JEC PARIS 15TH MARCH 2017

EFFICIENT MANUFACTURING OF COMPOSITES TODAY AND TOMORROW

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Dipl.-Ing Patric Winterhalter, Schuler Pressen GmbH
EFFICIENT MANUFACTURING OF COMPOSITES TODAY AND TOMORROW

AGENDA

▷ REQUIREMENTS FOR LARGE SCALE PRODUCTION PROCESS
▷ MULTIFUNCTIONAL SHORT-STROKE PRESS
▷ MODULAR CONSTRUCTION SYSTEM
▷ SAMPLES
▷ HYBRID PART MANUFACTURING
EFFICIENT MANUFACTURING OF COMPOSITES TODAY AND TOMORROW

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» MULTIFUNCTIONAL SHORT-STROKE PRESS
» MODULAR CONSTRUCTION SYSTEM
» SAMPLES
» HYBRID PART MANUFACTURING
LARGE SCALE COMPOSITE PRODUCTION PROCESSES
MATERIALS USED FOR COMPOSITE PRODUCTION

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Source: VDMA, Roland Berger
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LARGE SCALE COMPOSITE PRODUCTION PROCESSES
OVERVIEW OF MANUFACTURING PROCESSES OF FRP

<table>
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| **Long fiber**  < 50 mm  
Without fiber orientation | SMC  
[Image of SMC part] | GMT / LFT / LFT-D  
[Image of GMT/LFT/LFT-D part] |
| **Endless fiber**  > 50 mm  
Dedicated fiber orientation | RTM / HP-RTM  
[Image of RTM/HP-RTM part] | Organic sheet  
[Image of Organic sheet part] |

**SOURCE:** BMW AND BASF
NFPP FORMING AND NFPP HYBRID MOLDING

NFPP HYBRID MOLDING IS A TECHNOLOGY WHICH SIGNIFICANTLY HELPS TO SAVE WEIGHT AND PROCESS STEPS. THERE IS A TREND TO USE NFPP-HYBRID MOLDING FOR DOOR PANELS, DOOR UPPERS, SEAT BACK PANELS AND MORE, WHICH WAS FORMERLY MADE IN INJECTION MOLDING.

ORGANO FORMING AND ORGANOSHEET INJECTION

ORGANO FORMING IS MAINLY USED IN THE AIRCRAFT INDUSTRY. WITH THE INTEGRATION OF INJECTION MOLDING IT BECOMES INTERESTING FOR AUTOMOTIVE AS WELL. THERE IS A TREND TO USE IT FOR SEMI STRUCTURAL COMPONENTS LIKE DOOR MODULES, FRONTEND MODULES AND OTHERS.

RTM AND PREPREG

IN RTM AND PREPREG TECHNOLOGY IT IS STILL A CHALLENGE TO ACHIEVE THE CYCLE TIMES FOR AUTOMOTIVE LARGE VOLUME PRODUCTION. THAT’S WHY IT IS STILL USED FOR SMALL VOLUMES AND NICHE PRODUCTS, WHICH USE THE POTENTIAL OF FUNCTIONAL INTEGRATION TO MINIMIZE THE WEIGHT.

SOURCE: DAG, PAG, MAL
LARGE SCALE COMPOSITE PRODUCTION PROCESSES

REQUIREMENTS FOR MACHINE AND TOOL SUPPLIER

- Turnkey supplier for machines and tools required
- Innovative solutions through process and material combinations
- Standard lines out of a modular construction system
- Customized solutions
- Thermosetting applications
- Thermoplastic applications
EFFICIENT MANUFACTURING OF COMPOSITES TODAY AND TOMORROW

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MULTIFUNCTIONAL HYDRAULIC SHORT-STROKE PRESS

FUNCTION PRINCIPLE

1. Parallelism controlled rapid downstroke of the slide
2. Slide has reached the locking position
3. Slide locking and start of the press plate movement parallelism controlled
4. Working stroke with press plate from bottom
MULTIFUNCTIONAL HYDRAULIC SHORT-STROKE PRESS

MAIN CHARACTERISTICS

Significant reduction of machine height
▷ Reduction of machine height by 40%

Accessibility from all four sides
▷ Column machine design with lateral openings

Integrated parallelism control
▷ No adaption for different mould heights required

Short pressure build-up time
▷ With short stroke cylinders

Reduced energy consumption
▷ Significant less compression oil

Schuler short stroke press 36.000 kN with 3,6 x 2,4 m platen surface
MULTIFUNCTIONAL HYDRAULIC SHORT-STROKE PRESS USED ALL OVER THE WORLD

