Advanced compounds for superior parts

Michael Sommer
Menzolit Compounds International

Glenn Mazza
BYK

July 2007
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Rising demands

The demands for the compound

- Excellent reproducibility
- High productivity
- Superior performance

The demands for the part

- Emission of the car
  - Due to CARB etc.
- Fogging of the interior
- Smell of interior parts
- European legislation
- Low weight
- On-line paintability
- Excellent surface properties
- Complicated shapes
- Higher volumes with better reproducibility
Content

1. Rising demands
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4. Future challenges - outlook
5. The European Alliance for SMC/BMC
The demands for the compound

- Excellent reproducibility
- High productivity
- Superior performance

By applying the results of several projects such as TripleC (with DaimlerChrysler) many improvements in the process were implemented.

Diagram:

1. Raw storage
2. Metering
3. Mixing
4. Metering & mixing of resin & thickener
5. Compounding line
6. SMC
The demands for the part

- Emission of the car
  - Due to CARB etc.
- Fogging of the interior
- Smell of interior parts

With modifications in the compound and an optimization of the molding parameters the emission and fogging could be reduced drastically.

The smell was reduced by more pure resin systems and modification of formulation.
European legislation

- The EU requires a detailed analysis of the total life cycle of a vehicle – which means an analysis of all parts

- Eco efficiency analysis (environmental impact of the part)
  - Energy and raw material demand to make the part
  - Energy consumption of the vehicle due to the part
  - Energy consumption at the end of life cycle

  - This was done by BASF in comparison of decklids made from sheet metal, aluminum and SMC

  - The SMC part has a very positive eco balance
European legislation on eco efficiency

Comparison of passenger car decklids: Base Case

- SMC
- Aluminium
- Steel

Eco-efficiency Analysis 16 Dr.B.Handels / S. Schmidt

European Alliance for SMC/BMC
Due to the EU demand for 85% re-use the FRP industry will face a growing pressure on how to deal with their waste:

→ Landfill of composite waste will be forbidden by end of 2004 by most EU member states.

→ Incineration will have limits imposed on the level of energy content.

→ To comply with the various EU directives on end-of-life waste, customers especially in the field of automotive are asking for a waste management solution.
The solutions for the environment

Cradle to Grave, Life Cycle Analysis

Extraction of Raw Materials → Processes → Products → Recycling → Disposal

Eco-efficiency Analysis 2 Dr.B.Hanweis / S. Schmidt
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Automotive applications

Design freedom and integration

For many parts a very positive cost performance ratio is achieved by an extremely high degree of integration of functions.

Typical examples are the Volvo / Renault truck oil sumps.
Design freedom for engine materials

- Sheet metal
- Aluminum
- SMC
- BMC
- PA66 GF

Simple shape  
Complicated shape
VOLVO FM / FH oil sump of D12 engine
VOLVO / RENAULT oil sumps

High integration of functions and excellent strength
VOLVO / RENAULT oil sumps

<table>
<thead>
<tr>
<th>Type</th>
<th>engine</th>
<th>VOLVO truck</th>
<th>RENAULT truck</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 9</td>
<td>9 l</td>
<td>FH / FM</td>
<td></td>
</tr>
<tr>
<td>MD 11</td>
<td>11 l</td>
<td></td>
<td>Premium</td>
</tr>
<tr>
<td>D 12</td>
<td>12 l</td>
<td>FH / FM</td>
<td></td>
</tr>
<tr>
<td>MD 13</td>
<td>13 l</td>
<td>FH / FM</td>
<td>Magnum</td>
</tr>
</tbody>
</table>
Semi structural parts with high integration of functions in passenger cars

Sunroof frames of Mini One
• Integration of rail for shade
• Integration of belt for opening / closing sunroof
• Integration of devices

Side step of Mercedes Sprinter / Dodge Sprinter
• High strength required → load of 1.5 to
• Anti slip on top side
• Excellent stiffness required (part of body in white)

Citroen Berlingo roof module
• High integration of functions (boxes, storage, devices)
Mini One sunroof frame
BMW / Mini sunroof frames
Mercedes-Benz / Dodge Sprinter side step
CITROËN Berlingo roof module outside

The SMC roof module (inner and outer shell) is completed with windows and railing and
CITROËN Berlingo roof module
inner side with storage boxes
The new Mercedes-Benz CL 500 / 600 decklid

- Extreme difficult shape
- Extreme high demands for surface quality
- On-line painted
- Antennas integrated in part
Mercedes-Benz CL decklid
MERCEDES-BENZ SLR McLaren

Body in white designed like a racing car monocoque

Scuttle panel as part of the rigid structure of the body-in-white from carbon fibre SMC (Menzolit AdvancedSMC)

Exterior parts for weight reasons in low density SMC
SMC using carbon fibres ➔ AdvancedSMC

Mercedes Benz SLR McLaren
“Scuttle panel”
Using AdvancedSMC
Very high stiffness at low weight.
MERCEDES-BENZ SLR McLaren

Front side panels
Front vent panels
Cover mufflers
Hiding the antennas

Modern vehicles have several antenna systems for
- Radio
- Telephone
- GPS
- Remote control of lock and alarm system
- Automatic identification system

Antennas were often damaged by vandalism ➔ antenna are hidden nowadays

SMC parts are permeable for antenna waves ➔ antenna are mounted behind the exterior shell of SMC parts

Examples are:
- Mercedes GL, M, R, CL, CLK convertible
- Volkswagen EOS
- Renault CC
Mercedes-Benz ML rear roof section
Safety and maintenance

In town often accidents happen in stop and go traffic

Most often rear and front of vehicles are damaged

To save repair cost and lower insurance Renault integrated a rear crash panel on the Renault Megane
RENAULT Megane crash panel
Convertible Coupés ➔ a new trend

Car makers introduce vehicles that are a coupé with a rigid roof which can be opened and then this vehicles become a convertible.

