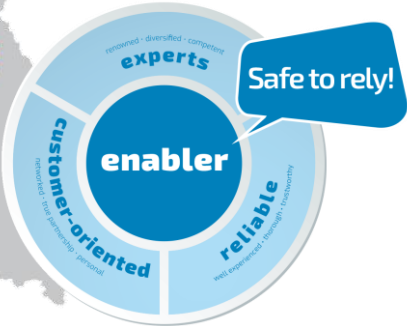


# Injection Moulding at SKZ

## - Moulding Machines & Technologies -

Dipl.-Ing. (FH) Christian Deubel  
11-2023



# The enabler – for the plastics industry



Founded 1961 in Würzburg

More than 430 employees

More than 400 members in the network

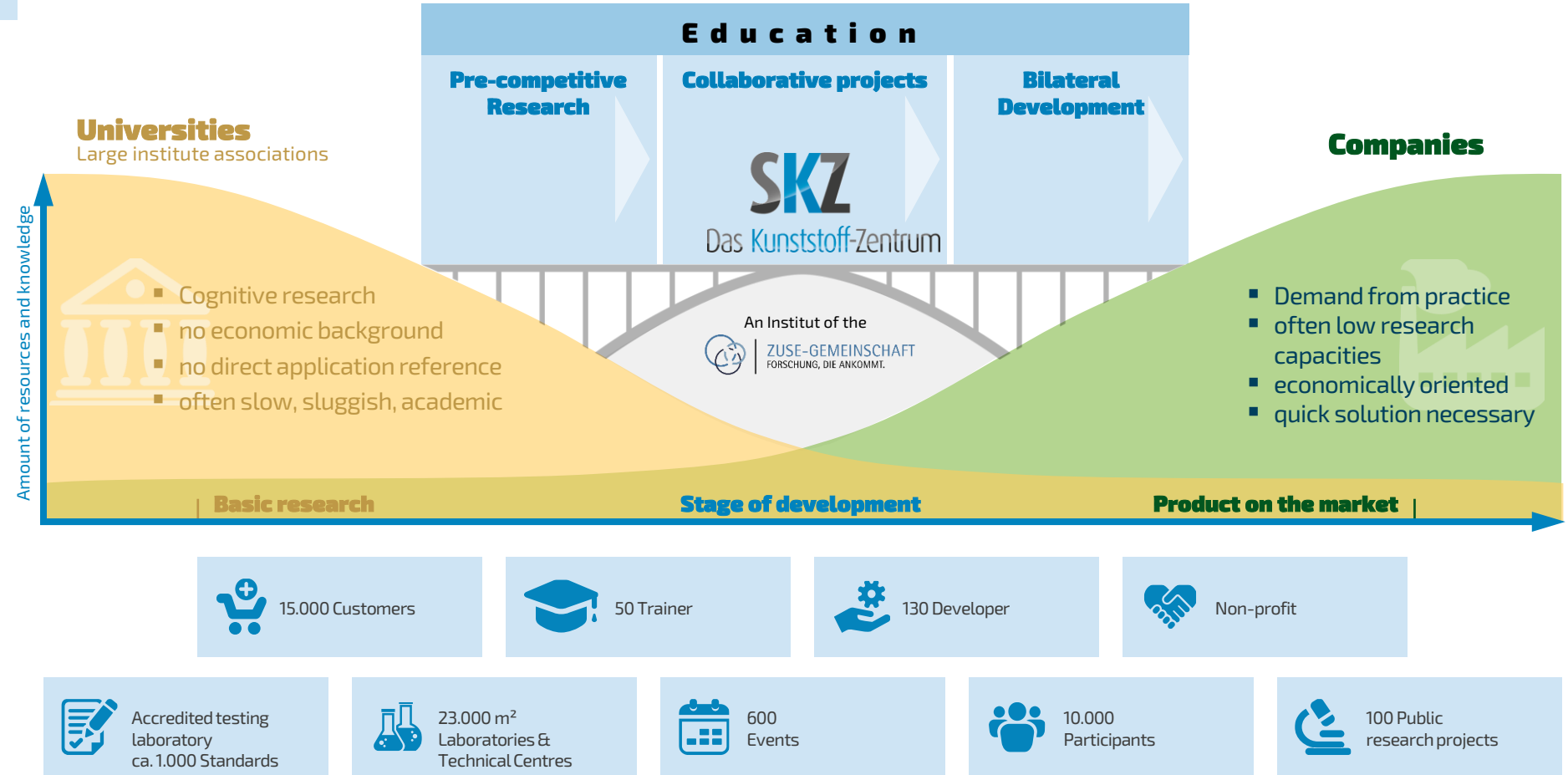
Member of the AiF and the Zuse Association

