Prepreg Technology at Polymer Engineering

Development of modern prepreg materials

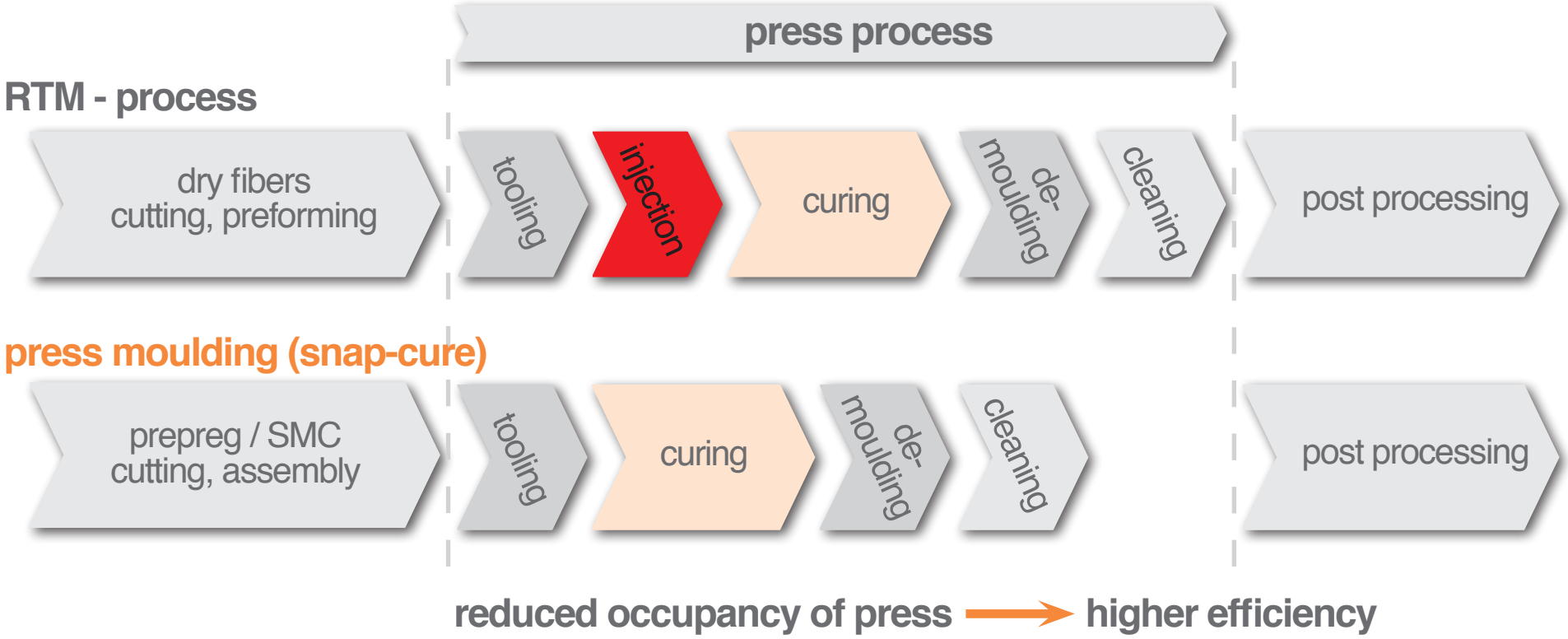
Department of Polymer Engineering / Professor Dr.-Ing. V. Altstädt / www.polymer-engineering.de

Applications of Prepreg Materials - Overview

Aerospace - Structural Components

A 350 wingskin

Automotive: Snap-Curing Prepregs



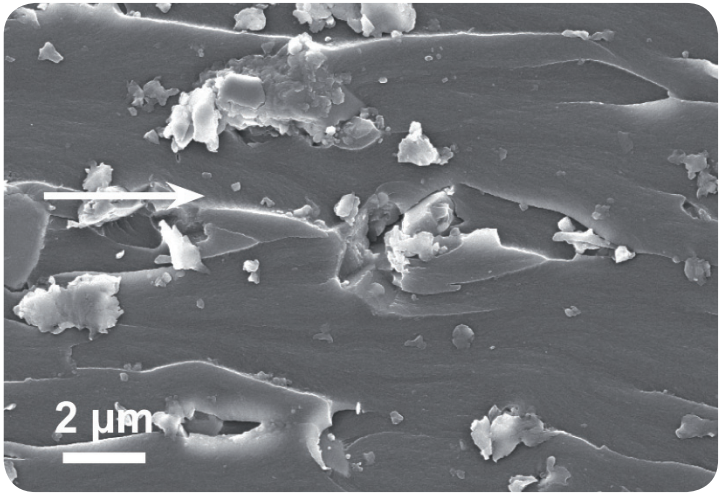
	curing temp / °C	curing time / min	cylce time / min	quantity / pcs.
press moulding	150 °C	2 - 3 min	3 min	> 50.000
resin transfer moulding	120 °C	2 - 5 min	> 5 min	< 50.000

Prepreg Processing Chain at Polymer Engineering

Resin Development for Prepreg Processes

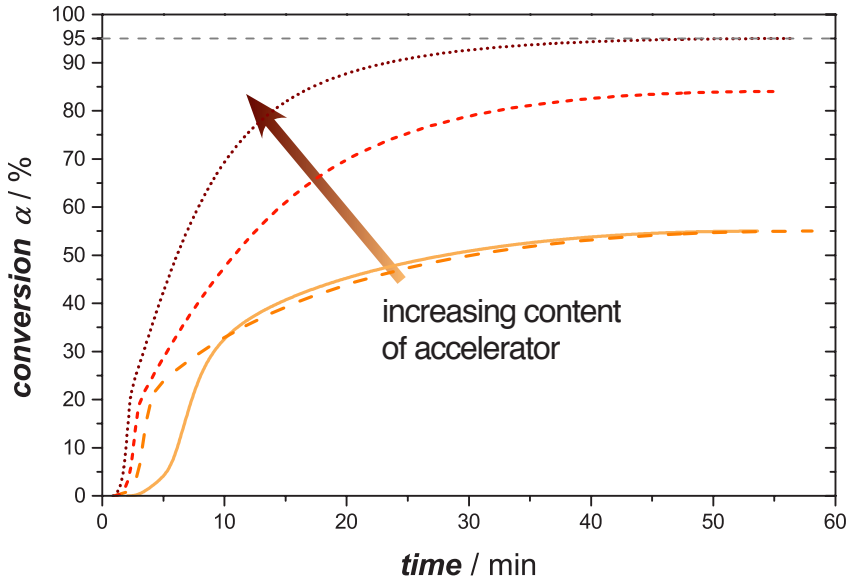
Challenges for novel prepreg resin systems

