Solutions thru Innovation

With Silafont®, Magsimal® und Castasil® to less CO₂!

RHEINFELDEN FAST ALLOYS®
THE SPIRIT OF RHEINFELDEN

Roadshow 2012
Rüdiger Franke
CEO RHEINFELDEN ALLOYS GmbH & Co KG

Oct 2012
RHEINFELDEN ALLOYS strategic area:

1. Solutions thru Innovation:
   - High grade alloys for the HPDC, for the „aggressive thin wall construction“ in Cast Aluminium
   - with Castasil-37, Magsimal-59, Silafont-36
   - Castasil-21 with higher conductivity for the rising electrification of vehicles

2. Rheinfelden Fast Alloys:
   - Wide spread variants for specification & delivering amount
   - short delivering times, highest quality within delivering and alloy composition
Trends of development in the automobile area from our RHEINFELDEN ALLOYS sight:

- **Automobile Structures**:
  - more and more light weight structures in aluminium high pressure die casting
  - Reduction of wall thickness
  - Integration of functions, castings are going to grow in size
  - Higher material strength is recommended
  - Deformability has to be given

- **Energy efficiency of the vehicles / Electromobility**:
  - Higher electric conductivity is recommended
  - thermal conductivity is recommended, esp. necessary for fuel systems with efficient concepts, aiming EU6
  - Heat spots have to be managed
Potential in reduction of CO2-emission with the use of modern HP Die Casting components:

- Examples from different vehicles
- Weight reduction in comparison to the recent generation

source: Bühler Druckguss, Uzwil

- Suspension strut bracket: -1.5 KG
- Rocker panel: -2.8 KG
- Connector: -1.1 KG
- Plate: -0.2 KG
- Total savings in weight per vehicle including other components: -44 KG
- CO2/km savings: -100 kg, -8.5 g
Advantages of aluminium in comparison to fibers:

- **Energy consumption:**
  - Production of Carbon fibers needs the same energy amount

- **Recycle-ability:**
  - Al as metal can be recycled in a glance
  - By separating the alloy family a real recycling can be done, instead of „downcycling“
  - Al castings can be recycled to similar castings
  - Al recycling infra structure is established

- Al is a well known material
  - Joining techniques for automotive production are state of the art

- Carbon fibers are 10 times more expensive
Chemical composition Silafont™-36
(Al Si10MnMg), AA 365, EN 1706:

<table>
<thead>
<tr>
<th></th>
<th>Si</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Mg</th>
<th>Zn</th>
<th>Ti</th>
<th>Sr</th>
<th>others</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>9,5</td>
<td></td>
<td></td>
<td>0,5</td>
<td>0,1</td>
<td></td>
<td></td>
<td>0,04</td>
<td>0,010</td>
</tr>
<tr>
<td>max</td>
<td>11,5</td>
<td>0,15</td>
<td>0,03</td>
<td>0,8</td>
<td>0,5</td>
<td>0,08</td>
<td></td>
<td>0,15</td>
<td>0,020</td>
</tr>
</tbody>
</table>

- good Castability
- no Sticking to Die
- Definition of $R_{p0,2}$, $R_m$, A
- Modification / Ductility

no coarse intermetallic phases
Chassis: Traverse Alfa Giulietta in Silafont®-36 F:

- Use in the as cast state
- Monoblock-design substitutes a welded construction
  => weight reduction, less mounting costs

Source: Alfa Romeo
Structure: shock tower in Silafont®-36 T7:

- Use in high volume production
- Highest recommended limits to strength & elongation
- riveted & welded

Source: Audi AG
## Chemical composition Castasil™-37, AlSi9Mn:

<table>
<thead>
<tr>
<th></th>
<th>Si</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Mg</th>
<th>Mo</th>
<th>Zr</th>
<th>Ti</th>
<th>Sr</th>
<th>Σ andere</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>8,5</td>
<td></td>
<td></td>
<td>0,35</td>
<td></td>
<td>0,2</td>
<td>0,2</td>
<td>0,04</td>
<td>0,006</td>
<td></td>
</tr>
<tr>
<td>max</td>
<td>10,5</td>
<td>0,15</td>
<td>0,05</td>
<td>0,60</td>
<td>0,06</td>
<td>0,3</td>
<td>0,3</td>
<td>0,15</td>
<td>0,025</td>
<td>0,2</td>
</tr>
</tbody>
</table>