Accredited for testing, monitoring and certification



# The enabler

for the plastic industry



# Overview

## of the business fields



More than 400 members in the FSKZ network | Events with more than 10.000 participants annually

## NETWORKING

Product monitoring  
Product certification  
Product testing  
Expert opinions  
Damage analysis

### TESTING



Product analysis  
Process measuring technology  
Damage analysis  
Polymer characterisation

### ANALYTIK SERVICE OBERNURG



Practical training  
Workshops  
Courses  
In-house training  
Training for masters and technicians  
Studies  
Online-courses

### TRAINING



Materials  
Processing  
Material development  
Compounding  
Extrusion  
Injection Moulding  
Additive Manufacturing  
Inspection and test methods  
Sustainability  
Circular Economy  
Lightweight construction  
Digitization

### RESEARCH



ISO 9001  
ISO 14001  
ISO 45001  
ISO 50001  
IATF 16949  
ISO 22000  
ISO 13485  
SpaEfV  
FW 605

### CERTIFICATION



## Material development

- Material/Additive Searches
- Formulation development
- Specifications, ...



## Compounding & Compounding Processes

- Modification of thermoplastics, incorporation of additives ..
- Manufacture of customer-specific materials



## Processing

- Extrusion (Profiles, tubes, foils)
- *Injection moulding*
  - *Manufacture of test specimens*
  - *Manufacture of components*
  - *Material/mould sampling*
  - *Simulations*
- ...
- Joining (therm. joining, US welding, gluing)
- Thermoforming
- Blow moulding
- 3D Printing (Thermoplastics & Resins)

## Surfaces

- Surface pre-treatment/activation (Plasma, Corona, VUV ...)
- Surface Characterization

## Testing's & Analyses

- Mechanical tests (static, dynamic)
- Creep tests
- Thermal analysis
- Spectroscopic analyses
- Chemical analyses
- Weathering/Storage Tests
- Microscopy, SEM and CT measurements
- ...

## Other Areas

- Sustainability & Circular Economy
- Digitisation
- Non-destructive testing
- Reactive Systems / Crosslinking Materials
- Dispersion process, resin development
- Micro/nanosuspensions

# Injection Moulding

at a glance



Over 130 industrial orders per year

More than 150 courses

20 - ongoing research projects

## Research, Industrial Services & Education

More than 10 injection moulding machines with clamping force of 500 – 5,000 kN

Multi-component injection moulding

Thermoplastic Foam Injection Moulding

ARBURG FDC , Processing of long fibres

Processing of thermosets

Processing of LSR

Industry 4.0 Injection Moulding Cell

Colouring with Masterbatch and Liquid Colours

### Injection molding

Adhesion of hard/hard and hard/soft composites (TPE, VDI2019)

Fiber Length Distribution (SKZ- "FiVer")

Determination of fiber fractions and orientations

Inline thermography for 100% component inspection (SKZ "TDI")

DOE: Statistical Design of Experiments (SKZ- "MESOS")

### Testing & Analysis

Practical courses

Workshops

Courses

In-house training

Master craftsman and technician training

Online training

Creation and provision of WBT's

Individual training and further education concepts

### EDUCATION

Production of standard and individual test specimens

Simulation of injection moulding processes (Moldex3D, SIGMASOFT)

Material and mould sampling

Processing of PVC and high-temperature thermoplastics

Customer-specific material/mould tests

On-site (process) consulting

Feasibility studies

### Industrial Services

Publicly funded projects (e.g. ZIM, IGF, BMBF ...)

