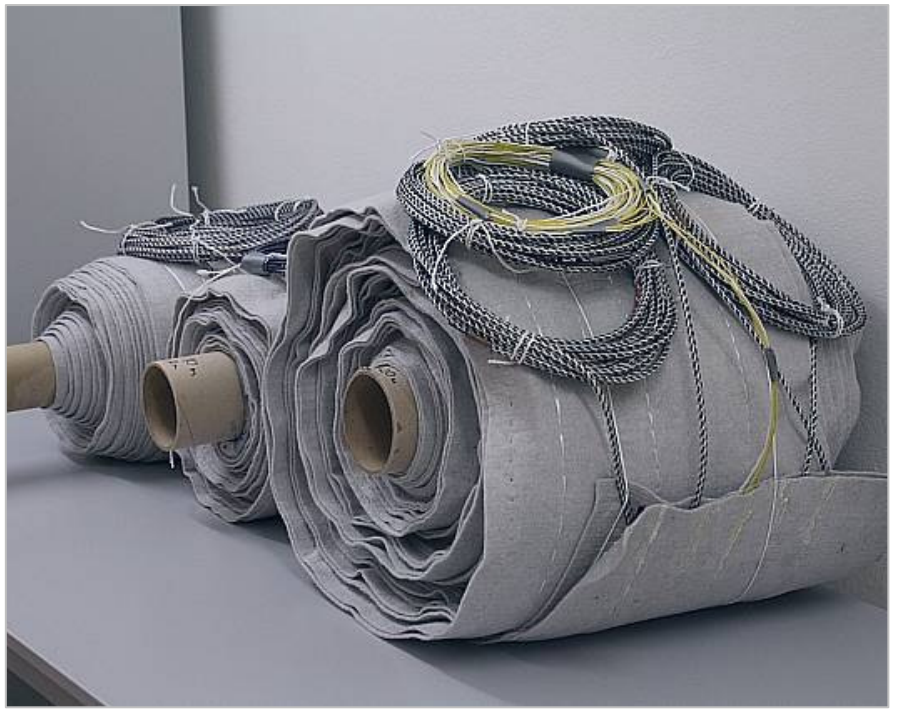


- Sheathing the sensor fibre by using the KEMAFIL® technology

Types of samples produced

3D Surface Type





View on our testing area

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.
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POLYTECT

Integrated Project for SMEs

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Video Presentation

in situ test
Railway Dam Chemnitz, Hilbersdorfer Kurve

Overview

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- 2.6 Example of an International research network

SAB Sächsische AufbauBank

SEERHAUSEN

SMK Stahl- und Metallbau Kaufmann GmbH und Co. KG

dwp

stfi

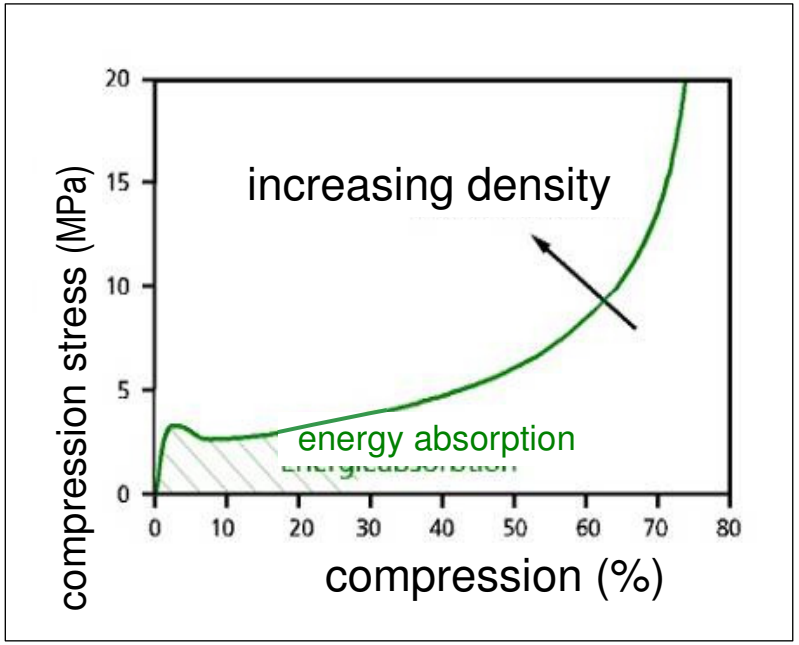
IWU Fraunhofer Institut Werkzeugmaschinen und Umformtechnik

