

technology solutions for
lightweight composites

A.Kadir Topuçar



- **Thermoplastic solutions**

- Shortest cycle times
- No recycling issues
- Lower mechanics



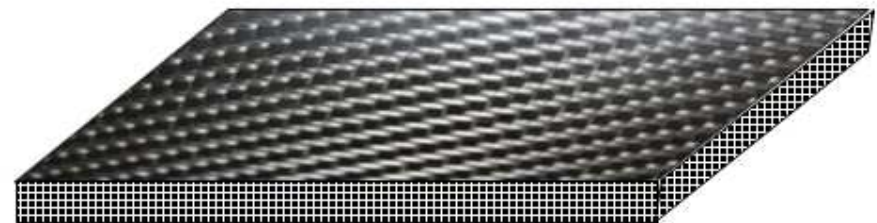
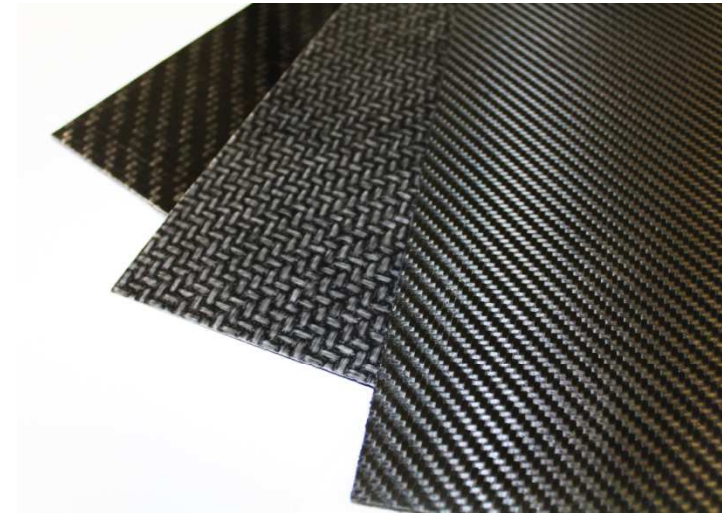
- **Thermoset solutions**

- Labour intensive process
- Force orientated lay up possible
- Highest potential for weight reduction



- **fibre reinforced thermoplastic prepregs**

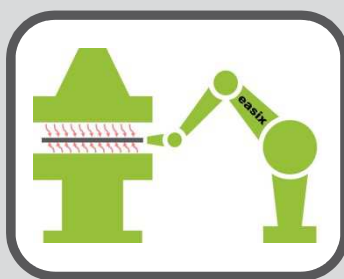
- fully impregnated and consolidated
- thermoplastic matrix
- Glass or carbon fibres



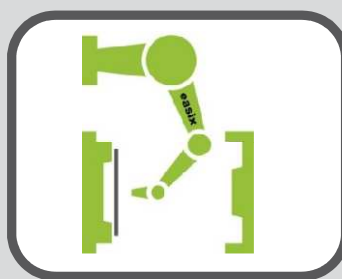
fully automated production of a thermoplastic composite structural part



grabbing



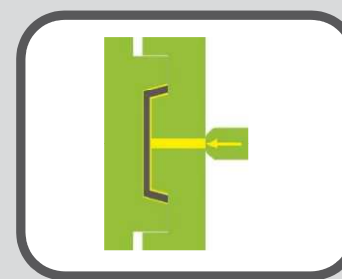
heating



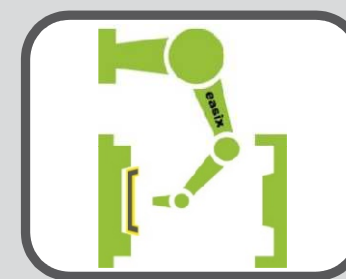
insertion



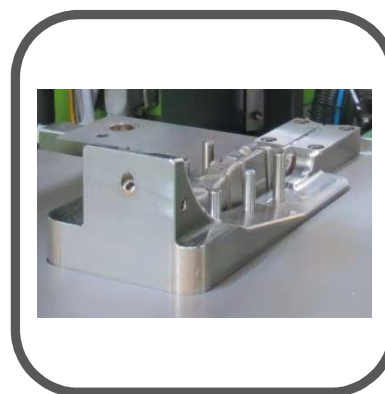
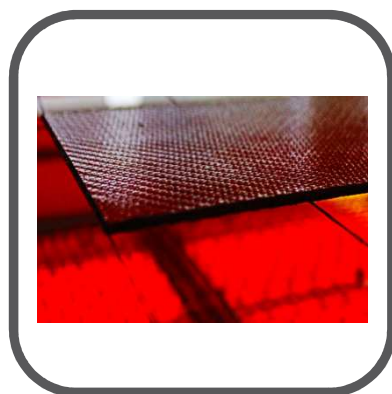
closing