NCC
National Composite Center
Bristol, England
CHAPU-3600-3.6x2.4
Already in use since 2014

AZL
The Aachen Center for Integrative Lightweight Production
Aachen, Germany
CHAPU-1800-2.8x1.8
Installation right now

IACMI
Institute for Advanced Composites Manufacturing Innovation
Detroit, USA
CHAPU-3600-3.6x2.4
Installation right now

OEM
R&D department / series application
Republic Korea
CHAPU-3600-3.6x2.4
Start of assembly
MULTIFUNCTIONAL HYDRAULIC SHORT-STROKE PRESS
CONGRUENT BENDING LINES OF SLIDE AND TABLE PLATE

DEFLECTION OF SLIDE AND PRESS PLATE IN
OPPOSITE DIRECTION AT TRADITIONAL DESIGN

- Increased part thickness in the middle

DEVIAITON OF BENDING LINES OF SLIDE AND PRESS
PLATE AT SHORT-STROKE PRESS +/- 0.2 MM

- To achieve uniform wall thickness
- Depending on mould design and part geometry
  optimization of bending-lines possible
- Concept of congruent bending lines successful
  realized at 14 presses

CURRENT RESEARCH PROJECT ICOMPOSITE 4.0

- Implementation of adaptive congruent bending
  lines

© Schuler and Frimo
MULTIFUNCTIONAL HYDRAULIC SHORT-STROKE PRESS
PARALLELISM CONTROL SYSTEM AND DYNAMIC FORCE CONTROL

PARALLELISM CONTROL DUE TO ECCENTRIC LOADS OUT OF THE PROCESS

- Non-symmetric part geometry
- Low viscosity of the flowing resin

REDUCED ENERGY CONSUMPTION

- Dynamic force control for reduced energy consumption

4 cylinders for parallelism control

2 big cylinders in the middle

Press table with cylinders

Side panel BMW i3 with eccentric force load
MULTIFUNCTIONAL HYDRAULIC SHORT-STROKE PRESS
HIGH IMPACT OF ADAPTIVE CONGRUENT BENDING LINES

Load case 1
Increased force at the corners

Load case 2
Homogenous force distribution

Load case 3
Increased force at the center

Strong impact on mould deflection of lower mould

Big influence of adaptive congruent bending lines on part thickness (up 0.5 mm for this part)
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MODULAR CONSTRUCTION SYSTEM

WHAT IS THE RIGHT SETUP FOR A LARGE SCALE COMPOSITE PROCESS?

Material Feeding

Cutting

Heating

Presses

Resin Injection

3D Cutting

Handling

Moulds
MODULAR CONSTRUCTION SYSTEM

MATERIAL SUPPLY

- Roll Storage with Pull Off Unit
- Manual Precut Layup
- Batch Feeding
- Stack Layup
- Multi Magazine
- Turntable
MODULAR CONSTRUCTION SYSTEM
PRE CUTTING

- Longitudinal Cutter Unit
- Cross Cutter Unit
- CNC-Cutter
- Ultrasonic Blade
- Bypass or Kiss Cut (Tool)
MODULAR CONSTRUCTION SYSTEM

HEATING

- Heating Presses
- Infrared Oven (up to 450°C e.g. for PEEK)
- Gas Heater
- Hotair Oven
- Microwave Oven
- Induction Oven
MODULAR CONSTRUCTION SYSTEM
PRESSES

COMPOSITES ALLIANCE
Partners in Lightweight Technology
MODULAR CONSTRUCTION SYSTEM
INJECTION OF THERMOPLASTIC AND THERMOSET RESIN

- Mix and Metering machines for PUR
- Mix and Metering machines for Epoxy
- Injection units for thermoplastic resin
- Material supply

- Technical data is depending on the used resin material
- Equipment will be designed to match the exact requirements of the component
MODULAR CONSTRUCTION SYSTEM
CUTTING

Bypass or Kisscut with Punching Tool
(60sec cycle)
Milling / Boring / Deburring
Blade Cutting
Waterjet Cutting
Waterjet Cutting, abrasiv
Laser Cutting
MODULAR CONSTRUCTION SYSTEM

AUTOMIZATION / HANDLING

Robots
Linear Transfers
Turntables
Material Gripper
Part Gripper
Toolchange Gripper
MODULAR CONSTRUCTION SYSTEM

