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LARGE SCALE PRODUCTION LINE WITH NEW MULTI-FUNCTIONAL HYDRAULIC SHORT-STROKE PRESS

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Dipl.-Wirtsch.Ing. (FH) Thomas Joachim, FRIMO Group GmbH
LARGE SCALE PRODUCTION LINE WITH NEW MULTI-FUNCTIONAL HYDRAULIC SHORT-STROKE PRESS

AGENDA

» REQUIREMENTS FOR LARGE SCALE PRODUCTION PROCESSES
» MULTI-FUNCTIONAL PRESS
» MODULAR CONSTRUCTION SYSTEM
» HP RTM-INJECTION
» MOLDS AND SAMPLES
LARGE SCALE COMPOSITE PRODUCTION PROCESSES
MATERIALS USED FOR COMPOSITE PRODUCTION

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<th>Fibers</th>
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Source: VDMA, Roland Berger
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LARGE SCALE COMPOSITE PRODUCTION PROCESSES

WHICH PRODUCTION CONCEPT IS THE “FUTURE CONCEPT”? 

- Increasing Automization
- Factory -> Chained Lines
- Short Cycle RTM-Process (< 10 min)
- Thermoplastic Press-Processes (< 2 min)

Source: VDMA, Roland Berger
LARGE SCALE COMPOSITE PRODUCTION PROCESSES

REQUIREMENTS FOR LARGE SCALE PRODUCTION

- Low Cycle Times (1 – 5 min)
- High Availability (> 85%)
- Process Data Acquisition
- Automated Processes
- Process Combinations
- Waste Prevention
- Energy Saving
- Cost Reduction

AUTOMOTIVE
- Low cycle times for middle scale series
- Strong cost reduction

AEROSPACE
- Maximum precision
- Repeatability / process stability
- Very complex shapes and layups

WIND ENERGY
- Low Invest
- Large Parts

MACHINE BUILDING
- Maximum Flexibility for high part variation
- Different Requirements for different products

Source: VDMA, Roland Berger
LARGE SCALE COMPOSITE PRODUCTION PROCESSES

REQUIREMENTS FOR MACHINE AND TOOL SUPPLIER

- Turnkey Supplier for machines and tools required
- Innovative Solutions through Process Combinations
- Standard Lines out of a Modular Construction System
- Customized Solutions
- Thermosetting Applications
- Thermoplastic Applications
LARGE SCALE PRODUCTION LINE WITH NEW MULTI-FUNCTIONAL HYDRAULIC SHORT-STROKE PRESS

AGENDA

- REQUIREMENTS FOR LARGE SCALE PRODUCTION PROCESSES
- MULTI-FUNCTIONAL PRESS
- MODULAR CONSTRUCTION SYSTEM
- HP RTM-INJECTION
- MOLDS AND SAMPLES
FORERUNNER OF THE NEW SHORT-STROKE PRESS

WELL KNOWN MACHINE CONCEPT OF THE SHORT-STROKE PRESS

- Built several times during the 80s and 90s
- Still in use at Daimler Sindelfingen for the production of SMC trunk lids
FUNCTION PRINCIPLE – SHORT-STROKE PRESS

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
CONSTRUCTION HEIGHT OF THE PRESS

- Conventional long-stroke press: 10 m / 32 ft
- New designed short-stroke press: 5.8 m / 19 ft

Reduction of machine height by more than 40%
PRESS WITH HYDRAULIC UNIT AND ACCUMULATOR
TECHNICAL SPECIFICATION OF THE PRESS

TECHNICAL SPECIFICATION

- Press force 36,000 kN (4,000 US tons)
- Table dimension 3.6 x 2.4 m (142” x 9”)
- Daylight 2.8 m (110”)
- Stroke 2.4 m (94”)
- Rapid downstroke and return speed 1,000 mm/s (39”/s)
- Processes: Every known press process for thermoset and thermoplastic material
SPECIAL REQUIREMENTS FOR THE UNIVERSAL PRESS

- SHORT CLOSING- AND PRESSURE BUILD-UP TIME
- UNIFORM WALL THICKNESS
- CONGRUENT BENDING LINES OF SLIDE AND PRESS TABLE
- PARALLELISM CONTROL
- MAINTAINING OF RESIN INJECTION POSITION FOR “GAP-INJECTION”
- GOOD ACCESSIBILITY AND GREAT VISIBILITY CONDITIONS
- COMPREHENSIVE PROCESS DATA ACQUISITION AND ANALYZE
- EFFICIENT ENERGY USE
- EASY AND INTUITIVE OPERATING
SHORT CLOSING- AND PRESSURE BUILD-UP TIME FOR SHORT CYCLE TIMES

RAPID DOWN- AND UPSTROKE WITH 1000 MM/S
- Separate parallelism controlled moving cylinders of the slide
- No prefilling

PRESSURE BUILD-UP < 0.2 S
- Short-stroke cylinder with 200 mm (7.8”) stroke
- Working speed up to 40 mm/s (1.55”/s)