Bilateral R&D projects  
Research

Industry Consortium Projects (SKZ Trailblazer)

### Research

# Our Injection Moulding Machines



# View in one of our three Technical Centres

SKZ





# Injection Moulding Machines



ARBURG	Allrounder 920 S
Clamping force [kN]:	5.000
Max. dosing volume [cm <sup>3</sup> ]:	792
Extras:	FDC Unit, PVC & Mixing Screw, Handling Device, High Temperature



Wittmann	Smart Power 240
Clamping force [kN]:	2.400
Max. dosing volume [cm <sup>3</sup> ]:	Kompakt: 442 / TSG: 331
Extras:	TSG - CellMould, Embossing, Handling Device, Additional Injection-Aggregate

# Injection Moulding Machines



ARBURG	Allrounder 570A
Clamping force [kN]:	2.000
Max. dosing volume [cm <sup>3</sup> ]:	1. Aggregate: 149 2. Aggregate: 58
Extras:	2nd. Aggregate – vertical, handling device, high temperature



KraussMaffei	PX 160
Clamping force [kN]:	1.600
Max. dosing volume [cm <sup>3</sup> ]:	220
Extras:	Latest I4.0 interfaces incl. all peripheral devices OPC-UA connected, handling device, interchangeable units

# Injection Moulding Machines



Haitian/Zhafir	ZE 1200
Clamping force [kN]:	1.200
Max. dosing volume [cm <sup>3</sup> ]:	147
Extras:	-



Wittmann	Eco Power 110
Clamping force [kN]:	1.100
Max. dosing volume [cm <sup>3</sup> ]:	283
Extras:	Handling device

# Injection Moulding Machines



ARBURG	Allrounder 470A
Clamping force [kN]:	1.000
Max. dosing volume [cm <sup>3</sup> ]:	201
Extras:	Special screws



Wittmann	HM800
Clamping force [kN]:	800
Max. dosing volume [cm <sup>3</sup> ]:	106
Extras:	Handling equipment, special screws



# Injection Moulding Machines



Engel	E-mac 465/100
Clamping force [kN]:	1.000
Max. dosing volume [cm <sup>3</sup> ]:	214
Extras:	Handling, IQ assistance systems, flomo



Demag	IntElec 50
Clamping force [kN]:	500
Max. dosing volume [cm <sup>3</sup> ]:	20
Extras:	-

# Injection Moulding Machines

- for cross-linking polymers -



Engel	E-motion 740
Clamping force [kN]:	240
Max. dosing volume [cm <sup>3</sup> ]:	390
Extras:	Handling device, thermoset unit, IQ-Flow, IQ-Weight



KraussMaffei	PX50
Clamping force [kN]:	500
Max. dosing volume [cm <sup>3</sup> ]:	14
Extras:	LSR unit, Nexus dosing system



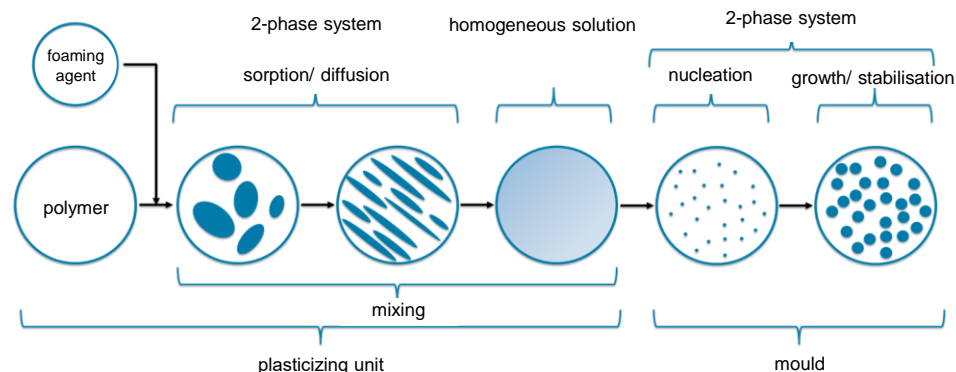
# Injection Moulding Technologies

# Injection Moulding Technologies:

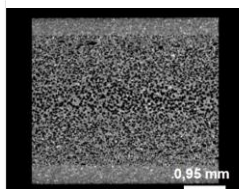
## TSG – Thermoplastic - Foam Injection Moulding