- Optimize tack properties for automated placement
- Fast curing at moderate temperatures
- Out of autoclave curing
- Optimisation of cure induced warpage and shrinkage
- Functionalities:
    - Fire behaviour
    - Electrical properties
    - Barrier properties
- Improved Toughness

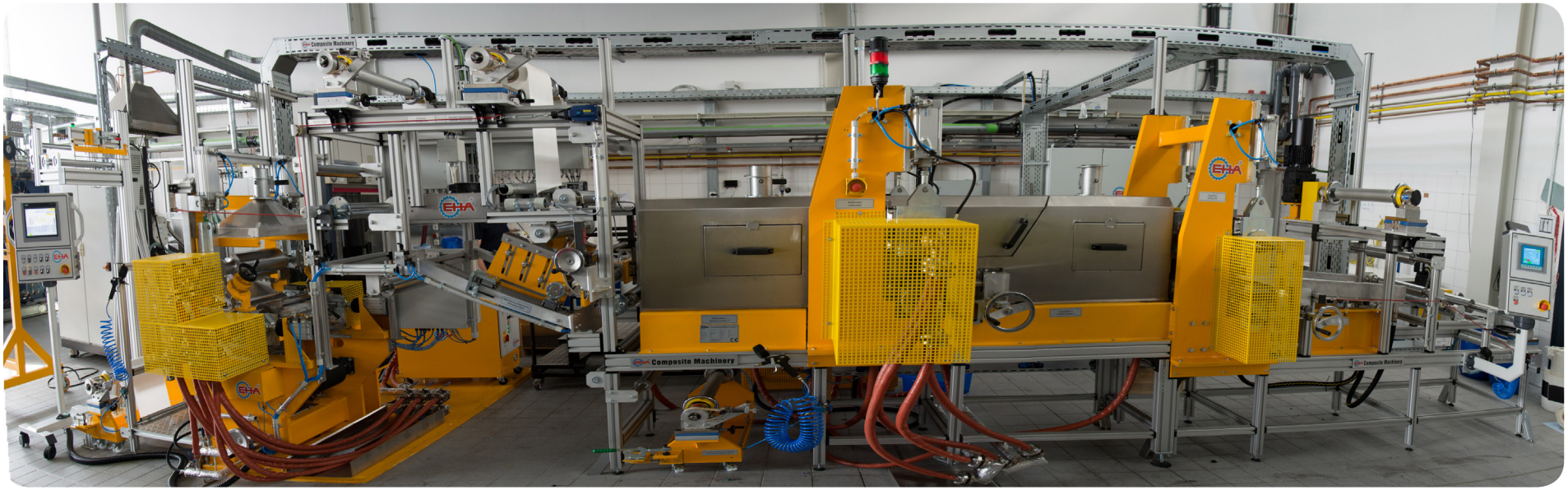


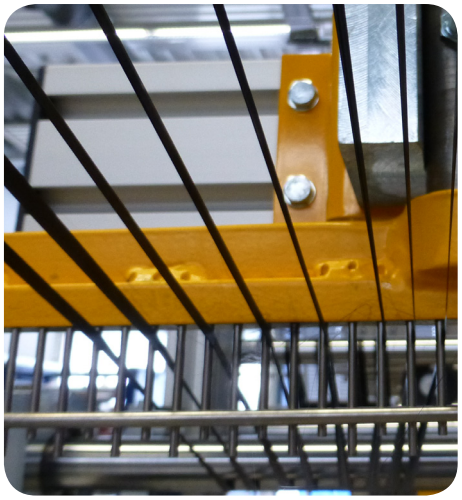
Equipment for Resin Formulation

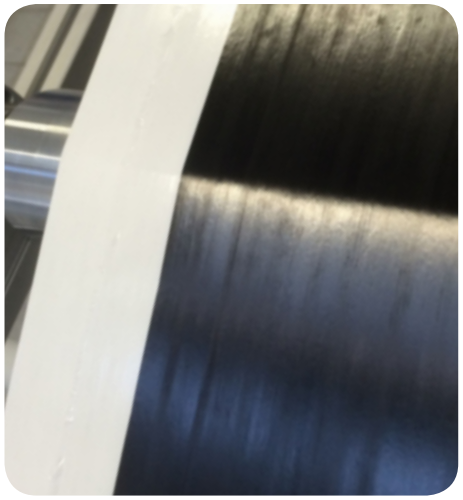
- Chemistry lab for formulation of thermoset resins
  - Speed Mixer
  - Curing Ovens
  - Vacuum Mixing Unit
- Dispersion of fillers in nano- and micro scale
  - High-Pressure Disperser
  - Ultasound Dispersing
- Determination of curing kinetics and decomposition behaviour:
  - (High pressure) DSC
  - Thermogravimetric Analyzer
  - Rheology Lab