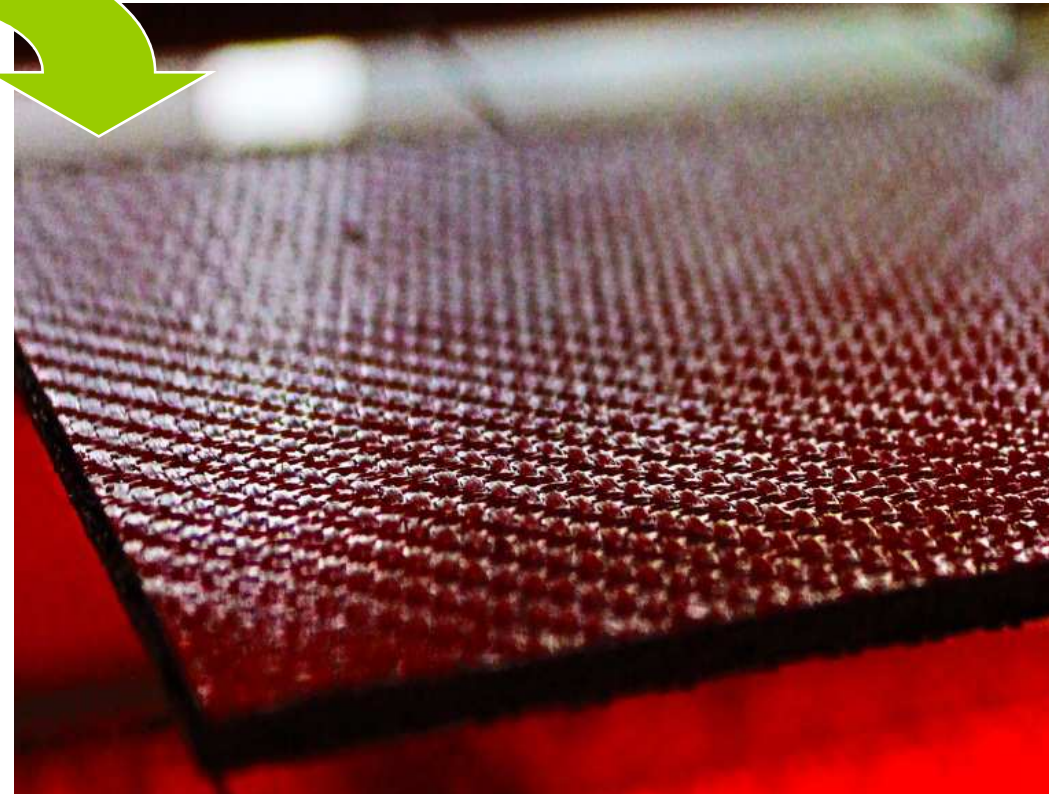


injection



demolding

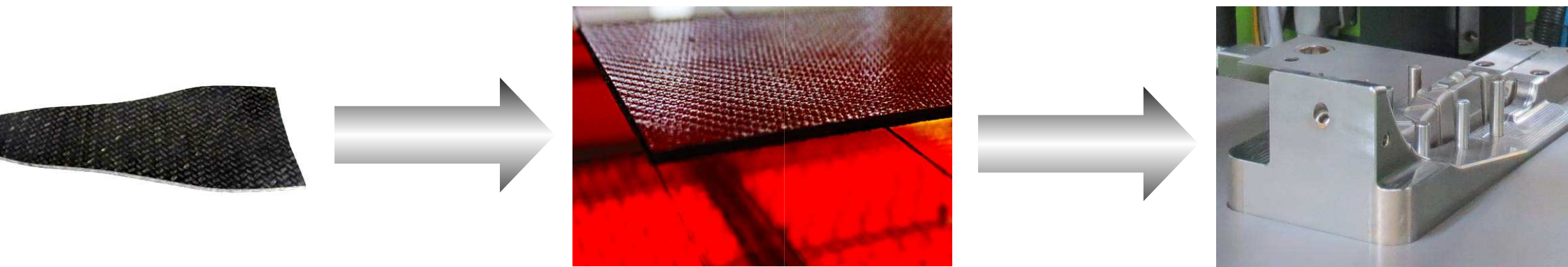




ENGEL composite technologies | ir-oven

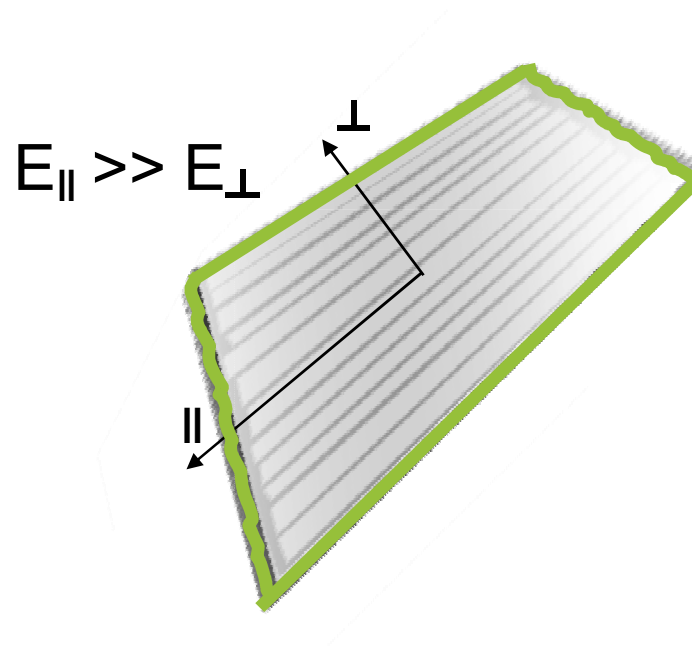
ENGEL





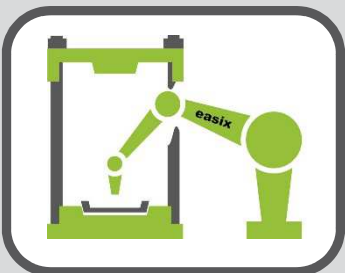
Choosing **UD-tapes**

- Force orientated
- Optimized use of material
 - Building up of layers
 - Preforming and backmolding

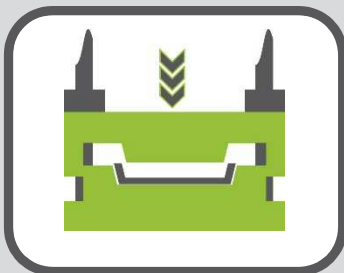


Thermoset composites | High Pressure - Resin Transfer Molding

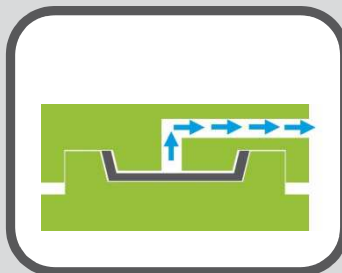
- Application for structural parts
- Optimized fiber orientation possible
- Good fiber impregnation