LIGHTWEIGHT DESIGN WITH ALUMINIUM FOAM

Material parameters of aluminium foam

Poisson´s ratio	0,31 - 0,34
density	**0,5 - 0,9 g/cm³**
compression strength (0,7 g/cm³)	approx. 15 N/mm²
heat conductivity (0,7 g/cm³)	approx. 20 W/m·K
material damping (0,7 g/cm³)	approx. $4{,}5 \cdot 10^{-3}$

→ technologically well controllable: 0,7 g/cm³



- fulfills the fire protection requirements according to DIN 4102
- temperature resistance up to approx. 500 °C
- high energy absorption

Benefit of aluminium foam in various fields

Lightweight ⇨ Light core in filigree hollow structures and sandwiches:
Function: structural reinforcement and spacer

Damping ⇨ High material damping parameter:
Function: conversion of oscillation energy

Energy absorption ⇨ High impact energy absorption in terms of deformation work:
Function: crash energy absorber

Joining ⇨ Increase of the volume in the production process:
Function: metallic, high-temperature resistant “adhesive“

Fire protection ⇨ Resists a standard fire of 45 to 60 minutes:
Function: fire protection element

Design ⇨ Aesthetic value of the foam structure:
Function: design element

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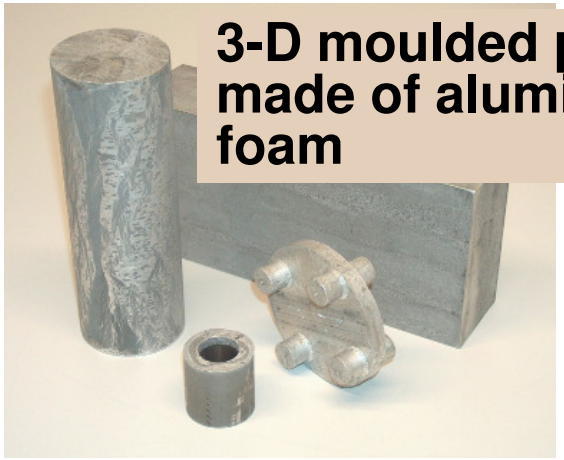
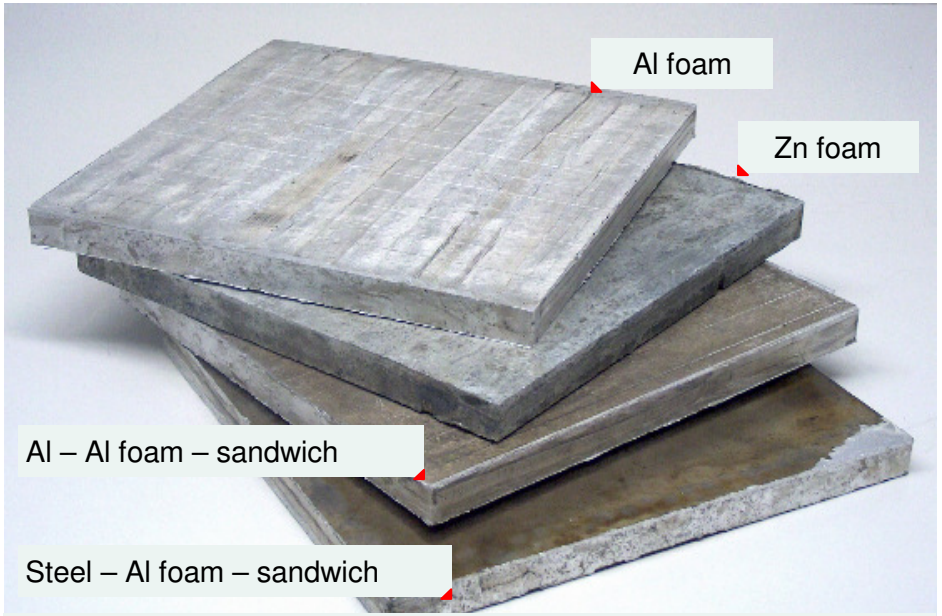
Typical semi-finished products



