Efficient fibre reinforcement at reduced material costs
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SENIOR SALES MANAGER LIGHTWEIGHT

SPE Automotive Composites Conference & Exhibition
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LONGFIBRE APPLICATIONS–VARIED POTENTIAL
SOLUTION FOR CURRENT TRENDS

Circular Economy
- design for recycling
- PCR-material
- CO₂ footprint
- substitution
- wall thickness
- longer fibres

FIBRE DIRECT-COMPOUNDING
- competitiveness
- efficiency
- part cost reduction
- material cost savings
- mould design
- flexible material selection
PROCESS PRINCIPLE

Glass fibre feed

Cutting and dosage of the fibres

Dispersion and homogenisation

Plasticising of matrix polymer
INJECTION UNIT AND FDC-UNIT

Two-stage screw
Plasticising of granulate; insertion of fibres and homogenization of material

Cutting device
Cuts continuous fibre strands into different lengths

Side feeder
Adds fibres directly to the liquid melt
## CUTTING FIBRES TO VARIABLE LENGTHS

<table>
<thead>
<tr>
<th>Number of blades</th>
<th>Cutting length [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>5.6*</td>
</tr>
<tr>
<td>9</td>
<td>11.2*</td>
</tr>
<tr>
<td>6</td>
<td>16.8*</td>
</tr>
<tr>
<td>3</td>
<td>33.6*</td>
</tr>
<tr>
<td>2</td>
<td>50.4</td>
</tr>
<tr>
<td>1</td>
<td>100.8</td>
</tr>
</tbody>
</table>

* Recommended length © Copyright by ARBURG 07 / 2019
INTEGRATION IN SELOGICA CONTROL SYSTEM

- Simple programming with dedicated symbols
- Full integration in SELOGICA via real-time interface
- Integrated quality control

FDC symbols
INTEGRATION IN SELOGICA CONTROL SYSTEM
QUALITY CONTROL

- Process parameters
  - Amount of fibres
  - Vacuum side feeder
  - Melt cushion
  - Injection pressure
  - Dosage time

- Inline weight control
  - Shot weight control with scale
  - Shot weight as protocol parameter
FACTORS FOR FIBRE LENGTH

- fibre breakage during molding
- fibre breakage during injection
- fibre breakage during dispersion
- fibre feeding
- material plasticising
POTENTIAL

Source: Thomason and Vlug – Influence of fibre length (PP/GF qualitative)
## ECONOMIC COMPARISON*

<table>
<thead>
<tr>
<th>Material</th>
<th>Component</th>
<th>Percentage</th>
<th>Price/kg (EUR)</th>
<th>Cost/kg (EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-fibre granulate</td>
<td>PP LGF 30</td>
<td></td>
<td></td>
<td>EUR 2.35</td>
</tr>
<tr>
<td>FDC process</td>
<td>PP</td>
<td>67%</td>
<td>EUR 1.40/kg</td>
<td>EUR 0.94</td>
</tr>
<tr>
<td></td>
<td>Glass-fibre roving</td>
<td>30%</td>
<td>EUR 1.25/kg</td>
<td>EUR 0.38</td>
</tr>
<tr>
<td></td>
<td>Bonding agent</td>
<td>3%</td>
<td>EUR 3.50/kg</td>
<td>EUR 0.11</td>
</tr>
</tbody>
</table>

### Cost benefit per kg

**EUR 0.92**

39 %

* depending on region / purchase quantity

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ECONOMIC COMPARISON*

- Shot weight: 791gr
- Cycle time: 45s
- PP LGF 30

<table>
<thead>
<tr>
<th></th>
<th>PP LGF 30</th>
<th>FDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material costs*</td>
<td>2,35 EUR / Kg</td>
<td>1,45 EUR / Kg</td>
</tr>
<tr>
<td>Material costs / year**</td>
<td>803.277 EUR</td>
<td>495.639 EUR</td>
</tr>
<tr>
<td>Savings of material costs / year</td>
<td><strong>307.639 EUR</strong></td>
<td><strong>estimated 250 days / Year 3-shift 90% Availability</strong></td>
</tr>
</tbody>
</table>