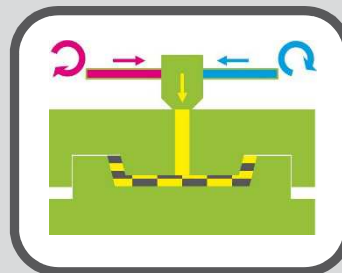
insertion



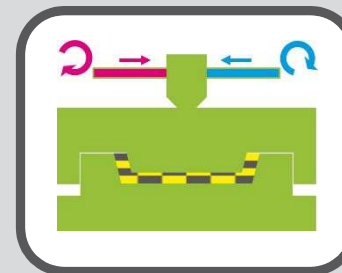
closure



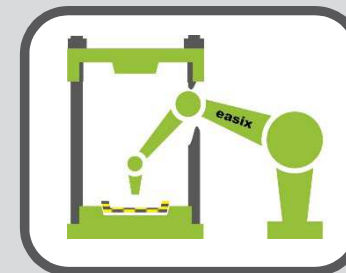
vacuum



injection



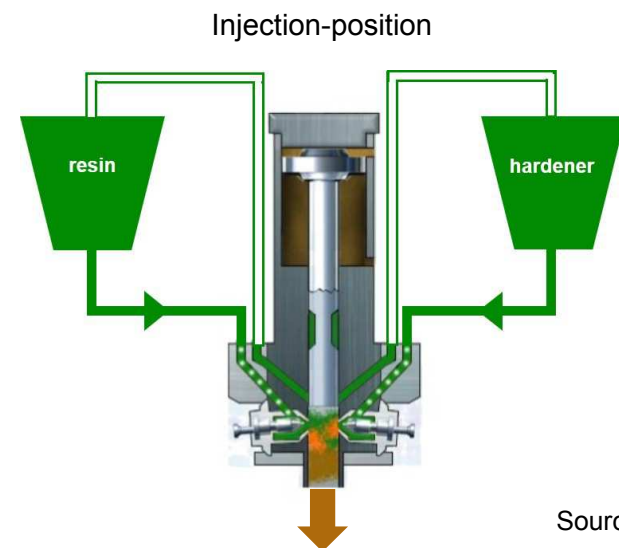
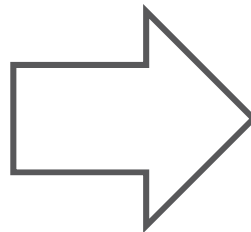
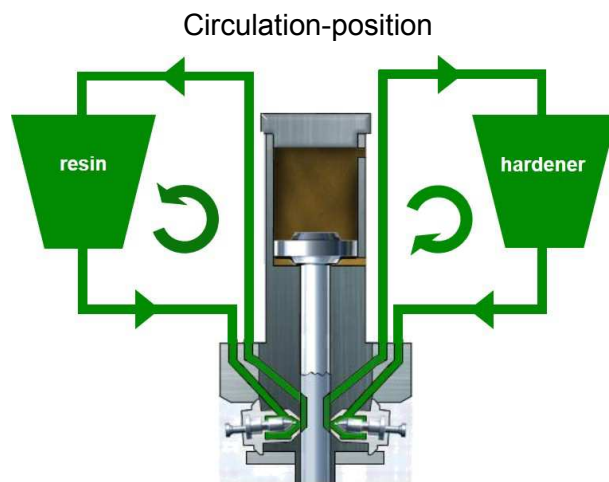
curing



removing

HP-RTM | reactive technology

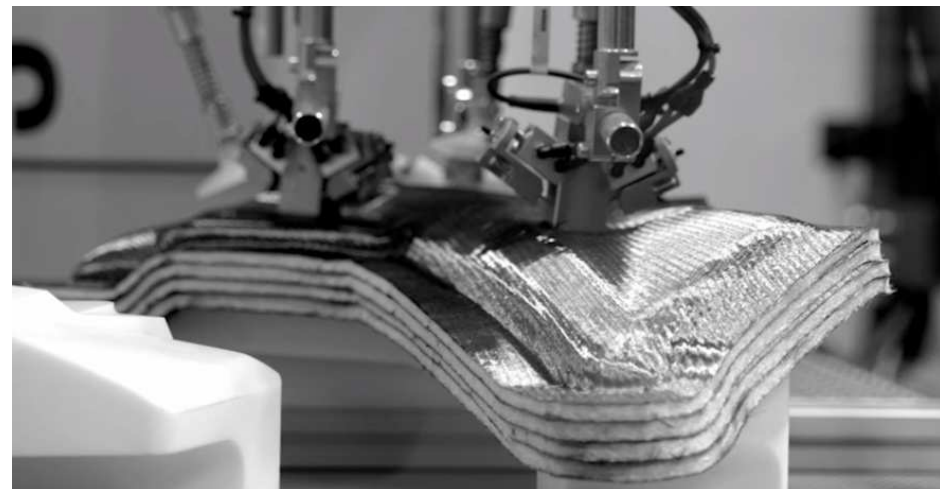
- Material
 - Polyurethane systems (A: polyol, B: isocyanate)
 - Epoxy systems (A: resin, B: hardener)
- Mixing head
 - Recirculation of the components in the standard position
 - Cleaning-free output of residual materials into the mold