MOULDS

HP-RTM Moulds
Preform Moulds
Wet RTM Moulds
Prepreg Layup and Curing Moulds
SMC / C SMC Moulds
GMT Moulds
LFT / LFT-D Moulds
Moulds for combined processes
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SAMPLES – THERMOSET APPLICATION

HP-RTM

- Eleven production lines for HP-RTM
- Serial production with 25,000 parts per year
- Approx. 6 min cycle time
- Automatic toolchange
SAMPLES – THERMOSET APPLICATION

WET-MOULDING AND HP-RTM MANUFACTURING LINE

- short-stroke press
- mould change
- batcher
  HP-RTM / wet RTM
- preform feeding
- heating station
- handling-robot
- draping table
- cutting table
- coil supply
- resin table
- resin robot
- preform storage
SAMPLES – THERMOSET APPLICATION
MOULDS

HP-RTM tools for roofs
HP-RTM tools for large structures
Tool inner pressure from 10-200bars
RTM wet tools for large structures
Reduced cycle time (5min)
Preform tools
Preform tools with integrated cutting
Tools for R&D
SAMPLES

THERMOPLASTIC APPLICATION

Production Line for Door Panels

**60 sec cycle time**

Forming and Cutting in Oneshot

Additional Lamination of a Textile layer is feasible in Oneshot

Main Applications: Door Panels, Inserts, Seat Back Cover, etc..
SAMPLES

THERMOPLASTIC APPLICATION

Organosheet Forming Line for automatic production of Clips for Airbus A350 XWB
SAMPLES

THERMOPLASTIC APPLICATION

AIRBUS Clips production line
1min cycle time
1 min tool change time
5 sec handling time
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MANUFACTURING OF METAL-CARBONFIBRE-POLYAMID HYBRID COMPONENTS

RESSOURCENEFFIZIENTE MISCHBAUWEISEN FÜR LEICHTBAU-KAROSserien

Fertigung des hybriden Tunneldemonstrators im kombinierten Umform-Spritzgieß-Prozess
RESEARCH PROJECT ICOMPOSITE 4.0 (2016-2018)
MANUFACTURING OF CFRP-PARTS AT HIGH VOLUME WITH LONG AND ENDLESS FIBRES

- Combination of specific process advantages at one complete system
- Maximization of resource efficiency (processing time -30 %, piece costs – 50 %)
- Customized mass production through data consistency and self optimization

Paradigm change: Regulation of component properties, not the process parameters
From geometry based manufacturing to the product function based manufacturing
RESEARCH PROJECT ICOMPOSITE 4.0 (2016-2018)

PROJECT PARTNER

INSTALLATION OF COMPLETE MANUFACTURING LINE AT THE AZL (UNIVERSITY OF AACHEN)
HYBRID PART MANUFACTURING

COMBINATION OF HOT STAMPED STEEL AND FIBRE REINFORCED PLASTICS

HOT STAMPING OF STEEL

FIBRE REINFORCED PLASTICS

CFRP-Steel Hybrid

Source: BMW
HYBRID PART MANUFACTURING
HOT STAMPING OF STEEL - PROCESS

HIGH STRENGTH STEEL PARTS WITH **SHORT CYCLE TIME OF 8 SECONDS** AND **HIGHEST OUTPUT OF FOUR PARTS** AT THE SAME TIME
MODULAR CONSTRUCTION SYSTEM FOR HOT STAMPING OF STEEL
TURNKEY SUPPLIER ALONG THE WHOLE PROCESS CHAIN

MORE THAN 70 HOT STAMPING PRODUCTION LINES DELIVERED BY SCHULER

Blanking lines
Tailored blank lines
Blank loader
Furnace
Press loading und unloading
Presses
Hot stamping dies
Part stacking system
HYBRID PART MANUFACTURING

MODULAR CONSTRUCTION SYSTEM ALONG THE WHOLE PROCESS CHAIN

R&D PARTNERSHIP

Joint product development together with you

PROTOTYPE AND SHORT-RUNS

Manufacturing infrastructure at our TechCenter and partner institutes

FOCUSED ON THE MARKET

Member of the board of the Working Group Hybrid Lightweight Technologies

VDMA
JEC PARIS 15TH MARCH 2017

THANK YOU VERY MUCH FOR YOUR ATTENTION AND SEE YOU SOON AT OUR BOOTH HALL 5A N49/M50

Dipl.-Wirtsch.Ing. (FH) Thomas Joachim, FRIMO Group GmbH
Dipl.-Ing Patric Winterhalter, Schuler Pressen GmbH