Plastics and Lightweight Design
Topics

- Weight-reducing structural and drive components
- Material design, joining and connection techniques for functional and high-performance systems
- Functionalized automotive components, material systems and surfaces
- Flexible, efficiency-enhanced processing chains suitable for serial production
- Environmental compatibility and processing of renewable raw materials
- Material and process simulations for design and optimization of molded parts and manufacturing processes

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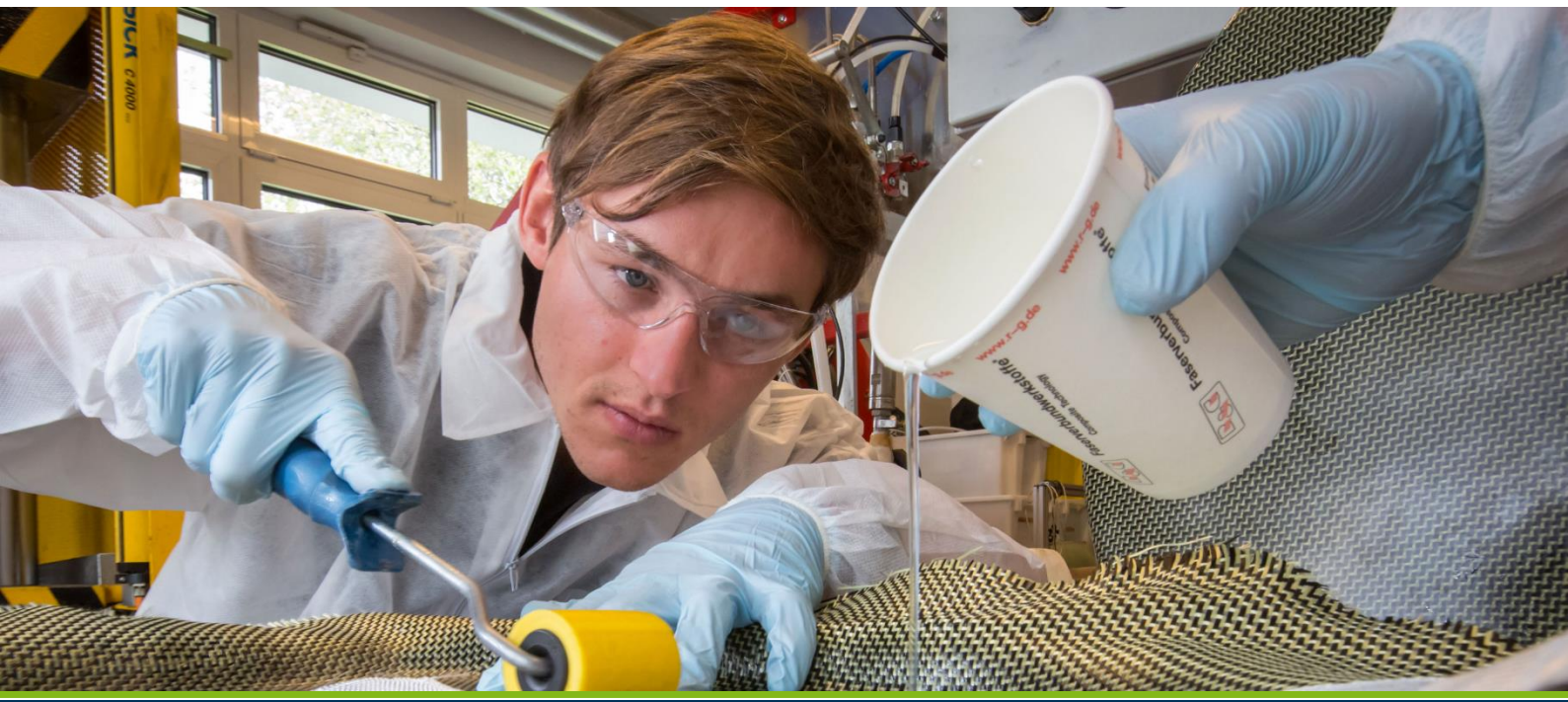


Extrusion and Foil processing

Single-screw extruder ES 45

- Plastification of plastic granules & powders
- Processing of plastic into foils or semi-finished products

Specifications:

- Screw diameter: 45 mm
- Screw length: 25 D to 50 D
- Screw speed max. 160 rpm
- Drive power: 17.2 kW
- Extrusion height: 1,000 mm
- Throughput PE: 150 kg/h
- Throughput PP: 150 kg/h
- Amount of sensors: 8
- Smooth und grooved feed section

Source: WEBER

Cast film line TYP LCR 350 HD

- Production of organic sheets, films and boards

Specifications:

- Roller group with three big rolls
- Roll diameter: 145 mm
- Roll width: 400 mm
- Production of boards with 0.3 to 2 mm thickness and 350 mm widthness
- Oil-based roll heating

Twin-screw extruder ZSK 40

- Compounding thermoplastic materials
- Incorporating organic and inorganic fillers and reinforcing materials, flame retardants, reinforcing fibres

Specifications:

- Screw diameter: 40 mm
- Screw length: 38 D
- Screw speed: max. 400 rpm

Twin-screw extruder ZSK 25

- Compounding thermoplastic materials
- Incorporating organic and inorganic fillers and reinforcing materials

Specifications:

- Screw diameter: 25 mm
- Screw length: 36 D
- Screw speed max.: 600 rpm

Blown film line „Blowmaster“

- Miniaturized blown film line with a comparable range of functions

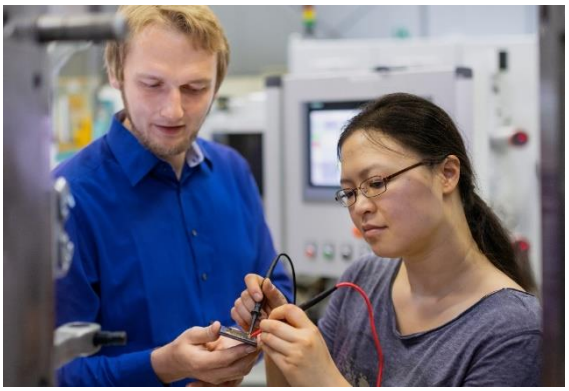
Specifications:

- Max. height: 2,10 m
- Assemblable and transportable
- Max. foil width: 500 mm
- Incl. stabilization of the foil tube by an integrated cooling ring

Injection molding

KraussMaffei type KM 160/750/180 CX V

- **Two-component injection molding**
- Overmolding of aluminum and organic sheets with suitable plastics
- Multiple component injection molding for manufacturing plastic components that conduct electricity
- Sandwich injection molding
- With turntable tool



Specifications:

- Clamping force: 1,600 kN
- Fully hydraulic dual-platen clamping system
- Injection unit 1: Size: 750; horrizontal; Screw diameter: 45 mm; Nozzle radius: 10 mm; Nozzle bore: 4 mm
- Injection unit 2: Size 180; vertical; Screw diameter: 30 mm; Nozzle radius: 10 mm; Nozzle bore: 4 mm

KraussMaffei type KM 80 CX 380

- Injection molding machine with interchangeable mold inserts
- Production of specific molded parts

Specifications:

- Clamping force 800 kN
- Fully hydraulic dual-platen clamping system
- Injection unit : Size: 380; horizontal; Screw diameter: 35 mm
- Working volume: 154 cm^3
- Injection pressure max.: 2,429 bar

Fibre composite technology with a hydraulic 4-column press

ATM Typ RWP700

- RTM process and fibre composites

Specifications:
- Clamping force: 100 t
- Opening stroke: 500 mm
- Clamping area: 750 x 750 mm
- Settable time and temperatures
- Heating temperature: max. 250 ℃

Resin preparation systems and purifiers

Wolfangel 100/120/25/17

- Piston injection system
- Epoxy resin and unsaturated polyester resin

Specifications:
- Pressure: up to 10 bar
- Vacuum-supported
- Variable mixing ratio

Eldomix 103

- Heatable gear pump
- Suitable for epoxy resin, unsaturated polyester resin, polyurethane (including foams)

Specifications:
- Mixing ratio: 100:100 to 100:20
- Volume flow: 0.1 – 1.0 l/min
- Melt temperatures up to 80 ℃
- Vacuum support possible

Production and processing of organic sheets

Thermoforming System

Rucks type KV 293-5

- Hydraulic 4-column upstroke press 430 kN
- Integrated preheating station and material transfer system
- Vacuum pump 3 mbar, 13 m³/h
- Energy consumption display and diagnostic program
- Forming of thermoplastic semi-finished products, in particular organic sheets and foils

Source: Rucks

Direct extrusion line to produce continuous fiber reinforced organic sheets

SUCHY Textilmaschinenbau GmbH 022/19

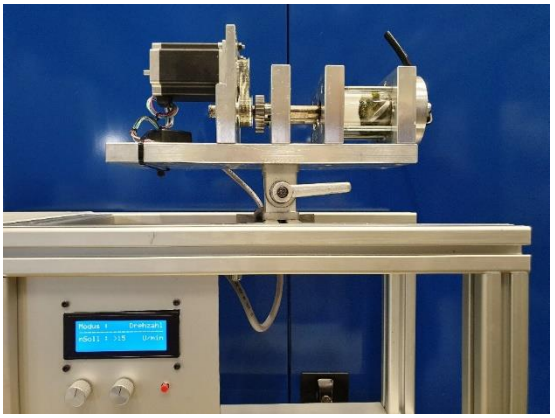
Impregnation of three endless fiber layers with thermoplastic melt