### Our capabilities

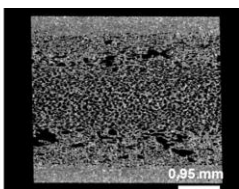
- The SKZ has been conducting research in the field of TSG for many years
- With our machines and moulds, we can foam chemically and physically
- Comprehensive analysis options are also available for the characterization of the component



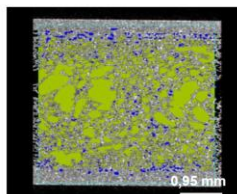
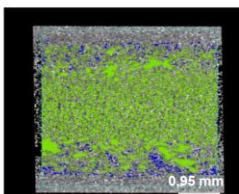
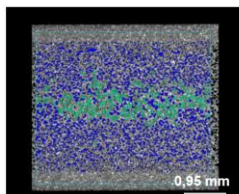
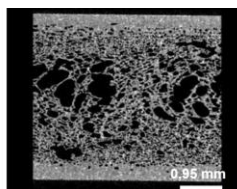
weight saving  
13 %



weight saving  
19 %



weight saving  
26 %



### Our offer

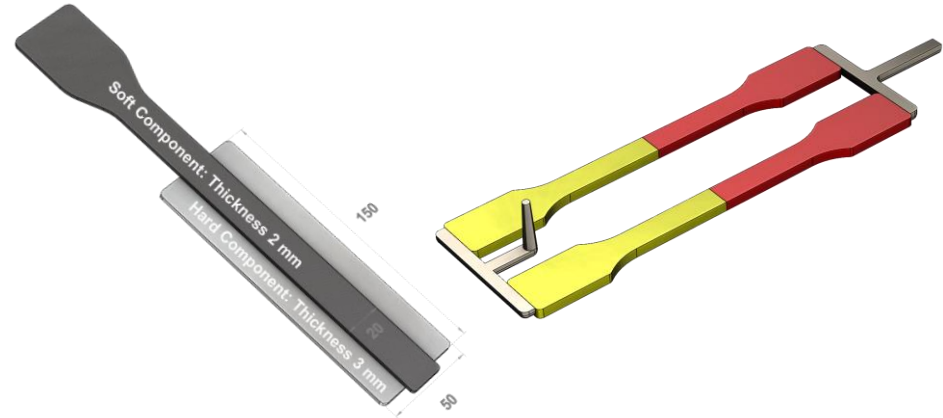
- Sampling of different thermoplastics regarding foaming behaviour
- Comparison of physical foams with chemical foams, with microcapsules or the combination physical/chemical
- Execution of test series with an SKZ or customer mould/component
- Qualitative and quantitative assessment of the foam structure

# Injection Moulding Technologies:

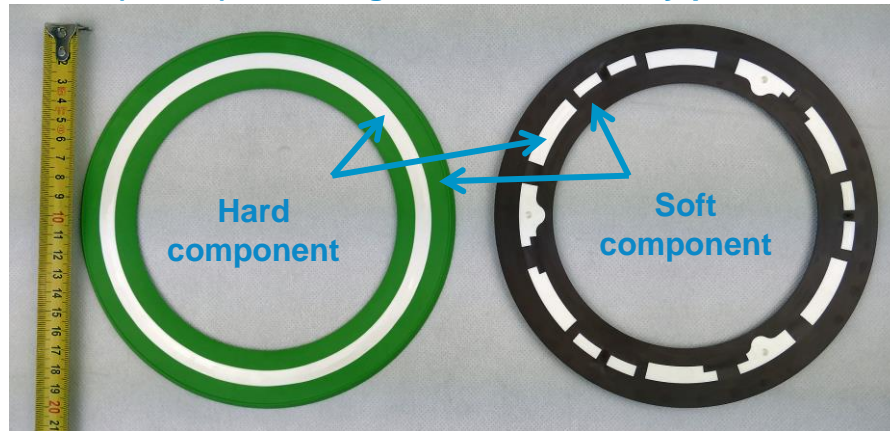
## Multi-component injection moulding

### Our capabilities

- For more than 15 years, the SKZ has been investigating adhesion composites in multi-component injection moulding
- These include hard/hard- and hard/soft-composites with TPE



(whiter) Inner ring can be individually printed



### Our offer

- Sampling of different material combinations
- Test specimen production in the 2C process or insertion method (cold insert)
- Execution of test series for the quantification of individual injection moulding parameters for composite adhesion (DOE)
- Adhesion tests, with or without bearing influence