Pilot Prepreg Plant



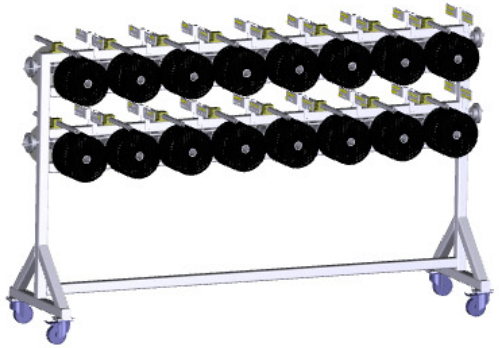


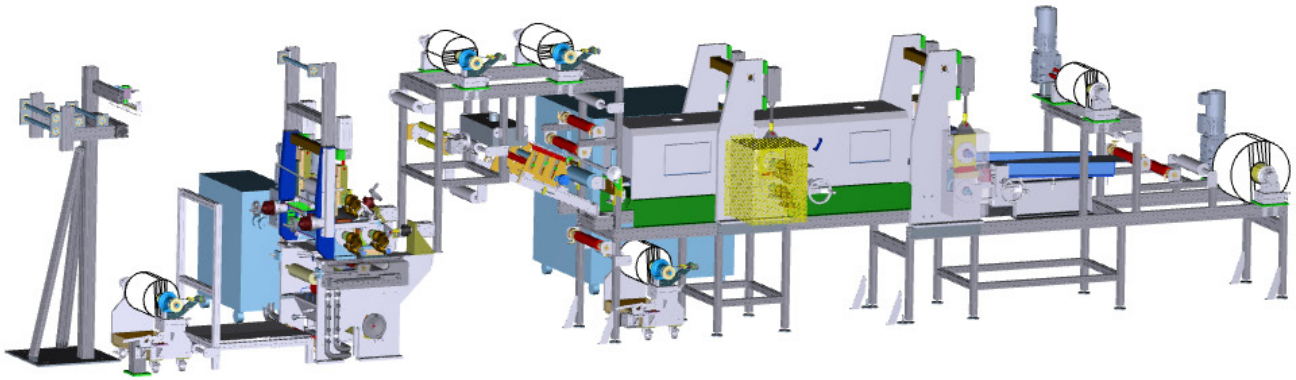


Pilot Prepreg Plant

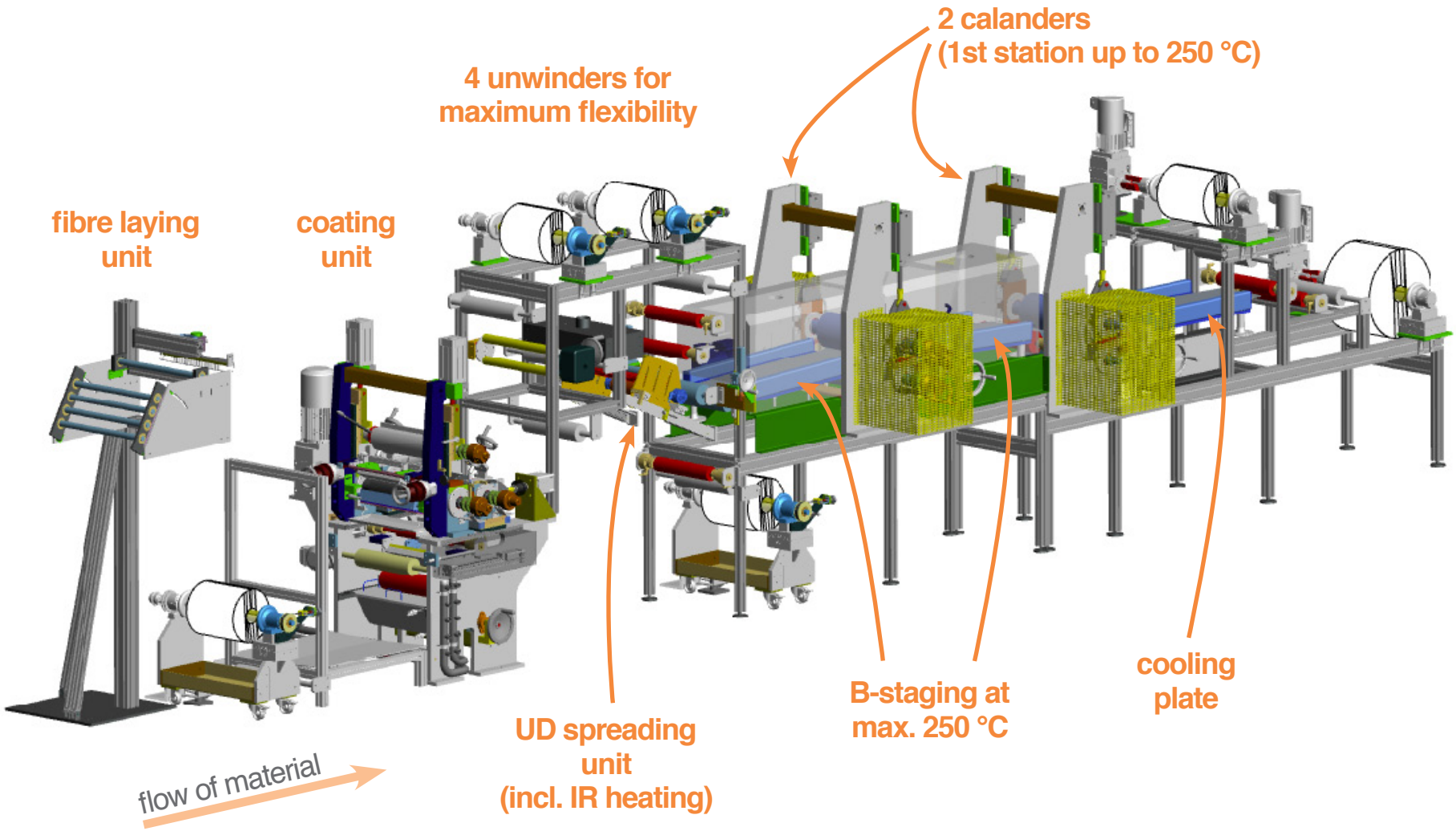
Specification:

- Working width: max. 30 cm
- Reinforcements: up to 32 UD-Rovings or textile fabric
- Matrix systems: solvent free resin systems - app. 10 to 50.000 mPas
- Line speed: 1 to 10 m/min
- Dimensions: app. 16.5 m x 2 m x 2.5 m (l x w x h)