Source: Hennecke

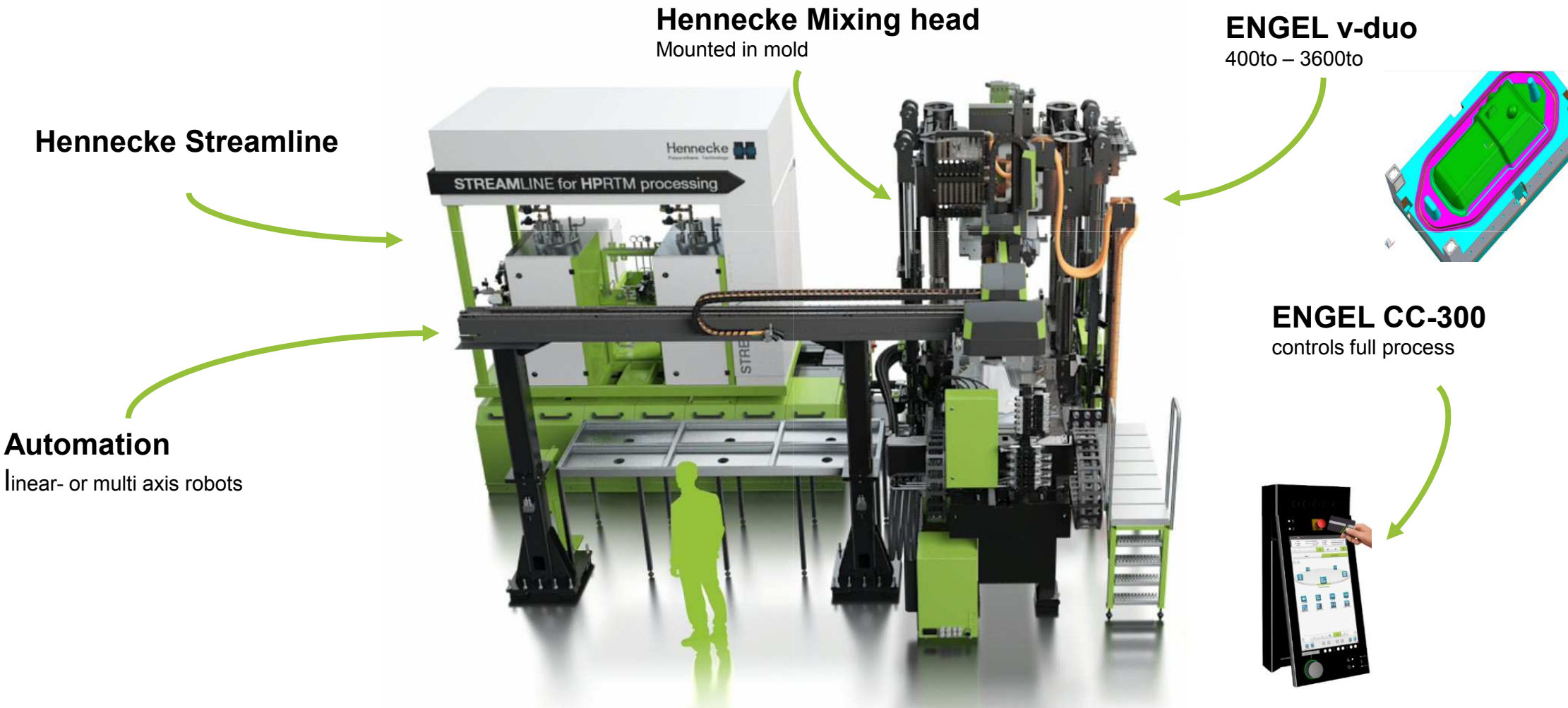


For reactive technologies, Hennecke's high-pressure metering machine *Streamline* is fully integrated into ENGEL operating system CC-300.



Reactive systems | **HP-RTM machine layout**

ENGEL



Reactive systems | **HP-RTM line layout**

ENGEL

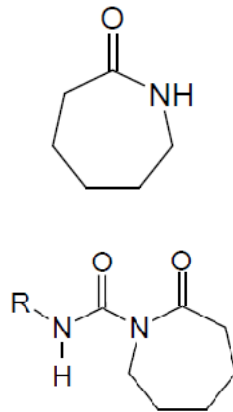


ENGEL

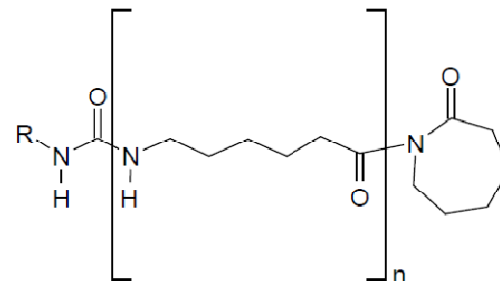
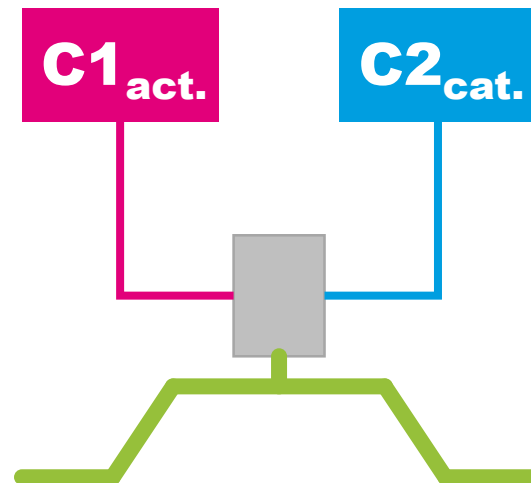
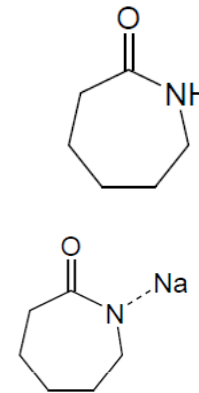