# Injection Moulding Technologies:

## Liquid Colours & Masterbatch

### Our capabilities

- The colouring and evaluation of the quality of self-coloured components has long been a focus of the SKZ
- Examples include numerous R&D projects to change colour in the process, the development of *in-line colorimeters*, and leak-free, easy-to-use *liquid colour* dispensing systems together with industry



### Our offer

- Sampling of *liquid colours and master batches*
- Use of *standard* and *special screws, static mixers* and different dosing systems as well as component geometries/surfaces
- Quantification of colour values and homogeneity, directly in the process after demoulding
- *Influence* of colour on *processability* and material *properties*

# Injection Moulding Technologies:

## Industry 4.0 Injection Moulding Cell

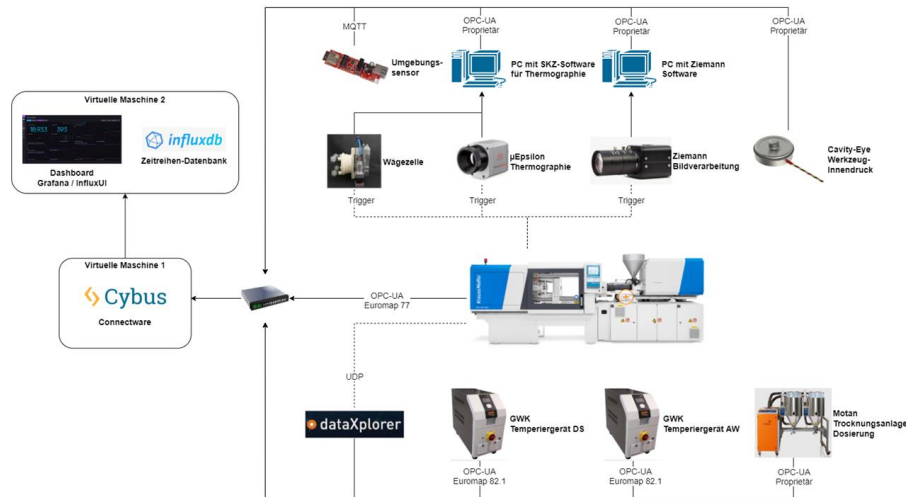
### Our capabilities

- Together with industrial partners, a complete I4.0 injection moulding cell was built
- In addition to the machine, all peripheral devices and QA systems are implemented
- All operational, process and measurement data are collected and evaluated in a central database synchronously



### Our offer

- Advice on the status and feasibility of I4.0 solutions
- Use of the SKZ - I4.0 injection moulding cell for tests and device/interface development
- Dataset creation for correlation analyses or as training data for self-learning systems





# Injection Moulding Technologies:

## FDC – Fiber Direct Compounding

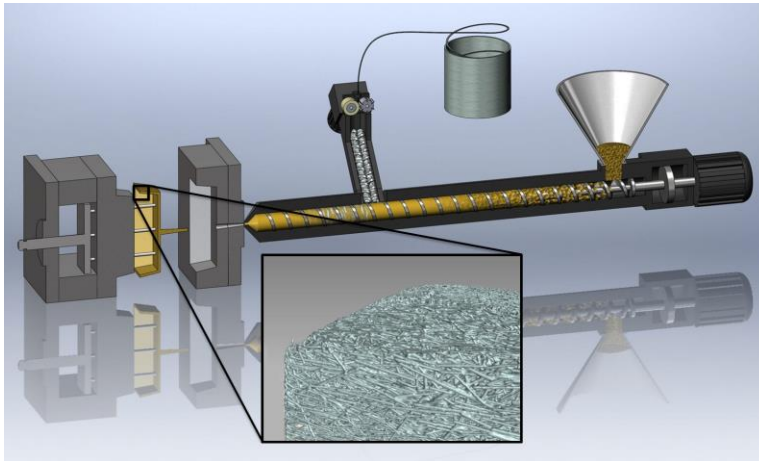
### Our capabilities

- Fiber Direct Compounding (FDC) can be used to produce long-fiber-reinforced components directly from a matrix polymer and fibers without a compounding step
- The fibers are added when the polymer has already melted
- Fiber damage is significantly reduced