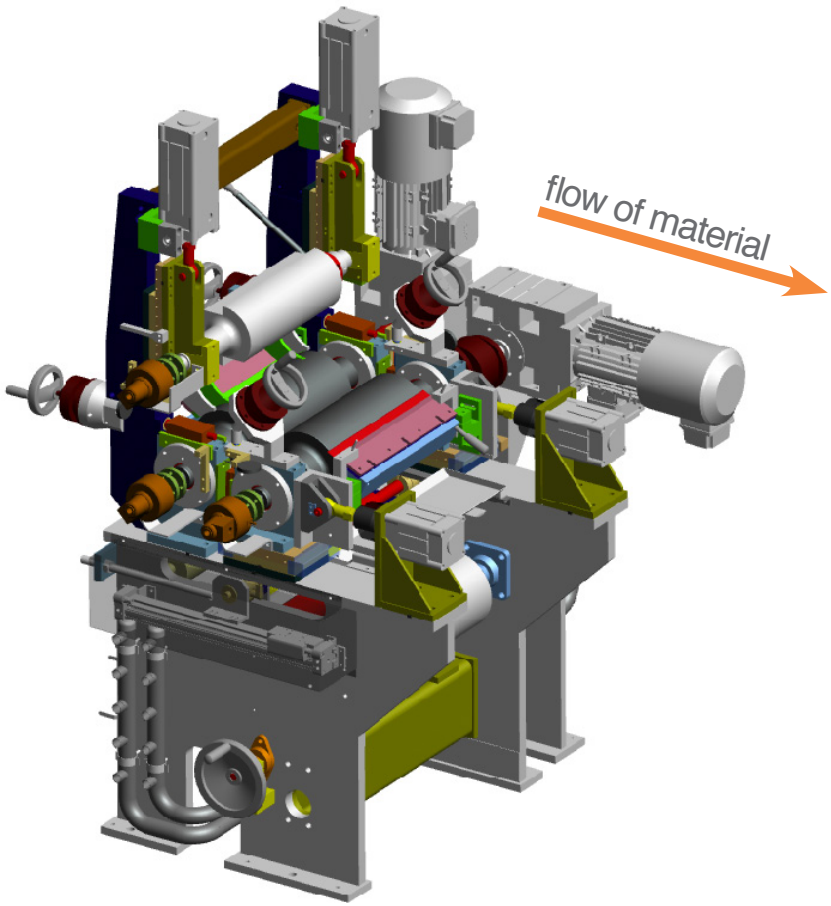




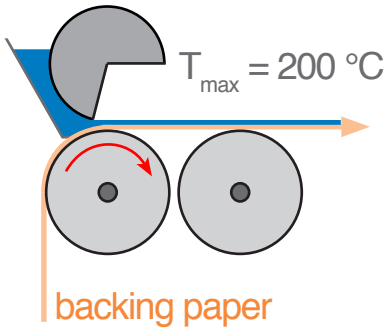
Pilot Prepreg Plant - Technical Details



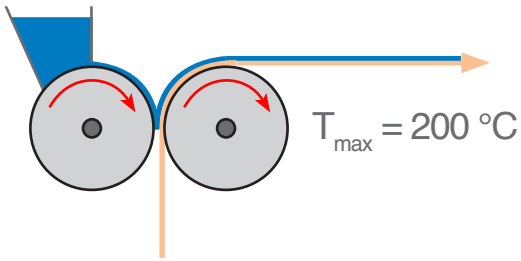
Flexible coating unit



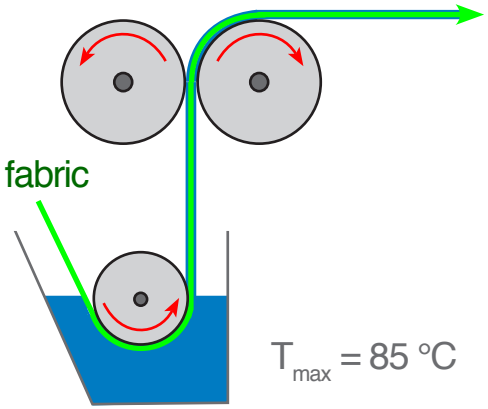
comma bar



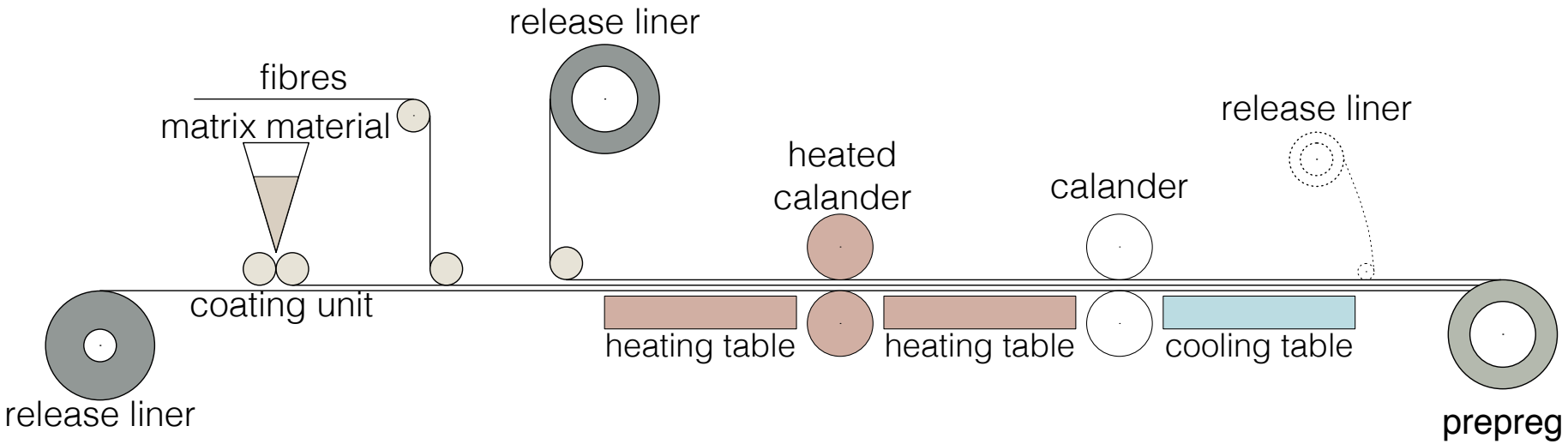
indirect coating



foulard



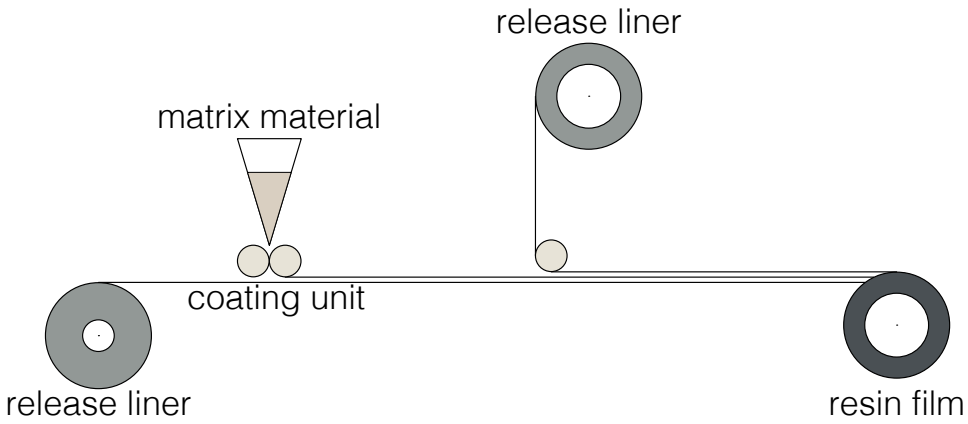
Prepreg Processing - In-line Impregnation



Direct in-line impregnation of UD-fibres or low aerial weight woven fabrics.

