Introduction of Voith Composites

Germany, July 2018

Meet the Future of Carbon Fiber Composites
Voith Group
One of the Biggest Family owned Companies in Europe

- In more than 60 Countries
- 19,000 Employees
- 5 Markets

R&D Ratio: 5.3%
Family-owned since 1867
Sales: €4.22 billion
Voith Composites operates independently of the four Voith divisions and reports – as an innovation unit and competence center – directly to the Board of Management.
Industrialized Production of High Performance Components
Voith Composites
Core Markets

Machinery
Rolls & shafts for Paper, Film and Solar Industries

Automotive
CFRP components and preforms

Aerospace
Engineering, prototypes and series production
Voith Composites
Services along the Product Development Process

Project Feasibility
• Component concepts & ideas (fiber and load path suitable)

Concept & Design
• Technical feasibility analysis
• Component engineering
• Component optimization
• Process development
• CFRP machine design
• Tool concepts
• Process simulation
• Quality assurance

Pilot Production
• Prototype production
• Sampling
• Tool engineering
• Quality assurance
• CFRP machine construction

Series Production
• Fully automated production line (direct fiber placement, 3D forming & cutting, RTM, milling, washing, assembly)
• Filament winding process
• Technical center for small scales and development projects
Innovative Preforming at Voith
From Fiber Straight to Component

Elimination of expensive semi-finished products, reduction of cycle time due to elimination of process steps, completely digitalized production based on “Carbon Production 4.0“
Automated CFRP Production
Audi A8 Back Rear Wall

- VRA
- 3D Forming
- 3D Cutting
- HP RTM
- CNC Milling
- Cleaning
- Assembly

50k Fiber
2D Dry Fiber Placement

2D → 3D
Segmented Stamp Forming

Ultrasonic Knife

High Production Rate, Curing Time < 120 s

High Speed Milling

Surface Cleaning with Poor Water

Automated Riveting & Bonding
Voith Process Facilitates Manufacturing of High Quality Products in High Volumes

Audi A8 CFRP Rear Wall

- ~ 65,000 components p.a. producable
- Largest component of the occupant cell
- Contributes 33% to the torsional rigidity of the vehicle
- Absorption of longitudinal and transverse loads
- Optimized fiber lay up with 6-19 carbon fiber layers
Voith Composites
Industrialized Filament Winding Technology
CFRP - light weight rolls
Production Method

- fibers are unwound from a roving spool
- fiber immersion and impregnation in resin bath
- winding of the impregnated fibers onto the mandrel
  - mandrel is the negative shape of the component part and forms the roll inside diameter very precise
- the wound laminate is tempered in an oven to let the resin react and cure
  - this gives the composite structure its stiffness and strength
- finally, the mandrel is pulled from the composite roll
# CFRP - light weight rolls

## Advantages

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<tr>
<th>Advantage</th>
<th>Steel</th>
<th>Carbon Fiber</th>
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<tbody>
<tr>
<td>Higher stiffness and strength</td>
<td>Young’s modulus steel</td>
<td>210 GPa</td>
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<tr>
<td>Up to 80% lighter than steel</td>
<td>Density</td>
<td>7,8 kg/dm³</td>
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<tr>
<td>low thermal expansion</td>
<td></td>
<td>12 \cdot 10^{-6} , 1/K</td>
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<td>excellent running characteristics - exact inside contour</td>
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Highest Precision for Filament Winding Products up to 12m Length and 1.2m in Diameter
Voith Contribution in current Engineering Projects
Pilot Production & 0-Series

Voith Composites Competence
- Prototype production
- Sampling
- Tool engineering
- Quality assurance
- CFRP machine construction
Voith Contribution in current Engineering Projects
Project Feasibility, Concepts & Design

Competence for Concepts
- Composite Part Design
- Tooling Concepts
- Virtual Process Layout
  - VRA Lay Up Simulation / Digital Twin
  - Filament Winding Simulation
- PLC Programming, Tests and Simulation

Software
- CATIA V5
- Autodesk Inventor
- CADWIND
Voith Contribution in current Engineering Projects
Project Feasibility, Concepts & Design

Competence for Analysis
• Analytic Layout of Components
• Numerical Structural and Process Simulation (FEA)
  • Linear / nonlinear Statics
  • Linear Dynamics
  • Fluid-Structure-Interaction

Software
• ANSA / META / EPYLISYS
• ABAQUS
Quality
Different quality measurement methods

Competence for Analysis
• Mechanical testing
• Differential scanning calorimetry
• Microscopy
• Thermography
• Fibre volume content (thermic)
• Surface measuring (optical)

Certification
• DIN EN ISO 9001
• VDA 6.1
• DIN EN ISO 14001
• OSHAS 18001
Development of further Innovative Preforming Technologies

Voith Prepreg Winding (VPW)
Industrialized Filament Winding Technology
• Simultaneous production of a high number of preforms
• Low scrap rates and net-shape manufacturing due to efficient nesting
• No cost-intensive resin injection required

Voith Long-fiber Preformer (VLP)
Preforms for complex parts
• Fast and precise application of long fiber patches
• Automated production of 2D stacks with complex fiber architectures
• High degrees of design freedom in fiber assembly (deep drawing)
Voith Roving Applicator
The Next Generation

• Maintaining all advantages of VRA 2.0 (e.g. near net shaped lay-up, local reinforcements)
• With integrated inline impregnation of the fiber during the process
• Shortened process chain
• Simplification of subsequent processes
• Cost reduction
• Fully automated process in one machine
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