- Gravimetric feeding of plastic via a metering device to the twin-screw extruder
- Melting of the plastic in the extruder
- The thermoplastic is fed through a distributor into three melt pumps
- Transfer of the melt to three direct extrusion tools using two heating hoses each
- Impregnation of the fiber layers pre-stressed and preheated by the roll holders with the melt
- Feeding to a calender roller, which presses the layers together and pulls them through the system
- Side and length trimming to the required dimensions in the downstream integrated process
- Overall control of the system via a central touch screen

Treatment process, crash test and permeability

Miniature indoor mixer

- Transparent mixing chamber for simulating the mixing process of plastics with fillers in an internal mixer
- Model fluids (e.g. silicone oil) instead of plastic
- Motor torque: 3.1 Nm
- Speed: up to 600 rpm
  Rotor arrangement: counterrotating
- Gap width: 1 mm
- Chamber volume: 53.3 cm^3

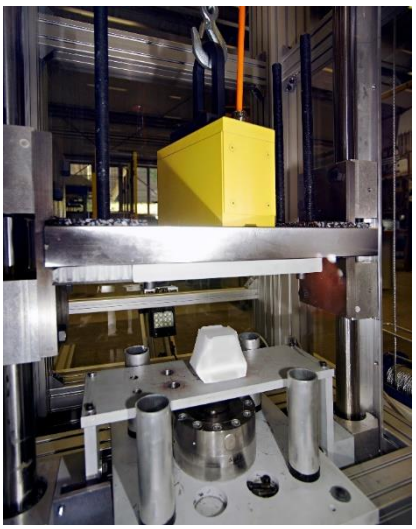


Drop tower

- Experimental investigation of crash relevant components regarding deformation behaviour
- Max. drop hight 3 m
- Max. mass 291 kg
- Max. impact speed 25 km/h
- Determination of force-displacement curves
- Optical evaluation using a high-speed camera

Permeability test for semi-finished fiber materials

- Measurement of the permeability of flat fabrics
- Glass tool 300 mm x 300 mm



Thermal analysis

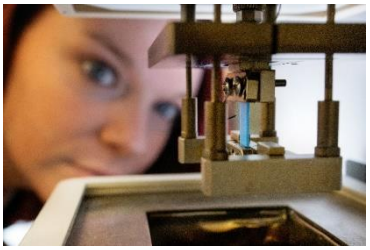
DSC Analysis (differential scanning calorimetry)

- Temperature range -170 °C to 600 °C DIN EN ISO 11357-1
- Glass transition temperature DIN EN ISO 11357-2
- Melting temperature DIN EN ISO/DIS 11357-3
- Melting enthalpy, specific warmth capacity DIN EN ISO 11357-4
- Crystallization behaviour

TGA-FTIR (thermal gravimetric analysis)

- Temperature range 23 °C to 1,000 °C DIN EN ISO 11358
- FTIR (infrared spectroscopy) with ATR Analysis
- Decomposition temperature, analysis of gas phases and solid materials DIN 51006
- DIN EN ISO 9924-1; DIN EN ISO 9924-2; DIN EN ISO 21870

DMA (dynamic mechanical spectroscopy)



- Temperature range -170 °C to 600 °C
- Frequency range 0.01 Hz to 100 Hz
- Tensile test, three-point bend test and shearing test
- Dynamic viscosity, glass transition temperature and temperature resistance
- DIN 53440, DIN 53513, DIN EN ISO 6721-1

TMA (thermomechanical analysis)

- Temperature range -170 °C to 600 °C
- Temperature-dependent dimension variation
- Glass transition temperature DIN 53752; ISO 11359-2, DIN EN 14617-11

Thermal analysis

Light-Flash-Apparatur

- Thermal conductivity measurements
- ASTM E1461, ASTM E2585, DIN EN 821-2, DIN 30905, ISO 22007-4, ISO 18755, ISO 13826; DIN EN 1159-2, etc.
- Temperature range -100 °C to 500 °C

HDT Vicat

- Softening temperature measuring system DIN EN ISO 306
- Heat deflection temperature DIN EN ISO 75-1, -2, -3

High pressure capillary viscometry

- Temperature range 23 °C to 400 °C
- Shear rate range 1 /sek to 10000 /sek
- Rheological behavior of polymer melts
- Viscosity testing
- DIN 54811