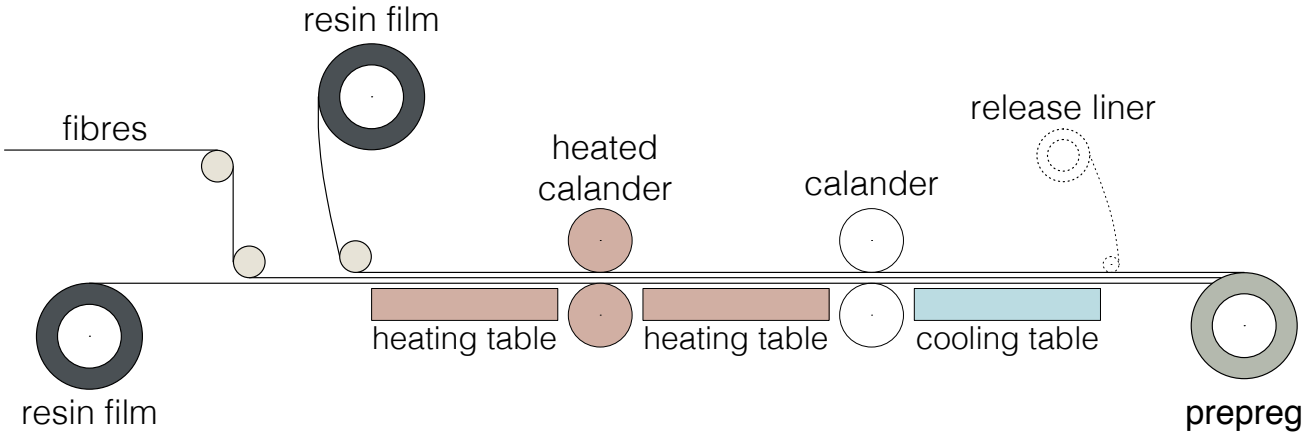
Prepreg Processing - Off-line Impregnation

Step 1: Resin film production



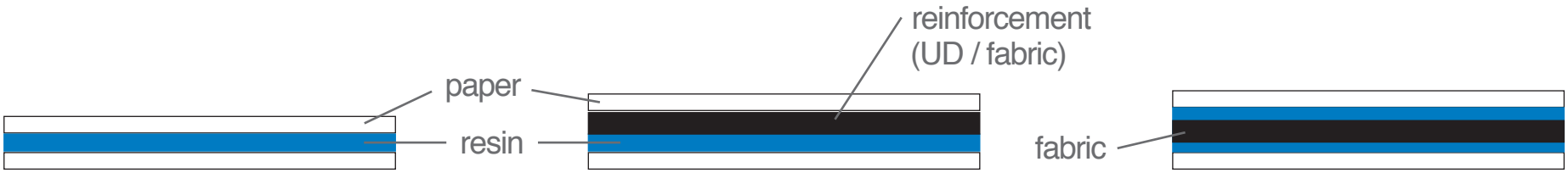
Bildquelle: 3M

Step 2: Prepreg impregnation



Maximum flexibility - tailoring prepregs

In-line impregnation (possibilities) - exemplary:

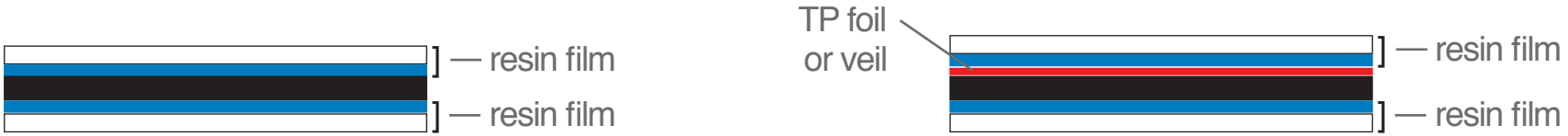


resin film

in-line impregnation
(from bottom side)

dipped fabric

Off-line impregnation (possibilities) - exemplary:



both sided film impregnation

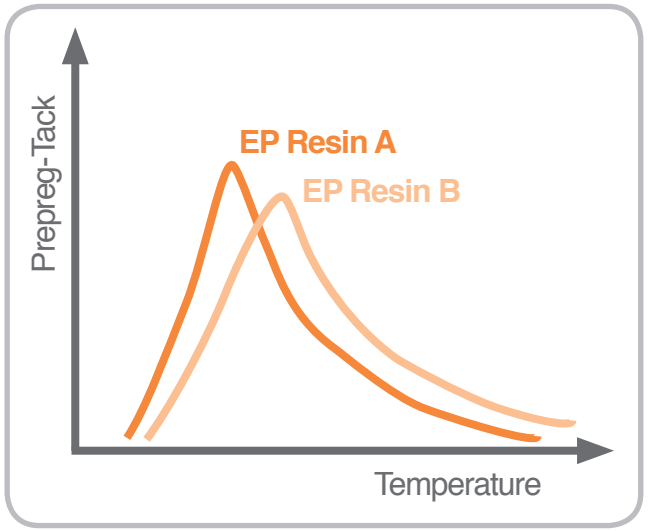
modification by foils or veils

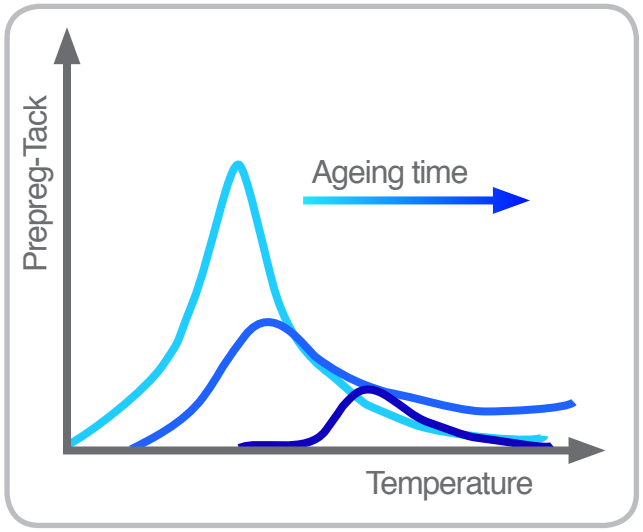
Characterization of Prepreg Properties

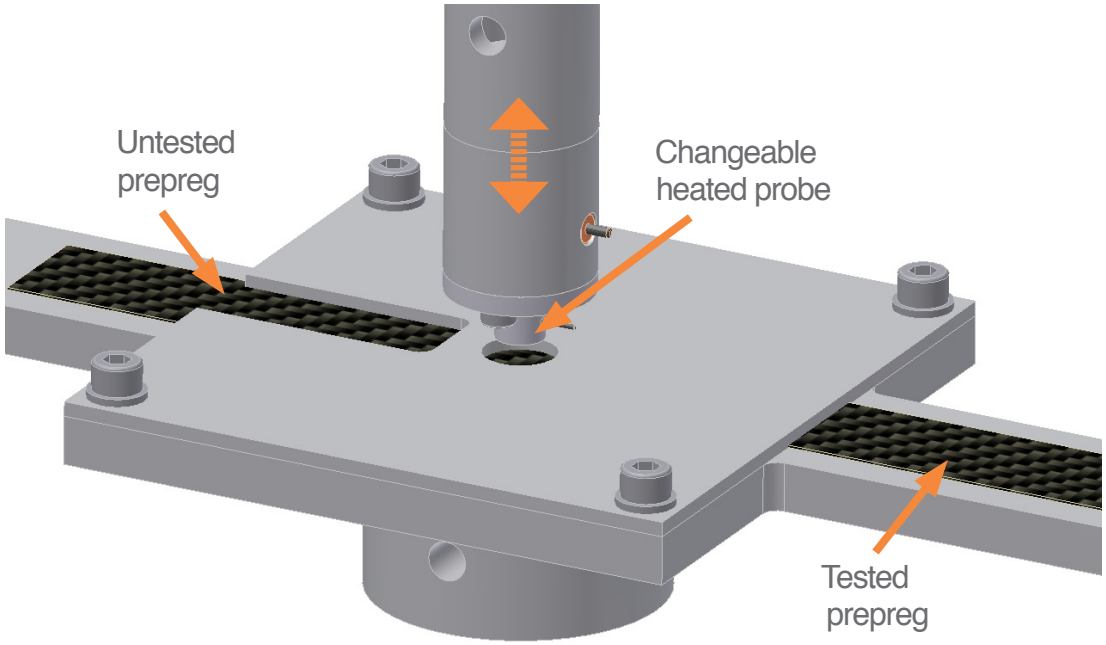
- Aerial Weight
- Resin Content
- Resin Flow
  (acc. to DIN, ASTM and IPC standards)
- State of Impregnation
- Tack properties