Examples are: Cadillac, Mercedes SLK, Renault CC, Volkswagen EOS, Ford Focus CC.

The decklid opens both ways to enable the roof to be stored in the rear or to use the rear for luggage. Therefore the demands for stiffness are high.
RENAULT Megane Coupé Cabriolét decklid
VW EOS decklid
Volkswagen EOS decklid
Demands for high performance parts

- Superior surface
- High annual volume

→ High demand for reproducibility
→ High degree of automation required
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Higher annual volumes and more often body facelifts of the same vehicle

Sheet metal: The 2 part design of exterior passenger car details requires at least 10 up to 12 steel tools for stamping and forming the sheet metal inner and outer part

SMC: The 2 part design of exterior passenger car details requires only 2 tools if SMC moulding technology is used
## Investment cost comparisons between sheet metal and SMC

### Outer panel moulded from SMC vs. stamped from sheet metal

<table>
<thead>
<tr>
<th>&lt; 80.000 p/a</th>
<th>&gt; 80.000 p/a</th>
<th>0 – 20.000.000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 press</td>
<td>2 presses</td>
<td>6 presses</td>
</tr>
<tr>
<td>Tool:</td>
<td>1 tool</td>
<td>6 tools</td>
</tr>
<tr>
<td>Postmoulding:</td>
<td>1 line</td>
<td>1 line</td>
</tr>
<tr>
<td>Cost:</td>
<td>22 %</td>
<td>40 %</td>
</tr>
</tbody>
</table>

- Equipment: 1 press
- Tool: 1 tool
- Postmoulding: 1 line
- Cost: 22 %

### Inner reinforcement moulded from SMC vs. stamped from steel

<table>
<thead>
<tr>
<th>&lt; 100.000 p/a</th>
<th>&gt; 100.000 p/a</th>
<th>0 – 20.000.000</th>
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<tbody>
<tr>
<td>Equipment:</td>
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<tr>
<td>Tool:</td>
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<td>5 tools</td>
</tr>
<tr>
<td>Postmoulding:</td>
<td>1 line</td>
<td>1 line</td>
</tr>
<tr>
<td>Cost:</td>
<td>30 %</td>
<td>45 %</td>
</tr>
</tbody>
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- Equipment: 1 press
- Tool: 1 tool
- Postmoulding: 1 line
- Cost: 30 %
Cost comparison with face lift after 3 + 6 years
SMC vs sheet metal

<table>
<thead>
<tr>
<th>Operation time [years]</th>
<th>Cost [units]</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>SMC 150000pa</td>
</tr>
<tr>
<td>2</td>
<td>SMC 60000pa</td>
</tr>
<tr>
<td>3</td>
<td>Sheet metal 150000pa</td>
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<td>4</td>
<td>Sheet metal 60000pa</td>
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1st facelift
2nd facelift
Reduction of CO2 Emission of new future vehicles

New future vehicles in Europe will have a limit of CO2 emission. This means that fuel consumption has to be reduced. Engines are already very effective, so more weight reduction is required. This means that more sheet metal will be replaced by other materials:

![Density graph](image)

- PA (GF)
- Class A SMC
- LD Class A SMC
- Carbon Fibre SMC
- Aluminium
- Sheet metal

Density g/cm
Pedestrian head impact

• In a pedestrian – car collision the EU requires new safety standards
• The European administration requires that certain damages to a human body are not exceeded in a collision.
• To assess the damage done to a human head colliding on to a bonnet the so called HIC (Head Injury Coefficient) is used.
• High impact forces, long impact duration and multiple hits make large HIC value.
• It is required that a HIC value of 1000 is not exceeded.
• The HIC value corresponds to damage done to a human brain.
Impact management

- To manage the energy of such a human – car collision basically deformation or a downwards movement of the bonnet is required.
- It is required that the impact is not multiple.
- Larger deformation or movement results in less impact forces and lower HIC values.
- Impact energy should be taken out of the system to avoid multiple impacts.
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The members

European Alliance for SMC/BMC
Menzolit compounds

Success needs high performance
Composite materials made by Menzolit®, to give you the competitive edge.
Whatever you plan to develop and produce, reinforced composite materials fit your applications. Take benefit of properties like strength, fire retardancy, colour, paintability or low weight. Material systems made by Menzolit® allow you to make new designs for cars, commercial vehicles, electrical industry or for general machinery and auxiliary equipment.

Thank you for your attention