REFERENCE CYCLE COMPARABLE TO CONVENTIONAL LONG-STROKE PRESS
- 1,000 mm (39”) rapid down stroke with slide locking
- 30 mm (1.2”) working stroke incl. pressure build-up
  ➔ Within 3 s realizable
UNIFORM WALL THICKNESS

CONGRUENT BENDING LINES OF SLIDE AND PRESS PLATE

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

- Increased part thickness in the middle

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

- Uniform wall thickness
- Concept of congruent bending lines successful realized at 10 presses

Illustration of congruent bending lines
UNIFORM WALL THICKNESS
PARALLELISM CONTROL

ECCENTRIC LOAD RESULTS FROM THE PROCESS

- Non-symmetric part geometry
- Low viscosity of the flowing resin when closing the mold

Side panel BMW i3 with eccentric force load

Press table with cylinders

4 x 4,000 kN (440 us tons) double-acting cylinder

2 x 10,000 kN (1,100 us tons) single-acting cylinder
MAINTAINING OF RESIN INJECTION POSITION FOR “GAP-INJECTION” FOR THE PROCESSING OF COMPRESSION-RTM

TASK

- Maintaining of injection position of press plate against raising internal resin pressure and raising eccentrically load

SOLUTION

- Closed-loop control of press plate with parallelism control cylinders
- Deviation of parallelism at eccentric load of 32,000 kN (3,520 US tons) at 0.05 mm (0.02”)
GOOD ACCESSIBILITY AND GREAT VISIBILITY CONDITIONS

LOADING AND UNLOADING / MOLD CHANGE
- Front and rear side possible

LATERAL ACCESS AND GREAT VISIBILITY CONDITIONS
- Full enclosure made out of transparent plastic
- Lateral access due to doors between columns

SAFETY- AND OPERATOR CONCEPT
- Light curtain with step behind protection
- Mould scanner
- Electrical monitored lateral access doors
- Four operator panels can be interlinked
COMPREHENSIVE PROCESS DATA ACQUISITION AND ANALYZE

PROCESS DATA ACQUISITION – DISCRETE VALUES

- Acquisition of process parameters for each cycle, e.g. max. press force, curing time, mold temperature, break-up force...
- Process parameters of current and one of the last five strokes can be compared at the visualization

PROCESS DATA ACQUISITION – CONTINUOUS VALUES

- Recording of up to 96 analog and 100 digital channels
- Illustration and analyze as curves at press visualization

EXPORT OF PROCESS DATA

- Parameters can be exported in excel compatible format
EASY OPERATING – SCHULER OPERATING PHILOSOPHY

VISUALIZATION - HYDRAULIC CIRCUITS
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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  
Peripheral devices
MODULAR CONSTRUCTION SYSTEM

MATERIAL SUPPLY

- Roll Storage with Pull Off Unit
- Manual Precut Lay Up
- Batch Feeding
- Stack Lay Up
- 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

- Mix and Metering Machines for PUR
- Mix and Metering Machines for epoxy
- Mixheads 2-6 components
- Working Tanks
- Container Station

- Technical data is depending on the used PUR or Epoxy material
- Equipment will be designed to match the exact requirements
- Mixing ratio from **5:100 – 50:50**
- Output from **10-15 gr/sec** - .................
MODULAR CONSTRUCTION SYSTEM

3D CUTTING

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

AUTOMIZATION / HANDLING

- Robots
- Linear Transfers
- Turntables
- Material Gripper
- Part Gripper
- Tool Change Gripper
MODULAR CONSTRUCTION SYSTEM

PERIPHERAL DEVICES

- Material supply and drying
- Pre-Heating Oven
- Climate chamber
- Extrusion and Injection units
- Transport Systems
- Testing Equipment
- Camera Systems and Image processing
- Process Data Acquisition
- Tool Change Systems
- Plasma Treatment
- Barcode Printer
- Exhaust Units
- Waste removal .....
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MODULAR CONSTRUCTION SYSTEM

THERMOSET APPLICATION
MODULAR CONSTRUCTION SYSTEM
THERMOSET APPLICATION

Material → Cutting → Alignment → Heating → Preforming → 3D Cutting → RTM Injection → 3D Cutting → Postprocess
MOLDS AND SAMPLES

THERMOSET APPLICATION

- Production line for RTM
- Serial production
- Approx. 8 min cycle
- Automatic tool change
MOLDS AND SAMPLES

THERMOSET APPLICATION

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

THERMOPLASTIC APPLICATION
MODULAR CONSTRUCTION SYSTEM

THERMOPLASTIC APPLICATION
MOLDS AND SAMPLES

THERMOPLASTIC APPLICATION

- Organosheet Forming Line for automatic production of clips for Airbus A350 XWB
- 1 min cycle time
- 1 min tool change time
- 5 sec handling time out of oven into press, until press is closed and full pressure is applied
MOLDS AND SAMPLES

THERMOPLASTIC APPLICATION

- Sample application – window retainer for AIRBUS
- Organosheet forming with back injection in Oneshot
- Further applications in progress but confidential
MOLDS AND 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.
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