Bildquelle:
Zoltek

Characterisation of Tack Properties

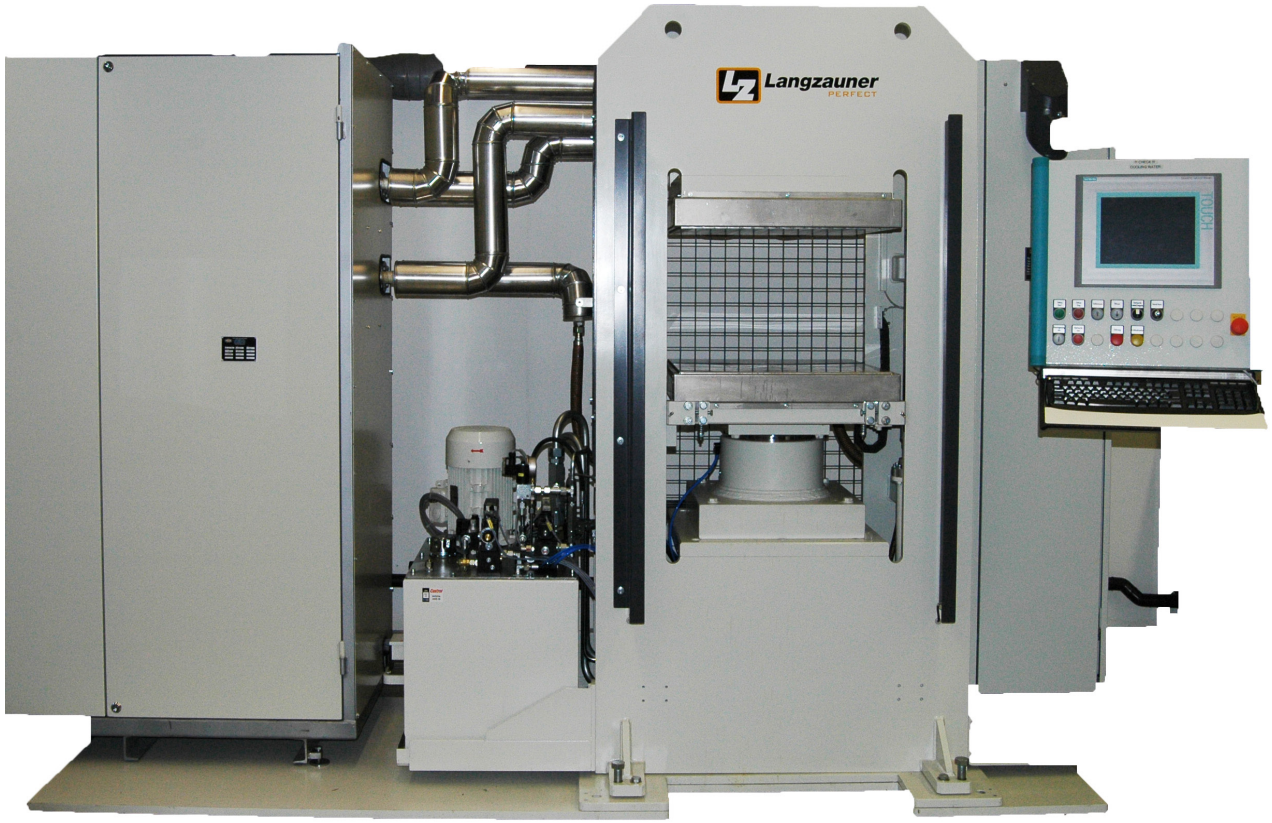






Tack is a major material property for automated as well as for manual fibre placement applications.

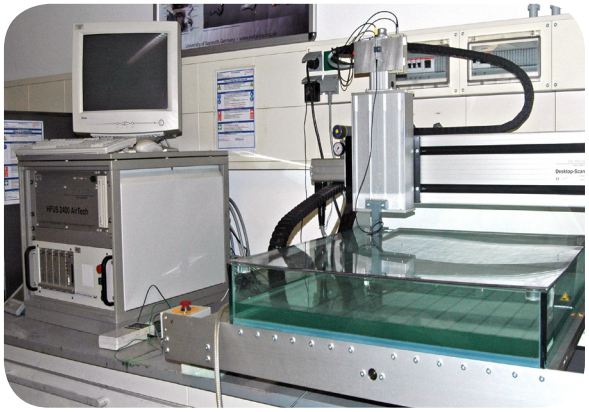
Out of Autoclave Curing

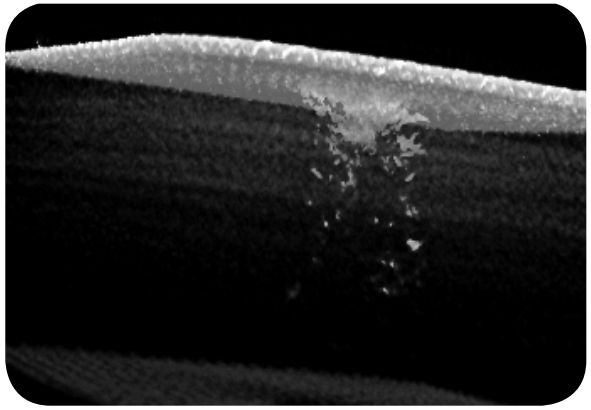


Hydraulic Heating Press

- Press area: 60 x 60 cm^2
- Press capacity: 1000 kN
- Temperature range:
  25 to 250 °C

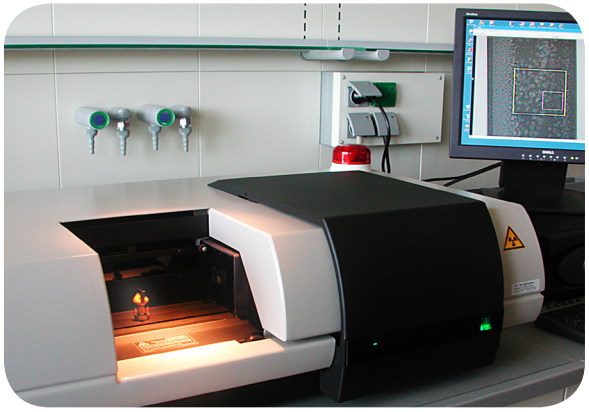
Non-destructive Testing

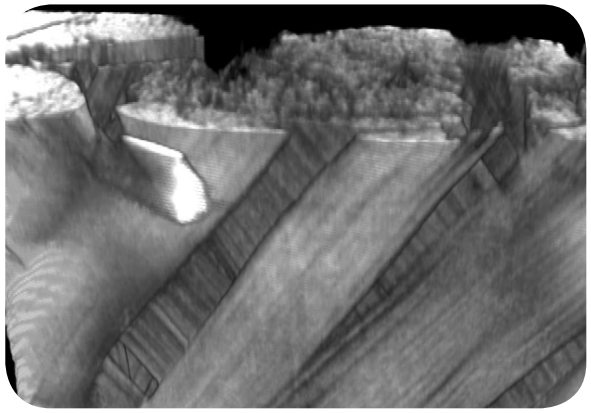




Ultrasonic Testing

- Quality Assurance
- B- and C-Scan Mode
- 3D Visualization





Micro-CT

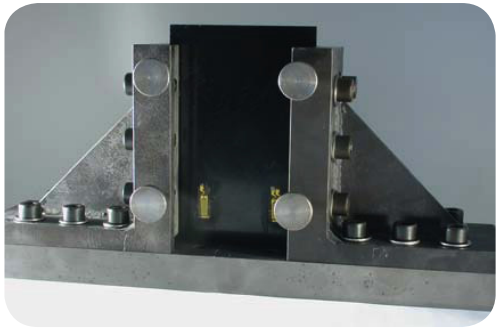
- max. resolution: 5 μm
- Porosity
- Fibre wetting