3-D moulded parts made of aluminium foam

Steel profiles foamed in pack



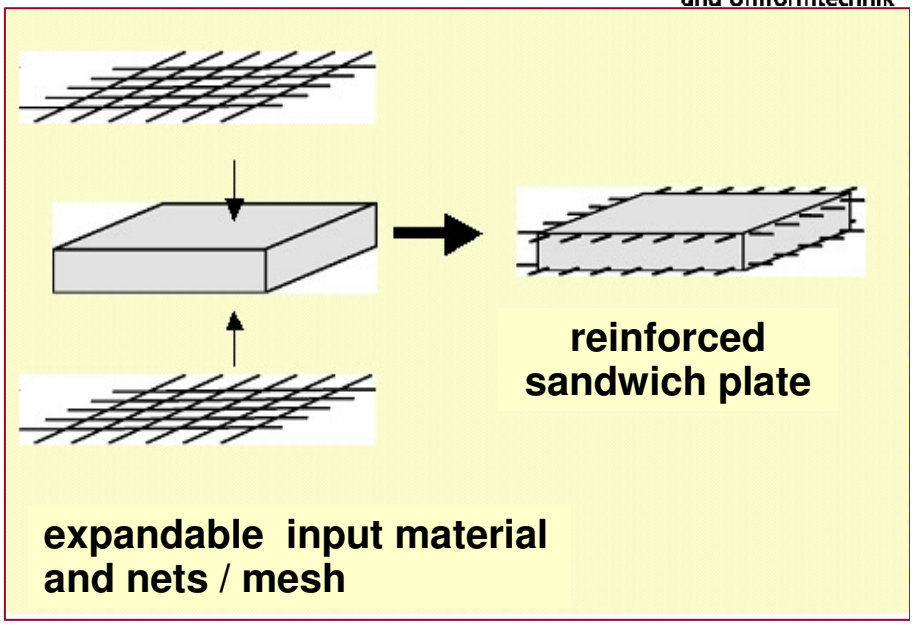
Metal foam and sandwich plates comprising metal foam

Definition of load cases for the composite design

Comparison of sandwich plates and plates reinforced by woven/knit fabrics:

Sandwich plate

- significant advantages in deadweight
- high tensile and shear strength (e.g. bonded)
- usually combination of strong surface layers and light-weight core)
- surface layers preferably stiff regarding strain, core smooth regarding shear



The composites can be subject to various loads

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Comparison:

Woven fabric

made of stainless steel

mass/area approx. **1,7 kg/m²**
($Ø_{wire}$ = 0.5 mm, 16 meshes/cm², fabric thickness 0.12 mm)

Steel sheet

of the same dimensions

approx. **9,4 kg/m²** **Fivefold !**

➡ **enormous lightweight design potential**,

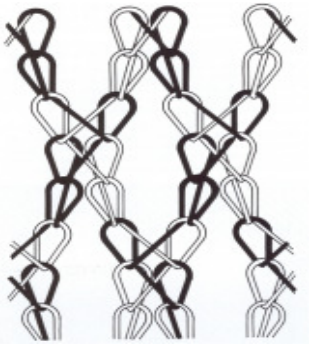
Condition: Absorption of the arising loads with novel composites

Advantages of fabric/knit fabrics compared to solid structures (sheets)

- **Drapeability** (complex geometries educible)
- Applications with just aluminium externally, but simultaneously **supporting structures near to the surface** which can absorb forces
- **Flexibility** to respond elastically to forces
  (e.g. yielding of slings/nodes or of drilled materials)
- Realisation of **anisotropic properties** which allow a particular reaction
  (e.g. load absorption, use of various wire materials in the fabrics/knit fabrics or asymmetric design like rectangular instead of square meshes)

