Injection moulding of lightweight parts

Technological highlights and innovative applications
Injection moulding of lightweight parts

What is that?

• Reduction in part weight
• Combining new materials
• Improved properties
• Economic production
• Economically efficient production

Why?

• Cost saving
• Conservation of resources
• New applications
• Quality optimization

Technological highlights and applications

ProFoam
Fibre Direct-Compounding
Multi-Material Design

ARBURG as an applications consultant and systems partner

Minimizing costs
Material substitution
Innovative products

Production efficiency
ProFoam process

Procedure

Blowing agent +

Diffusion Homogeneous Solutions

Nucleation Cell growth Fixation

Loading Mixing

Injection unit Mould

Source: IKV – Institut für Kunststoffverarbeitung (Plastics Processing Institute)

Advantages and disadvantages*

+ • Reduction of shrinkage, distortion and sink holes
  • Uniform longitudinal and transverse shrinkage
  • Weight savings
  • Reduction of viscosity
  • Lower locking force required
  • Part design can be optimised
  • Cycle times can be reduced

• Streaky surfaces
• Possible reduction of mechanical properties

* Depending on the application – advantages may be mutually exclusive
ProFoam process

Technology – easy to implement

- Blowing agent is added to the plastic granulate at room temperature
- Additional seal
- Patented granulate lock

Needle-type shut-off nozzle
Plasticising unit with standard three-zone screw
Blowing agent (N₂ or CO₂)

Blowing agent dissolves under pressure in the melt
Blowing agent expands during injection

ProFoam process
Mechanically resilient parts – with ProFoam

<table>
<thead>
<tr>
<th></th>
<th>Average fibre length [mm]</th>
<th>Penetration force [J/mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compact</td>
<td>ProFoam</td>
</tr>
<tr>
<td>Source: SABIC</td>
<td>* initial length of fibres 12.5 mm (granulate length)</td>
<td></td>
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</tbody>
</table>
ProFoam process

Reduced weight and high quality surfaces

Component: Glove compartment cover

- Improved flow properties when foaming allows the wall thickness to be reduced from 2.5 to 1.8 mm
- High grade surface thanks to variotherm mould temperature control

Graph:
- Compact: 279 g
- ProFoam: 190 g

ProFoam process

Foaming with new opportunities

- Ideal for shear-sensitive materials
- Longer fibres in the part
- Lower emissions of the part
- Compact injection moulding with the same cylinder module
- Flexible use on ALLROUNDER machines*
- Simple process, one parameter

* Machine must be prepared for ProFoam
Lightweight construction

Technology highlights and applications

- **ProFoam**
- **Fibre Direct-Compounding**
- **Multi-Material Design**

ARBURG as an applications consultant and systems partner

Minimizing costs

Material substitution

Innovative products

Production efficiency

Innovative products

Cost efficiency

Material substitution

Production efficiency

Fibre direct-compounding*

Longer fibres in part = greater strength

**Cutting device**
Cuts continuous fibre strands into 5.6-33.6 mm long pieces

**Side feeder**
Adds fibres directly to the liquid melt

**Two-stage screw**
Melt granulate; feed fibres and homogenise material

* Fibre direct-compounding = FDC
Fibre direct-compounding

The potential of the FDC process

- 95% potential improvement with the FDC process

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

<table>
<thead>
<tr>
<th>Fibre Type</th>
<th>Composition</th>
<th>Cost Breakdown</th>
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<tbody>
<tr>
<td>Long-fibre granulate</td>
<td>PP LGF 30</td>
<td>EUR 2.65/kg</td>
</tr>
<tr>
<td>FDC process</td>
<td>PP 67%</td>
<td>EUR 0.94 €/kg, EUR 1.40/kg</td>
</tr>
<tr>
<td>Glass-fibre roving</td>
<td>30%</td>
<td>EUR 0.41 €/kg, EUR 1.35/kg</td>
</tr>
<tr>
<td>Bonding agent</td>
<td>3%</td>
<td>EUR 0.11 €/kg, EUR 3.50/kg</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>EUR 1.46 €/kg</td>
</tr>
</tbody>
</table>

Cost benefit: EUR 1.19/kg (45%)
Fibre direct-compounding

PP GF30 power cable drive housing

• Replacement of long-fibre granulate
• Cost-effective high-volume production
• Fibre length: 11.2 mm
• Cooperation and exchange of knowledge with customers
• Fulfilment of all required quality specifications

Fibre direct-compounding

Cost-efficient fibre reinforcement

• Longer fibres in part
• Mechanical properties optimised in a targeted approach
• Individual adjustment of fibre length, fibre content and material combination
• Cost-effective high-volume production
Lightweight construction

Technology highlights and applications

ProFoam
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Multi-Material Design

Minimizing costs
Material substitution
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Innovative products
Material substitution
Production efficiency

Multi-material design

Focus: Improving properties

• Composite and hybrid parts – Multi-material design
• Combining advantages of different materials
• Exploiting wide range of materials and processes
• Functional integration
• Economical production

Source: RocTool S.A.
Multi-material design

Benefits combined – carbon fibre and thermoplas

- Laptop cover from PC/composite sheet
- IDH-Technologie (RocTool S.A.)
- Composite sheet (1mm) with carbon fibre
- Functional integration through injection moulding
- Advantages of hybrid part:
  - High rigidity
  - Low weight
  - Combination of high/low gloss surfaces (Class A)

Source: RocTool S.A.

Multi-material design

Innovative product – economical production

- ALLROUNDER with rotary table and six-axis robot
- Compact production cell
- Handling of cold composite sheet
- Short cycle time (~60 s)
- Ready-to-use part without up- or downstream processes

Source: RocTool S.A.
Summary

Lightweight parts – optimal efficiency and quality

- Innovative process for innovative products
- Exploiting expertise in various areas
- Process-appropriate design and part configuration
- ARBURG offers comprehensive advice on applications engineering

Source: Festo