COMPETENCE IN COMPOSITES

**caprolactam
and
activator**



**caprolactam
und
catalysator**



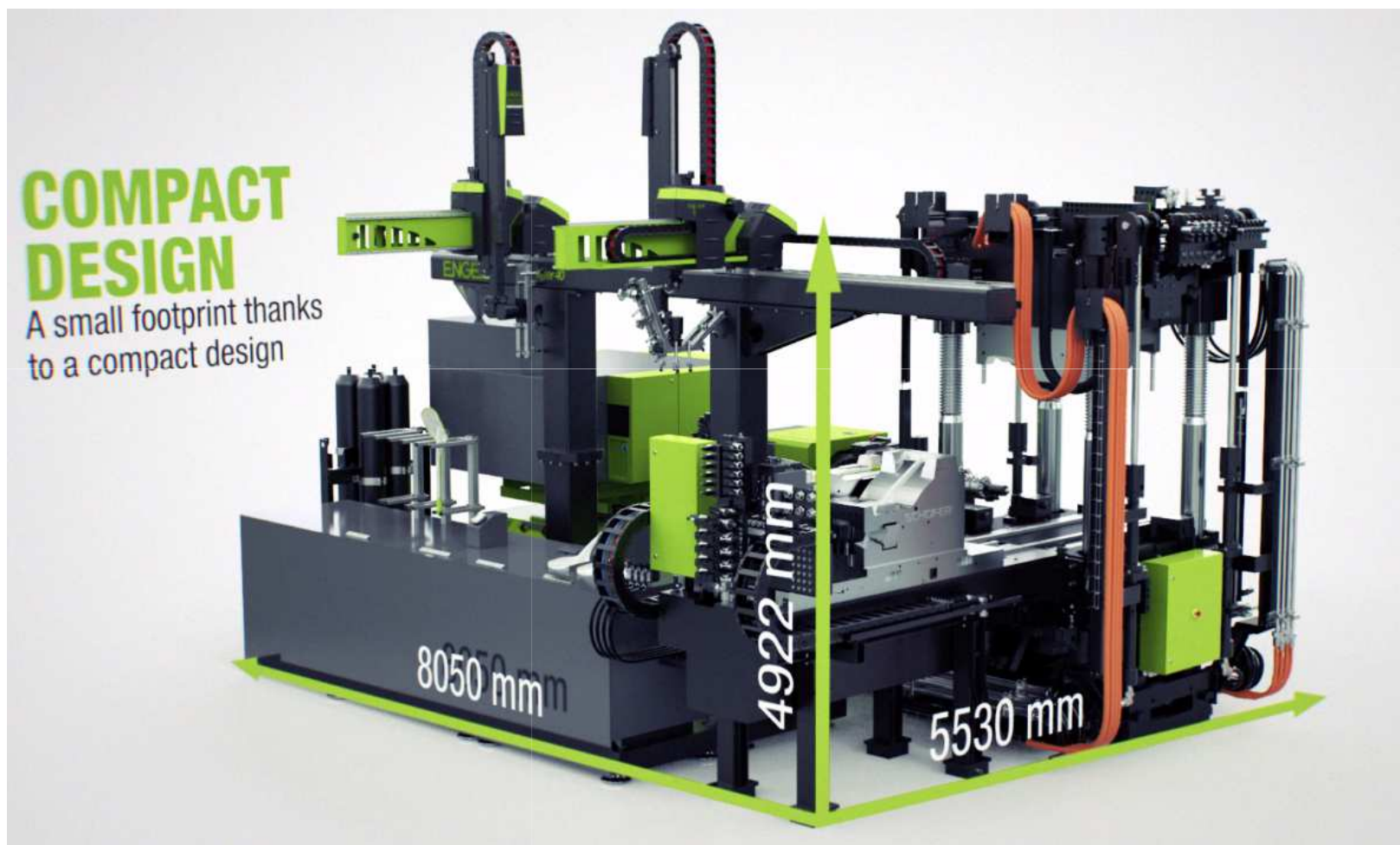
polyamide 6



ENGEL v-duo 700

Production unit

ENGEL



In situ

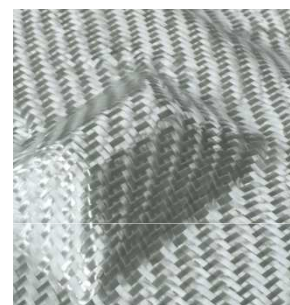
- Carbon or glass fibres, fabrics are fed dry
- The fibres are impregnated with melted caprolactam, which then polymerizes into polyamide 6.
- Through injection moulding, the thermoplastic fibre composite part can then be further functionalized in a second mould.



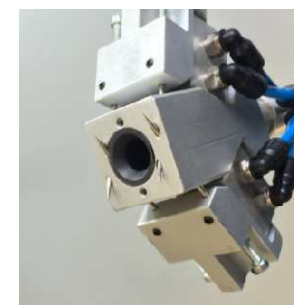
Added values with combined processes!

- The fully thermoplastic possibility for high end composites!
- Load orientated design of fibre orientations
- Low pressure impregnation because of lowest viscosities
- High impact resistance with cast-nylon
- Optimum bond strength because of working in a one material system

