Mg Thin Strip Casting

1. Motivation for Mg Use
- Lightest structural metal
- High specific strength and E-modulus
- Well-balanced mechanical properties of rolled products

2. Aims of the research
- Producing Mg-Strip with little segregation and a good surface quality
- Investigation of the effect of parameters on the quality of Mg-Strip
- Developing a CFD-model to study the flow and temperature impact on rapid solidification

3. Experiments
- Horizontal twin-roll-casting of MgAZ31
- Variable parameters (factors) investigated according to Tab.1.
- Using the DoE-method, the number of experiments are reduced from 48 (full-factor-experiments) to 18.

Tab.1 Variable factors and their levels

<table>
<thead>
<tr>
<th>variable factors</th>
<th>Nr. of levels</th>
<th>levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>d, (gap, mm)</td>
<td>4</td>
<td>3/3, 5/4/4, 5</td>
</tr>
<tr>
<td>v, (casting velocity, m/min)</td>
<td>4</td>
<td>2,5/3/3, 5/4</td>
</tr>
<tr>
<td>cc, (cooling capacity, l/min)</td>
<td>3</td>
<td>25/30/35</td>
</tr>
</tbody>
</table>

4. Results
- Segregation of Al<1% and Zn<0.5%, when roll force F<100kN
- Roll force and segregation are strongly affected by the variable factors (Tab.2).
- Meltflow- and temperaturefield could be investigated by CFD-Simulation (Fig.2).
- The grain size of as-cast strip is 200µm and after homogenization and hot-rolling reduced to 10 µm (Fig. 3).

Tab.2 Effect of variable factors

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<table>
<thead>
<tr>
<th>variable factors</th>
<th>aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>d, (gap, mm)</td>
<td>↑ ↑ ↓ ▼</td>
</tr>
<tr>
<td>v, (casting velocity, m/min)</td>
<td>↑ ↓ ↑ ▼</td>
</tr>
<tr>
<td>cc, (cooling capacity, l/min)</td>
<td>▼ ↑ ▼</td>
</tr>
</tbody>
</table>
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Fig.1 Effect of roll force on segregation

Fig.2 Fluidflow (left) and temperature (right) simulation during twin-roll-casting of MgAZ31

Fig.3 Mg-strip and its microstructure

5. Conclusion
- A suitable process-window for the production of Mg-strip is determined:
  d = 3 - 3,5 mm, v = 2,5 - 3,6 m/min, cc = 30 l/min
- The flow- and temperature-model for the twin-roll-casting of Mg-strip is developed.
- Mg-strip with little segregation and smooth surface are produced.