Special features of knitted fabrics

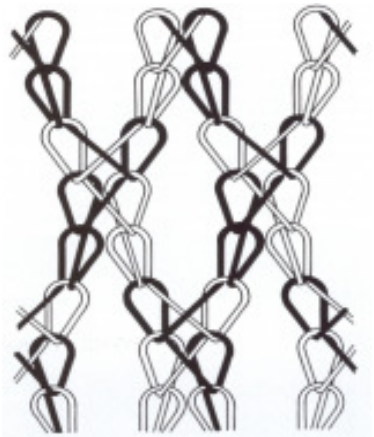
- Drapeability definable as required
- Flexibility / bending elasticity variable
- Strength and stress-strain-behaviour variable
- Net opening size as required



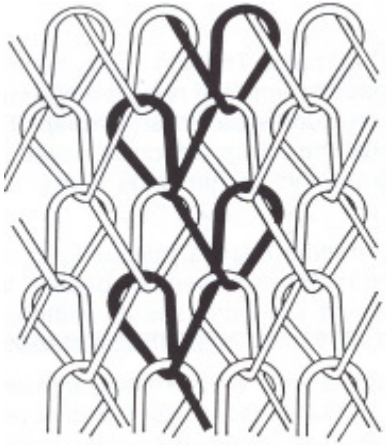
- Good dimensional stability (no sliding of the structural elements)
- Mechanical properties in both directions relatively independent
- Mono- and biaxial structures possible
- 3D structures imaginable

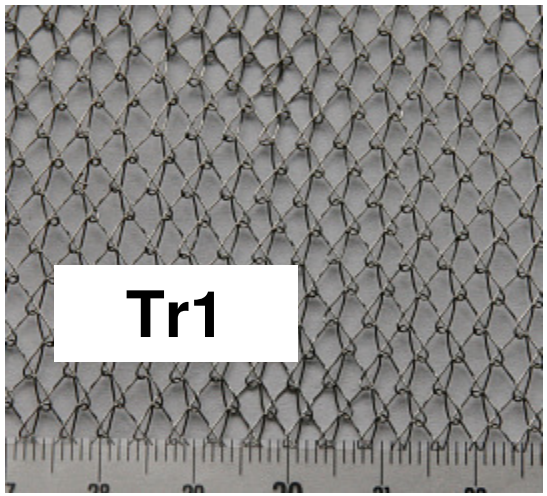
Examples

Net of 22,5 mm aperture size containing loop material only



Single-face tricot structure





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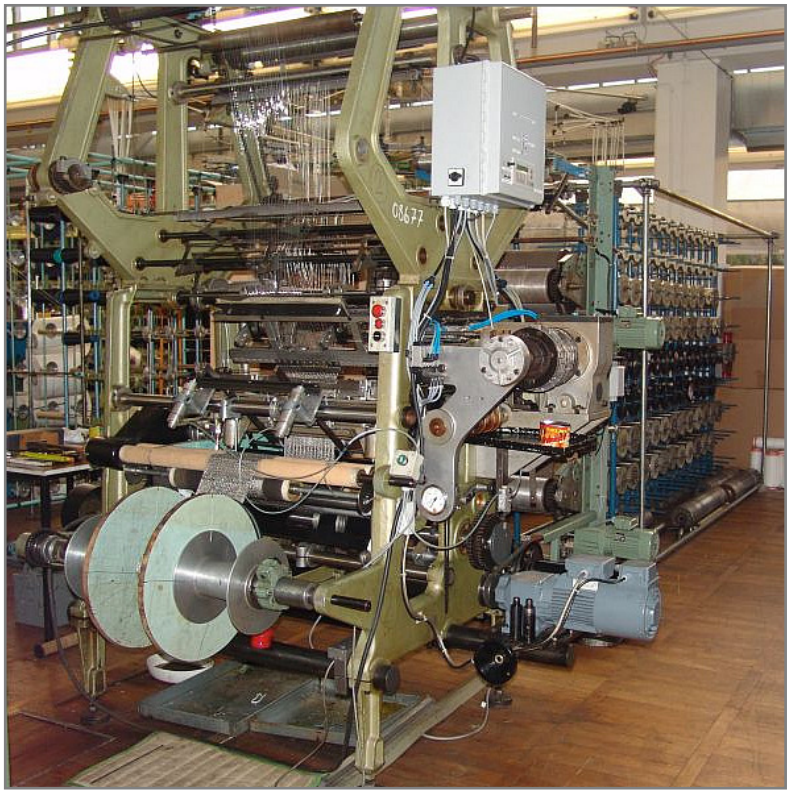
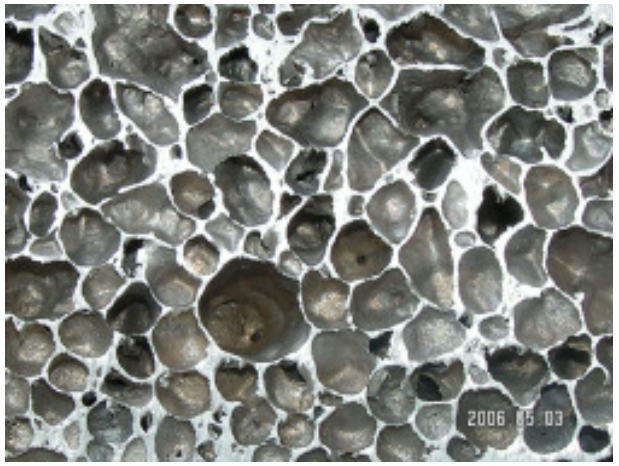
Machinery used