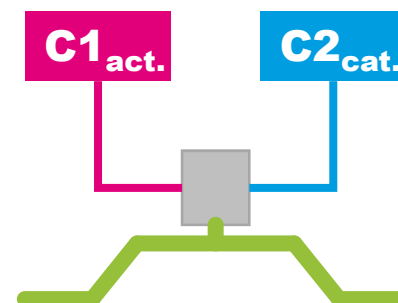
production of a preform



placing preform inside the mould



Reinforced structure made in situ process

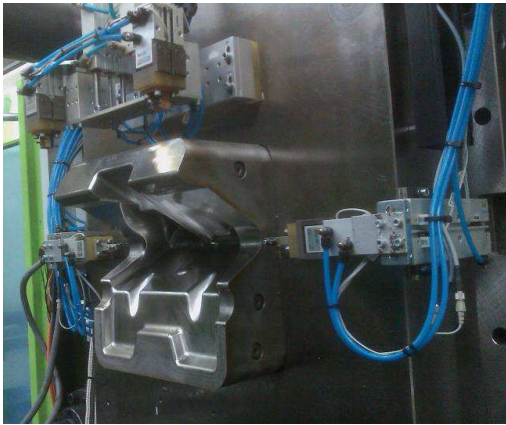


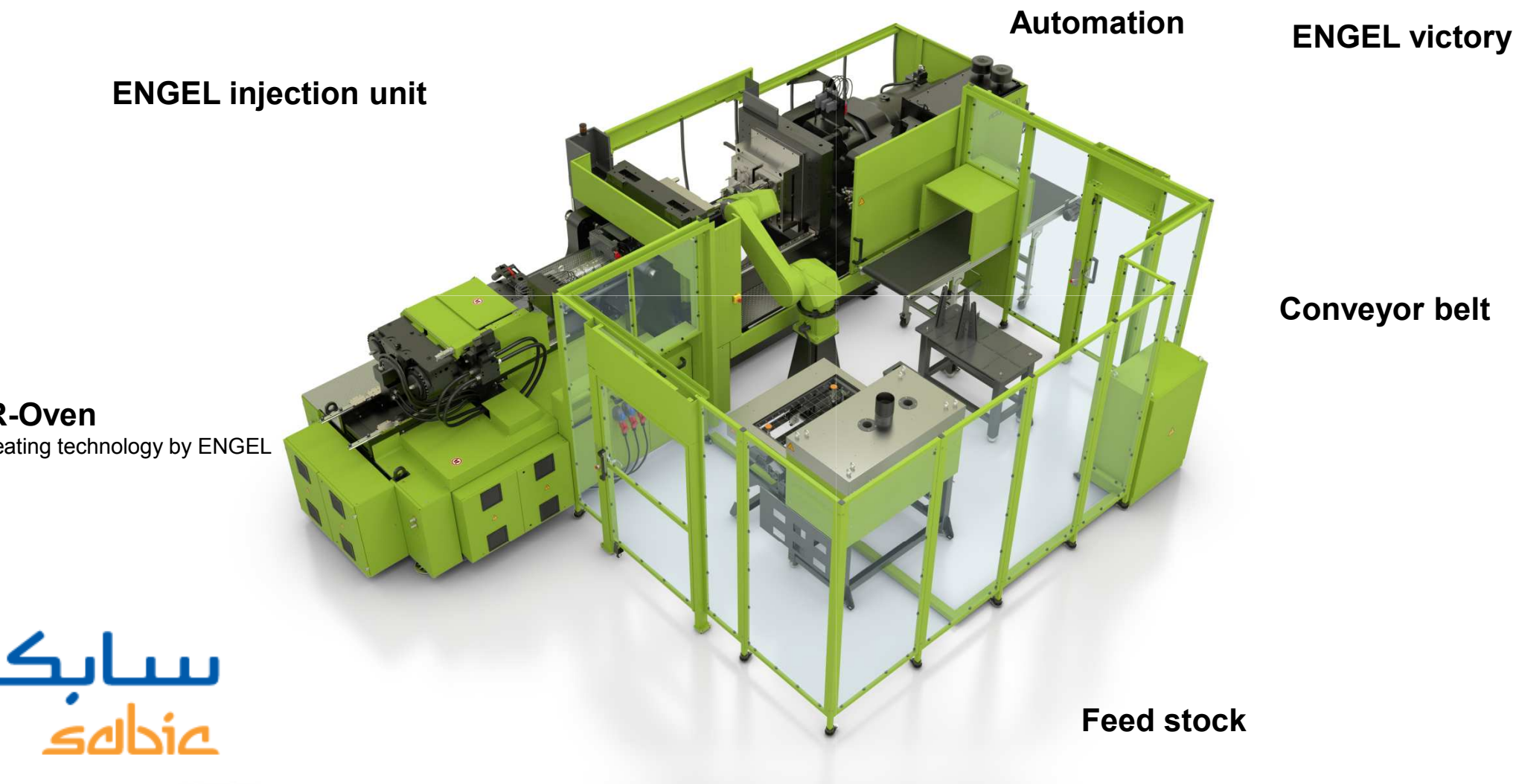
Injection moulding of functional elements



The best **clamp unit** for composites?