- **excellent castability**
- **Yield strength**
- **Modification of AlSi-Eutectic**

- no sticking to the die, no disturbing phase
- no long time aging of the casting
Structure: Joining part – ASF® Audi A8 in Castasil®-37 as cast:

- Crash recommendations are fulfilled in the as cast state
- No heat treatment
- Highest accuracy in shape
- Riveable & excellent weldable
- Weight ~10kg, size ~1,5m
Structure: Castasil®-37 in the front area of Jaguar XJ

- high accuracy in shape (without heat treatment)
- Crash limits in the front area are fulfilled in temper O
- riveted
Flaps: Castasil®-37 in VW Phaeton

- Net-shape design with 1.8 – 2.0 mm casting thickness
- Laser cutting
- Use in the as cast state => high accuracy in shape
- Monoframe design

Source: VW

Door inner panel
Chemical composition Magsimal®-59, AlMg5Si2Mn:

- No soldering problems
- High Yield strength and elongation, good corrosion resistance

<table>
<thead>
<tr>
<th></th>
<th>Si</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Mg</th>
<th>Zn</th>
<th>Ti</th>
<th>Be</th>
<th>Σ andere</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>1,8</td>
<td></td>
<td>0,5</td>
<td>5,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max</td>
<td>2,6</td>
<td>0,2</td>
<td>0,05</td>
<td>0,8</td>
<td>6,0</td>
<td>0,07</td>
<td>0,2</td>
<td>0,004</td>
<td></td>
</tr>
</tbody>
</table>

Mg$_2$Si-eutectic
Reduce dross formation
Chassis: control arm in Magsimal®-59 in temper F (as cast)

- use in the Porsche Cayenne, Audi Q7, VW Touareg
- High strength and elongation in the as cast state, especially with thin wall thickness
  - No heat treatment
  - High dynamic load
  - highest corrosion resistance
  - weight 0.7 kg
Structure part in Porsche Panamera in Magsimal®-59:

**Shock tower:**
- Integrated diagonal brace
- High fatigue strength
- High resistance against crack growth

**Door frame:**
- High stiffness in combination to low weight
### Chemical composition of Castasil®-21:

<table>
<thead>
<tr>
<th>Element</th>
<th>Si</th>
<th>Fe</th>
<th>Cu</th>
<th>Mn</th>
<th>Mg</th>
<th>Zn</th>
<th>Ti</th>
<th>Sr</th>
<th>Σ andere</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>8</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>max</td>
<td>9</td>
<td>0.7</td>
<td>0.02</td>
<td>0.01</td>
<td>0.03</td>
<td>0.07</td>
<td>0.01</td>
<td>250</td>
<td>0.2</td>
</tr>
</tbody>
</table>

- **good castability**
- **low limits to archive conductivity**
- No sticking
- Corrosion resistance, conductivity
- AISi modification
Castasil®-21 for electricity & heat conducting HPDC parts:

- Electric conductivity:
  - Up to $25 \times 10^6$ S/m in temper F
  - Up to $28 \times 10^6$ S/m in temper O (350 °C/60’)
  - In comparison:
    - Al 99.7 L has $\sim 35 \times 10^6$ S/m

- Good castability, because of 8-9% Si
- Medium strength, $R_{p0.2} = 85$-100 MPa
- Medium hardness, 55-70 HB
- Weldable
- Rivetable / Calkable
For further discussion:

- Rüdiger Franke  
  CEO  
  rfranke@rheinfelden-alloys.eu  
  phone  +49 7623 93 574

- Ralf Klos  
  application engineer for Aluminium casting alloys  
  rklos@rheinfelden-alloys.eu  
  phone  +49 7623 93 407