Hollow HP-RTM Carbon Fiber Parts

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Tobias Jansen, Sales Manager
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Hennecke GmbH
1945 Founded by Karl Hennecke in Sankt Augustin

1955 Development of the first high-pressure metering machine

2011 Presentation of HP-RTM technology and an accompanying processing system for the production of fibre-reinforced structural components

Number of employees of the Hennecke Group: ca. 500 (January 2016)

Ownership: 100 percent Capvis Equity IV L.P.

Worldwide presence through local agencies in over 100 countries
Founded in 1968

Comprehensive sales and after-sales portfolio with expert consulting, engineering and retrofit services

Experienced specialists in sales, project management, design and service

Hennecke Inc. TECHCENTER for live demonstration, courses, customer demos and trials

Employees: 44
Agenda

- Explanation of the CAVUS technology
- Project „License plate holder“
- Sand core process
- Braiding process
- Introduction of HP-RTM process
- HP-RTM production cell
- HP-RTM raw material
- Facts of process
- Future potentials
THE CAVUS TECHNOLOGY by KTM TECHNOLOGIES

» CAVUS – currently a unique process of its kind, innovated by KTM Technologies

» Technology for high volume production of complex, structural and hollow CFRP parts in short cycle times

» Combination of sustainable, water soluble core material with high volume production processes such as automated preforming and HP-RTM – with the efficient usage of materials and resources

» Achievements: high level of automatization, short cycle times, efficient usage of the materials, cost competitive, eco- and resource-friendly
THE CAVUS TECHNOLOGY by KTM TECHNOLOGIES

1. Sand core with binder
2. Braiding
3. HP-RTM Injection of a PU Resin
4. Washing out of the sand core
5. Finished hollow part
Project Definition R.A.C.E.

- Partnership project between
  - OEM
  - Material supplier
  - Machine supplier
  - University

- Design, simulation, testing and production machinery for hollow composite parts. Suitable for mass production!
Project „License Plate Holder“

Design specifications:

- Lightweight hollow part
- New and modern design
- Wall thickness ~3mm
- Demoldable
- Volume ~1l
Simulation and Design

Simulation of the whole manufacturing process

- Braiding process simulation
  - Prediction of fibre architecture
  - Consideration of real kinematics, material properties and friction behaviour
- Mapping of fibre architecture to infiltration model
- Infiltration simulation
  - Evaluate the right position of injection and the vacuum valve
  - Prediction of the material flow in order to fibre orientation, to core design and to the raw material

Various iterations between design freeze and simulation process, to define the right geometries
The sand core process

- New developed core material
  - Water as solvent
  - Nontoxic core material
  - Pressure resistant up to 200 bars
  - Core components separate themselves
  - Up to 98% of the core material can be reused
Braiding process

- Fully automated production process
- Load optimized fibre orientation
- Automatic robot path generation based on braiding simulation
The HP-RTM technology allows producers to fill molds with high content of fibre within seconds with a thermoset resin like Epoxy or Polyurethane.

Therefore raw materials can have a high reactivity for snap curing effects.

Vacuum assists during evacuation of the mold and during shot to achieve the right flow path.

The HP-RTM technology allows highly automated processes and short cycle times for parts with complex 3-D geometries.

HP-RTM technology is suitable for mass production.
STREAMLINE for HP-RTM processing

- Modular design
- Polyurethane
- Epoxy Resin
- Caprolactam / PA6
HP-RTM composite resins

- Polyurethane or epoxy based systems
- Standard Tg and high Tg grades
- Tunable reaction kick-off
- Low viscosity until Snap Cure
- Curing time of less than one minute possible
- High mechanical performance: toughness & ductility
- Internal release agent available
HP-RTM steel tool

- High quality surfaces
- Sealed against 200 bar inner pressure
- Integrated pressure sensors and temperature sensors
- Integrated electrical heating system
- Integrated ejectors and robot positioning system
Murlock®

- Insensitive to temperatures of up to 200°C
- Pressure resistant up until 200 bar
- Outstandingly easy to machine
- Short delivery times
- Chemically resistant to nearly all organic and inorganic chemicals
- The Murlock® material gives the sealing a high elasticity within the operating temperature range, so that any unevenness on the surface or any foreign particles on the sealing surface can be compensated for
HP-RTM production cell
Facts of Process

Production data of Pre Series Part

- Weight of final CFRP part: 226 gr
- Weight reduction: 62%
- Preform cycle time: approx. 120 sec
- Shot time: approx. 5,5 sec (mold pressure controlled)
- Curing time: 125 sec
- Part price: approx 30-40 EUR
Optimization potential

- Optimized Mold filling geometry
- Optimized Mold Ending geometry
- Preform cycle time optimization
- Sand core cycle time with multi cavity production
Future potentials
Thank you for your attention.

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