ENGEL

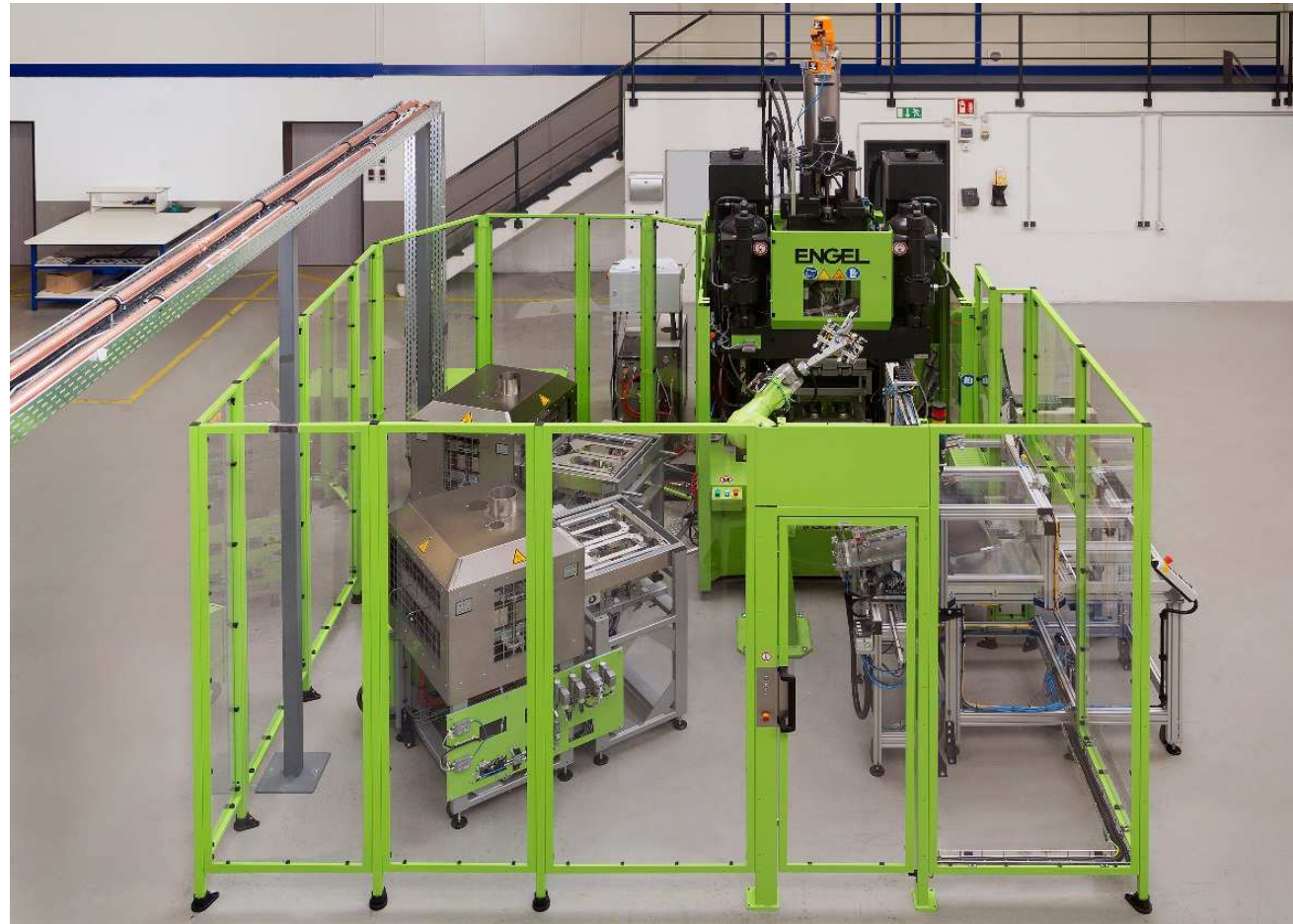




insert 500 v/130 with easix and 2 x IRO

BOND
LAMINATES

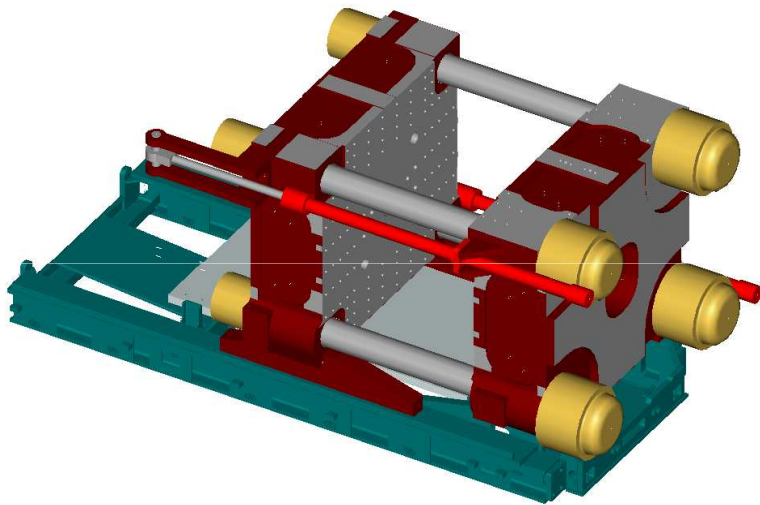
A company of the LANXESS group



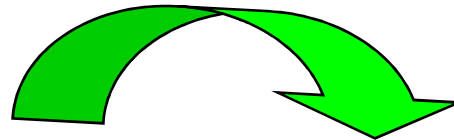


- v-duo 3600
- with 2 parallel injection units

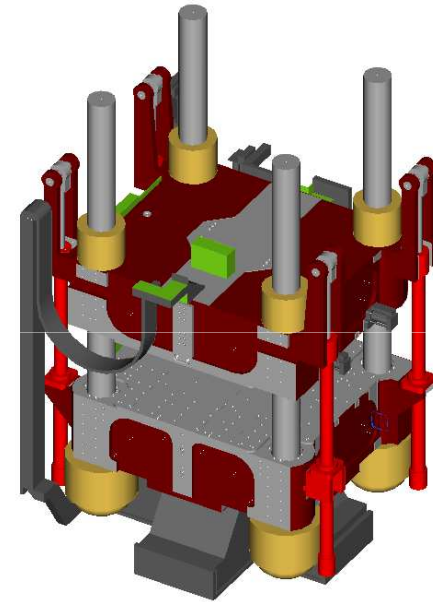
ENGEL duo



- 5.000 machines on the market
- Know-how in machine-concept
- Know-how in injection molding