### Our offer

- Sampling of different matrix polymers and/or fibers in the FDC direct process
- Using an SKZ or customer mould
- Variation of fiber content
- Execution of test series with different injection moulding parameters and quantification of fiber damage
- Manufacture of components for process validation



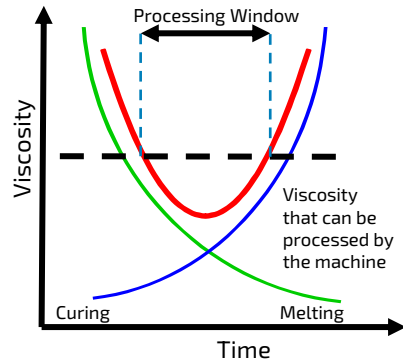
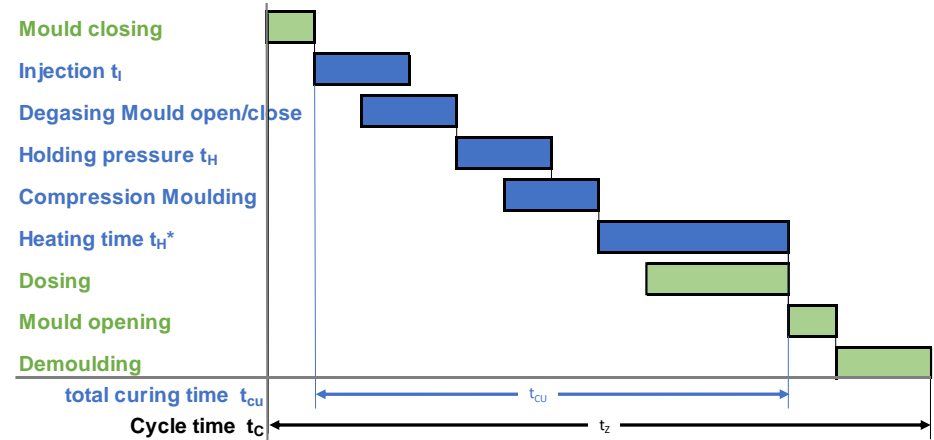


# Injection Moulding Technologies:

## Thermoset Injection Moulding

### Our capabilities

- The processing of thermosets is often a challenge
- At the SKZ, thermosets are investigated in material development, analytics, simulation, mould technology and processing processes
- Machines and the corresponding peripherals are available for free-flowing moulding compounds



Phenoplaste	Phenol-Formaldehyde-Resins PF	Poly-condensation
	Harnstoff-Formaldehyde-Resins UF	
Aminoplaste	Melamin-Formaldehyde-Resins MF	
	Melamin-Phenol-Formaldehyde-Resins MP	Poly-merisation
Resins	Ungesättigte Polyester-Resins UP	
	Diallylphthalat-Resins DAP	
	Epoxid-Resins EP	Poly-addition

### Out offer

- Simulation of thermoset components
- Processing of thermosets and production of test specimens
- Support in mould design
- Consultancy and training
- Analysis of moulding compounds and manufactured components

# Injection Moulding Technologies:

## LSR Injection Moulding

### Our capabilities

- Processing of LSR is possible in SKZ
- System setup:
  - LSR injection moulding machine,
  - Dosing system with static mixer and the possibility of adding liquid paint and
  - Modern high-temperature temperature control devices



### Our offer

- Sampling of LSR materials, even in small quantities by means of a "small quantity attachment"
- With SKZ or customer moulds
- Production of test specimens under different process conditions
- Consultancy and training
- Simulation of LSR components



# Thank you for your attention



## Your contact persons

### **SKZ – Das Kunststoff-Zentrum**

Friedrich-Bergius-Ring 22  
Fax: +49 931 4104 - 377  
97076 Würzburg

### **Christian Deubel**

*Industrial Service*

Tel: +49 931 4104 - 242  
E-Mail: [c.deubel@skz.de](mailto:c.deubel@skz.de)

### **Christoph Mussauer**

*Head of Injection Moulding Technical Centre*

Tel: +49 931 4104 - 190  
E-Mail: [c.mussauer@skz.de](mailto:c.mussauer@skz.de)