Rotation and oszillation type rheometer

- Temperature range 23 °C to 300 °C
- Shear rate range 0.0001 /sek to 1,000 /sek
- Flow curves, curing behaviour of resin systems with plate/plate and cone/plate
- DIN 53018, ISO 3210, DIN 53019, ISO 3219, DIN 54453

Melt Index Test

- MFI, MFR DIN EN ISO 1133

Material analysis

Gel permeation chromatography (GPC)
- Molecular weight distribution, chain lengths analysis
- Molecule chains degradation, ageing experiments

Oxygen transmission rate measurement
- Barrier properties of plastics versus oxygen
- Oxygen permeability measurements at foils and containers
- DIN 53380, ASTM F2622

Water vapour transmission rate measurement
- Barrier properties of plastics versus water vapour at foils and containers
- Water vapour permeability measurements
- ASTM F-1249, TAPPI T557, JIS K-7129

Moisture analyzer
- Measurement of residual humidity content
- DIN EN ISO 15512

Density analyzer scale
- Density determination of products with buoyancy force
- DIN EN ISO 1183-1

Sieve analysis
- Grain size determination and grain size distribution
- DIN 66165

Infrared spectroscopy
- To analyse the composition

Sample preparation
- Microtome, grinding and polishing

Sample conditioning
- Mobile granulate dryer with dry air technology
- Dynamic clima chamber for standard-compliant material tests under dynamic conditions (5 K/min, -40 ° C to 180 ° C, 10 to 98% r. h.)
- 30 litre cool box up to a temperature of -40 °C
- Muffle/preheating/ashing furnaces ans accessories

Analysis of the mechanical properties and behaviour of materials

Universal test machine

- Tensil test, compression test, torsion test and bend test up to 20 kN
- Optional thermal stress test (20 °C to 200 °C)
- DIN EN ISO 527-1, -2; DIN EN ISO 178

Universal test machine

- Tensil test, compression test, torsion test and bend test up to 50 kN
- DIN EN ISO 527-1, -2
- Special tests possible

Pendulum machine

- Impact strength test
- CHARPY DIN EN ISO 179-1
- IZOD DIN EN ISO 180

Hardness tester

- Testing the Shore hardness: Shore A, D and A0
- DIN EN ISO 868 and DIN ISO 7619-1
- Ball impression hardness DIN EN ISO 2039-1
- Microhardness of surface layers DIN EN ISO 4516

Analysis of surface functionalities

Stereomicroscope

- Optical assessment of damage cases
- Measurements and visual inspections
- Detail and overview shots

Polariscope

- Evaluation of stress conditions in transparent structural components

Roughness measurement

- Single test: 20 mm +/- 300 μm
- R_z, R_a, A_{Max}; waviness; DIN EN ISO 4287

Contact angle measurement with different test liquids

- Camera supported system, Sessile-Drop-Methode Pendant-Drop-Methode; DIN EN 828; DIN EN ISO 15989
- Wettability analysis; incl. temperature chamber

Microhardness and Mechanical Properties

- Measurement of thin film systems, surface properties
- DIN EN ISO 4516

Wallthickness analysis

Gloss and Colour Meter

- Lab values with and without gloss trap

3. Software and Lizenses

Moldex3D
- Simulation of extrusion and injection molding processes (flow behavior and resulting properties)

B&R Automation (limited licenses)
- Machine control
- Developing digital twins with simulated parameter settings

ANSYS
- Polyflow - flow behavior during extrusion and injection molding
- Fluent - flow simulation
- Thermal - thermal simulation
- Mechanical - static and dynamic calculation of mechanical load cases
- LS-Dyna inside Workbench - highly dynamic load cases, crash behavior
- ACP - calculation of anisotropic material properties of fiber composites
- OptiSLang - Optimization of parameterized simulation models (across modules)

MATLAB
- Solving mathematical problems

Altair
- EDEM (DEM-software for bulk solids simulation)

MSC One
Structural mechanics
- Apex - CAD direct modeling, generative design
- Dyntran - structure-fluid interactions
- Marc - simulation of large deformations
- Nastran - mechanical load cases
- Patran - Creation of FE-optimized CAD models

Multi-body dynamics
- Adams - Simulation of Mechanical Systems
- Easy 5 - simulation of regulation and control technology

Acoustics and fluid simulation
- Actran - vibrations and acoustics simulation
- Cradle - fluid dynamics

Material simulation
- Digimat - Nonlinear, multiscalar material & structure modeling
- MaterialCenter - material models, data and process analysis

Simulation data and process management
- SimManager - data management along development processes

Lifetime and operational strength
- CAEfatigue - simulation of permanent load, damage modeling

Process simulation
- Simufact - simulation of forming, joining prosess, additive manufacturing

Thermal simulation
- Sinda - Complex Thermal Analysis