Mechanical Testing Center

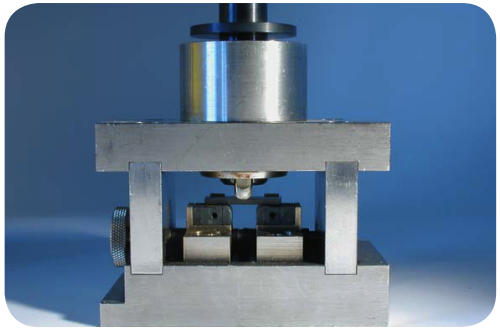
Zeitstandsprüfung im Kellergeschoss

Composite Testing - Mechanical Characterisation

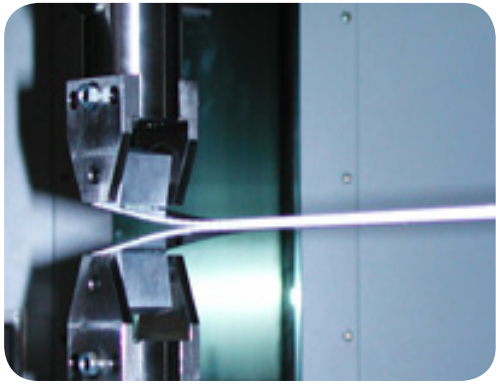
Impact

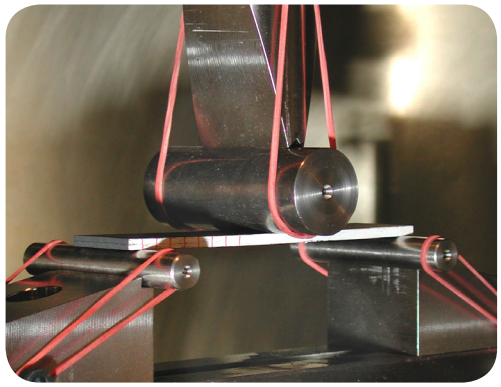


Compression after impact



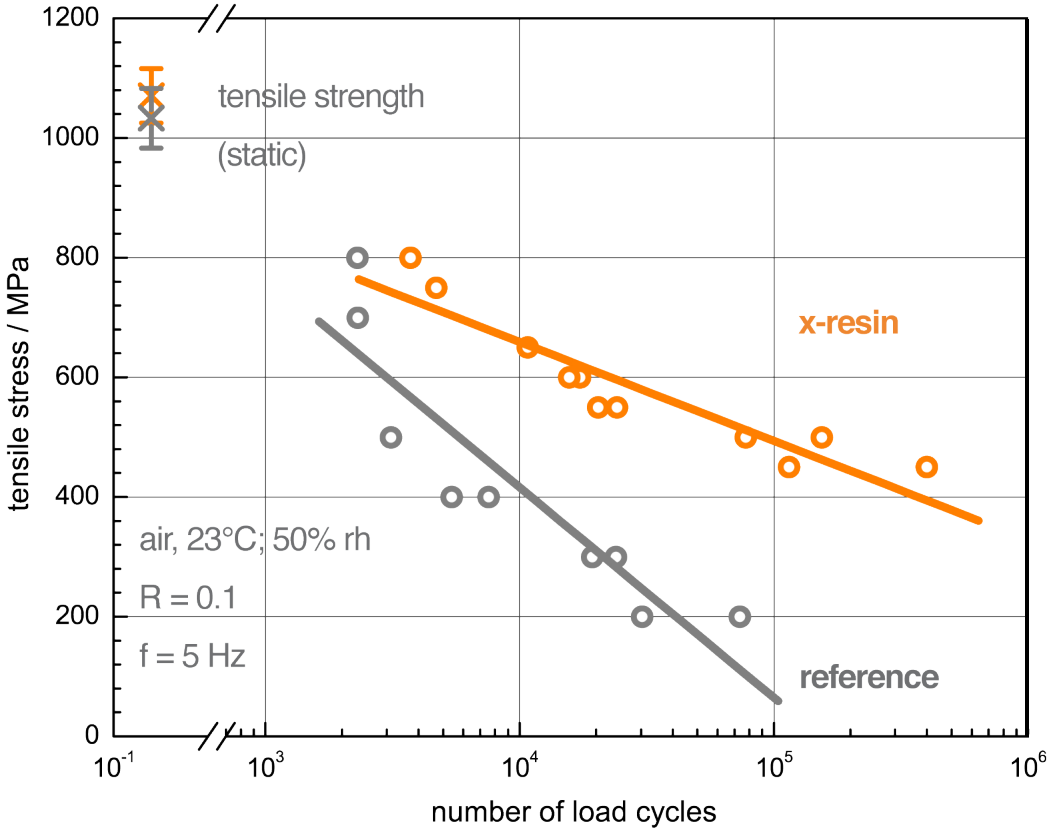
ILSS

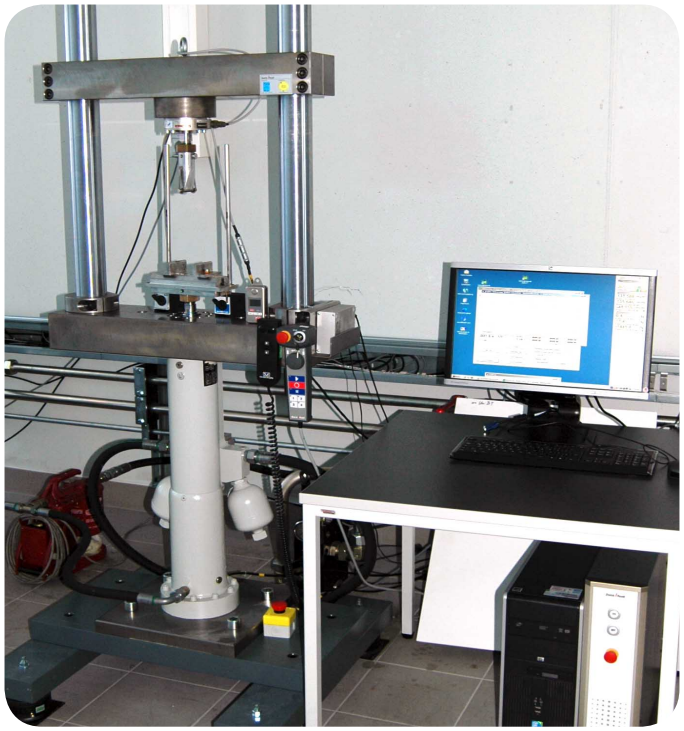




Interlaminar fracture toughness mode I & II

Dynamic Testing of Composites





7 servohydraulic testing machines. Maximum dynamic load: 40 kN

Prepreg Processing Chain at Polymer Engineering

How to Cooperate?

- Public funded research projects
  in coopreration with industrial partners
- Direct industrial cooperation

- Material development
- Evaluation of processability
- Production of sample material
- ...

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