Test rig



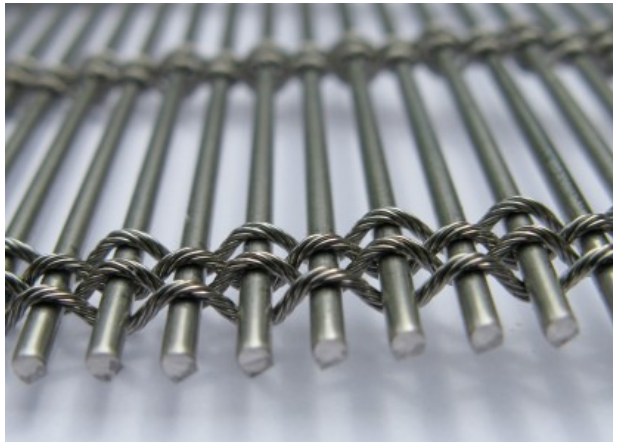
Textile Reinforced Aluminium Foam

Demonstrator balcony platform



Aluminium foam

Bending specimen of reinforced foam



Rod-steel mesh

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

1. Technical textiles – General Aspects

1.1 Classification
1.2 Characteristics Features
1.3 Production technologies, material

2. Research and Development

Some Examples of Research Work by STFI,
Dep. Technical Textiles, Weaving and Knitting

2.1 Erosion Protection and Planting of Embankments
2.2 Technical Textiles for Water Purification
2.3 Textile Plant Carriers and Irrigation Mats
2.4 Multifunctional Rope-like Structures
2.5 Textile Reinforced Aluminium Foam

2.6 Example of an International research network

International Colaboration

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

German-Czech network of excellence „Geotextiles for Restoration, recultivation and environment”

Initiative of the Federal Ministry of Education and Research (BMBF)

to spread knowledge about Germany's diverse science and research landscape and to find suitable partners for research collaborations

Network of Excellence

SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

Comparable **conditions** in post landscapes of lignite opencast mining in Germany and Bohemia

Aim:

Building up a network and application-oriented clustering of core competencies in the field of research and development together with industrial partners, universities and other institutions in the field of the application of geotextiles - crossboarder scientific dialog

Focus: Application of textiles in geotechnics, water revitalisation and management, environment, landscaping, ecology and related standards

Network of Excellence

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Main activities

- **4 workshops**
  1 in Germany, 3 in the Czech Republic),
- **2 field trips**,
- **several partner meetings**,
- **boots on 2 exhibitions**
  Envibrno (Cz), GaLaBau 2009 (D)

➡ **Great number of contacts acquired as a basis for future cooperation**

Network of Excellence

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Workshop in Chomutov (Cz)

Boot at GaLaBau Nuremberg

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SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

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SÄCHSISCHES TEXTIL FORSCHUNGS INSTITUT e.V.

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For further info and contacting us please visit the Web Page of the project:

http://www.polytect.net

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Die Abschlussberichte können beim STFI e. V. Chemnitz abgefordert werden.

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