* depending on region / purchase quantity

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EXAMPLE: AIRBAG HOUSING

Cavities: 2
Part weight: 330 [g]
Material: PP GF 30
DETERMINED FIBRE LENGTH IN PART

- **Long-fibre granulate**
  - ~30% of fibres longer than 2 mm

- **FDC process with 16-mm fibres**
  - ~50% of fibres longer than 2 mm

Source: SKZ – Extract from laboratory report on material testing

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EXAMPLE: CABLE DRIVE HOUSING

- Replacement of PBT through PP LGF material
- Cost-effective high-volume production through FDC process
- Cooperation and exchange of knowledge with customers
- Fulfilment of all required quality specifications
EXAMPLE: CABLE DRIVE HOUSING

Serial production:
- ALLROUNDER 630 S 2500 - 2100 / FDC
- 4 cavity mold
- Part removal with robot

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Cycle time [s]</td>
<td>33</td>
</tr>
<tr>
<td>Shot weight [g]</td>
<td>186</td>
</tr>
<tr>
<td>Matrixmaterial</td>
<td>PP</td>
</tr>
<tr>
<td>Fibre type</td>
<td>Johns Manville LFT 490</td>
</tr>
<tr>
<td>Fibre length [mm]</td>
<td>11,2</td>
</tr>
<tr>
<td>Fibre content [%]</td>
<td>30</td>
</tr>
</tbody>
</table>

Ros received Brose Innovation Award Europe for implementation of innovative ideas (2017)
EXAMPLE: CABLE DRIVE HOUSING

- 8 cavity mold
- About 50% longer fibres in the part (compared to LGF-material)
- Competitiveness thanks to FDC
- Fibre content monitored via shot weight
EXAMPLE: JOINT

Machine:
- ALLROUNDER 820S 4000 – 3200 / FDC
- 1 cavity mold
- Part removal with robot

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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Cycle time</td>
<td>[s]</td>
<td>40</td>
</tr>
<tr>
<td>Shot weight</td>
<td>[g]</td>
<td>214</td>
</tr>
<tr>
<td>Matrix material</td>
<td></td>
<td>PA 6</td>
</tr>
<tr>
<td>Fibre type</td>
<td></td>
<td>Johns Manville LFT 895</td>
</tr>
<tr>
<td>Fibre length</td>
<td>[mm]</td>
<td>11,2</td>
</tr>
<tr>
<td>Fibre content</td>
<td>[%]</td>
<td>15</td>
</tr>
</tbody>
</table>
FDC* WITH THERMOPLASTIC COMPOSITES

- Two composite-sheets of different thicknesses as inserts
- Functional and reinforcement elements through FDC
- Cavities: 1
- Part weight: 202 [g]
- Material: PP + GF

* fibre direct-compounding
FDC* WITH THERMOPLASTIC COMPOSITES
EXAMPLE: SEAT REST

- **Hybrid part**
  - Glasfibre reinforced Organosheet
  - Carbon-Fibre reinforced UD-Tape
  - Metall inserts
  - PP LGF with Fibre Direct Compounding

- **Modular production system**
  - Dieffenbacher 3.600to press
  - ARBURG SPE 4600 / FDC
  - Automation (fibre forge, robot, heating, feeding of inserts, …)
SUMMARY

- Longer fibres in the part
- Mechanical properties optimised in a targeted approach
- Individual adjustment of
  - Fibre length
  - Fibre content
  - Material combination
- High material availability
- Reduced part costs
THE HOME OF INJECTION MOULDING

QUALITY  KNOW-HOW  MACHINES  TECHNOLOGIES
MARKET LEADERSHIP  PASSION  VISION  INNOVATION

WIR SIND DA.