Hydroforming in Large-Scale Production

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May, 10th 2016
The Salzgitter Group and Salzgitter Hydroforming in brief

Market and Customer Demands on Hydroforming

- Trends in Hydroforming
- Boundary Conditions for hydroforming serial production and their effects
  - Chassis Components
  - Exhaust Components

Special Topics for Serial Production

- Different Production Concepts
- New Automated Production Line at Salzgitter Hydroforming

Conclusion
Salzgitter Hydrof. as a Member of Salzgitter Group

Salzgitter AG Group (BY 2015)

- Sales: €9.0 bn
- Employees: 23,600

Flat rolled steel:
- Employees: 6,100

Unit Plate / Section Steel:
- Employees: 3,000

Energy:
- Employees: 4,900

Trading:
- Employees: 1,900

Technology:
- Employees: 5,100

Strategic Business Units:
- Employees: 2,500

Financial independency and decentral management structure
Crimmitschau (DE)  160 EMP
Brumby (DE)  60 EMP
Chomutov (CZ)  70 EMP

• Start of production: 1999
• Employees: 290 (BY 2015)
• Certificates: ISO/TS 16949
                  EN ISO 9001
                  EN ISO 14001
                  EN ISO 50001

The Salzgitter Group and Salzgitter Hydroforming in brief

Locations

Basic Data

Plants

Crimmitschau
Brumby
Chomutov
Market and Customer Demands on Hydroforming

European autom. Production and Hydroforming Business
Market and Customer Demands on Hydroforming

Number of Hydroforming - Presses in Europe

![Bar chart showing the number of hydroforming presses in Europe from 1990 to 2016.](chart_image)
Market Segments and their influences on Production

Chassis&Body

High Volumes
150,000-800,000/a

Standardized Process Chains

Cost driven Processes

Medium Volumes
5,000-150,000/a
Exceptional cases > 1 Mill.

Great Diversity
Many derivatives

Balance between Costs and technical performance

Exhaust Components 2013

Exhaust Components 2015

Exhaust

Medium Diversity
Similar Topologie
Low No. of Derivatives

Complex Process Chains

Annual series volume

Further increase in medium volume parts
Different Process Routes according to Complexity

**Chassis Route**
- Input Material
- Preforming
- Heat Treatment
- Hydroforming
- Finishing

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**Exhaust Route**
- Input Material
- Preforming
- Heat Treatment
- Hydroforming
- Wash
  - Laser/Machining
  - Deburring/Washing

**Standard Process chain for Hydroformed Chassis Components with few working steps**

**Complex Process chain for Hydroformed Exhaust Components with many working steps**
Product specific flexibility (varying customer needs)
- Produktspezifische Flexibilität (variierende Kundenwünsche)

Capacity based flexibility (deviation in part volumes)
- Kapazitätsbezogene Flexibilität (Volumenschwankungen)

Customer Demands

Production Method

- Workshop manufacturing
  - Werkstattfertigung

- Line chained manufacturing
  - Verkettete Linienfertigung

- Island Manufacturing
  - Inselfertigung

- Combination of both methods
  - Kombinationen von Verfahren
Special Topics for Serial Production

Conflict of objectives for serial production

Low/Medium Volumes (e.g. Exhaust Parts)
- Workshop manufacturing
- Island manufacturing
- Combination of both methods

High Volumes (Car Body and Chassis Parts)
- Island manufacturing
- Line chained manufacturing
- Combination of both methods

![Graph showing the conflict of objectives for serial production. The graph plots Investment and Flexibility against Volume of Parts, with Low, Medium, and High volume categories.](image-url)
## Special Topics for Serial Production

### Different Production Concepts

<table>
<thead>
<tr>
<th>Production Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td><strong>Workshop Manufacturing</strong></td>
<td>High flexibility</td>
<td>High stocks</td>
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<tr>
<td></td>
<td>High efficiency</td>
<td>High lead times</td>
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<tr>
<td></td>
<td>Less sensitive</td>
<td>High planning effort</td>
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<tr>
<td><strong>Chained line Manufacturing</strong></td>
<td>Low stocks</td>
<td>Limited flexibility</td>
</tr>
<tr>
<td></td>
<td>Short lead times</td>
<td>High investments</td>
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<td></td>
<td>Good QA-loop</td>
<td>High empty / setup costs</td>
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<tr>
<td><strong>Island Manufacturing</strong></td>
<td>High flexibility</td>
<td>Reduced efficiency</td>
</tr>
<tr>
<td></td>
<td>Good division of labor</td>
<td>Highly skilled personnel</td>
</tr>
<tr>
<td></td>
<td>Good QA-loop</td>
<td>High implementation costs</td>
</tr>
</tbody>
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![Working station](image1.png) ![Stock](image2.png)
Example for combined manufacturing at SZHF

Finishing Center – Single working steps concentrated in a group:

- No intermediate stocks in workflow
- Usage of small handling containers
- Flexible system with good Q&A

Workflow:
1. Laser cutting of multiple parts
2. Deburring and quality check
3. Rolling, milling & deburring
4. Calibration & QA
5. Output (ready for shipment)

Handled by two/three workers
Automated Exhaust Parts Production – Video

Fully automated inline manufacturing at SZHF Crimmitschau

Please contact us for more detailed information…
New Automated Production Line

Fully automated line chained manufacturing at SZHF Brumby

- Division into 3 working spaces (Forming, Cutting, Washing & Package)
- Working spaces in cell design
- Cells fully functional also without being chained
New Automated Production Line – Bending

Fully automated line chained manufacturing at SZHF Brumby

Bending cell:
- Tube feeding
- 3 bending machines
- Intermediate stock
- SPC-Interface
- Discharge of nok parts
New Automated Production Line – Preforming

Fully automated line chained manufacturing at SZHF Brumby

Preform Cell:
- Lubrication
- Hydraulic Press
- Possibility for outfeeding
Special Topics for Serial Production

New Automated Production Line – Hydroforming

Fully automated line chained manufacturing at SZHF Brumby

Hydroforming Cell:
- 50,000 kN-Press
- Hole control
- Intermediate stock
- In- & outfeed
- Discharge of nok parts
New Automated Production Line – Laser Cutting

Fully automated line chained manufacturing at SZHF Brumby

Laser Cell:
- 2 twin-cabin-laser-system
- Power & Free conveyor
- Intermediate stock
- SPC-Device
New Automated Production Line – Washing and Package

Fully automated line chained manufacturing at SZHF Brumby

Washing & Package Cell:
- Cleaning is splashed water based
- Power & Free conveyor
- Automated package station for different products
- Mixed operation modus for manual and automated feeding with different products possible
New Automated Production Line – Video

Fully automated line chained manufacturing at SZHF Brumby

Please contact us for more detailed information…
Conclusion

Market and customer needs in hydroformed components vary significantly in quantity, design, material, available invest etc. Therefore adapted process chains for different applications have to be established.

Optimized customized production concepts consider principles of
- Island…
- Workshop …
- Line chained Manufacturing.

Competitive approaches are often mixed ones.

Salzgitter Hydroforming has taking into operation in 2015 a new automated Line for large scale production of Chassis&Body components. Furthermore automated hydroforming production islands for multi cavity and multi stage hydroforming for exhaust applications were also become operational.
Thank you for your attention!