ENGEL v-duo

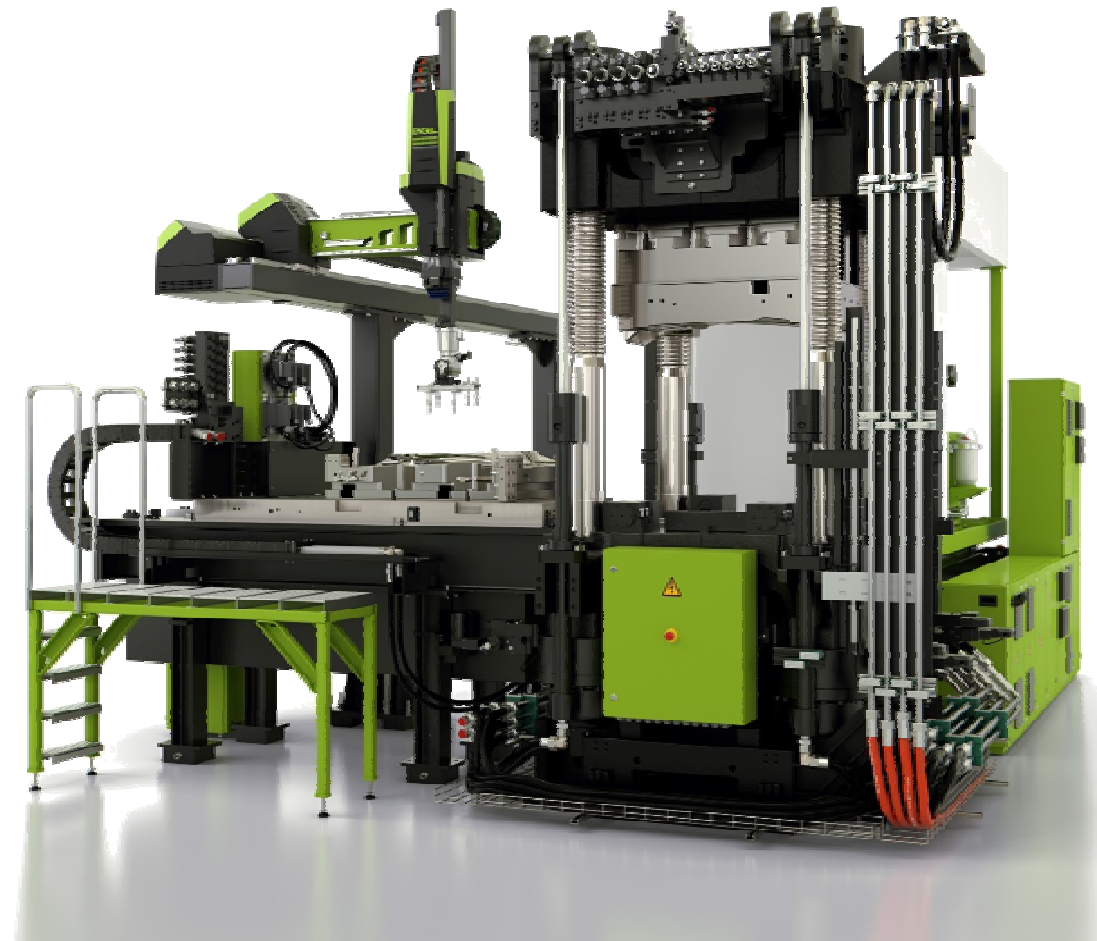


- based on two-platen concept of duo
- same components
- use of gravity
- compatible with injection units

v-duo | A new concept for composite processing

ENGEL

- Optimized handling of inserts, because of vertical clamp system
- High accessibility with sliding table
- Well proven, compact 2-platen-clamp system in new vertical design
- Energy saving drive system
- Optimized parts quality by parallelity controlled EXPERT-coining

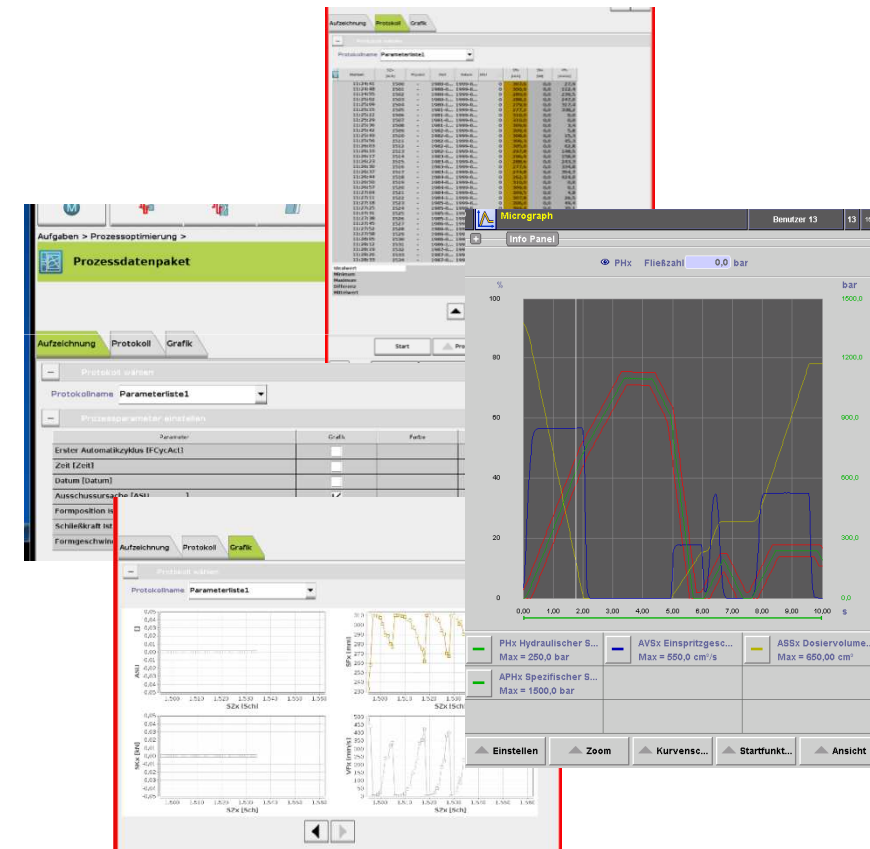


Clamping force sizes

400to / 700to / 1100to / 1700to / 2300to / 2700to / 3200to / 3600to



- v-duo 1700
- with HP-RTM-unit
- Compression of prepregs and CF-SMC



- **Hardware for R&D and Customer trials**

- v-duo 3550/1700
 - HD-RTM Streamline
 - V-duo 700 with in- situ unit
 - Easix TX200L
 - Viper 12 preforming cell
 - IR-Oven
 - Chemical lab
- etc.



- **hardware**

- ENGEL duo 1700
- ENGEL duo 1500 combi-m
- ENGEL duo 700



organomelt-tyr outs in proven horizontal-technology

Summary | **composites & injection molding out of one hand**

ENGEL

HP-RTM on ENGEL v-duo 3600



ENGEL v-duo for BMW, Landshut



BMW, Leipzig

IM on ENGEL duo 4000



**Composite technologies
need
composite development!**