Aluminium production efficiency while reducing PFC emissions

Jostein Søreide
Senior advisor
2014-10-22
What is PFC?

- PFC = per-fluor-carbones
  - CF4  GWP = 7 390 kg CO2e/kg
  - C2F6  GWP = 12 200 kg CO2e/kg

- Caused by reaction between the electrolyte and the anode in the aluminium electrolysis process – so called anode effects

- Unstable production = high PFC emissions
Carbon footprint of aluminium

- Casting
- Electricity production
- Aluminium electrolysis
- Anode production
- Alumina refining
- Bauxite mining
Development in PFC emissions

Figure 9 – Absolute PFC emissions (as CO₂e) and primary aluminium production (Mt Al)

Anode effect minutes

80% reduction
How did we get there?

• Stricter regulations has led to increased focus
• Phase out of old technology
• New technology elements
• Operational stability
• Good, fact-based dialogue with the authorities
• High level research on the relation between operational control and emissions has led to increased understanding and better operational stability

• Good control = high efficiency = low emissions
Way forward

- Potential for further reductions in PFC emissions is limited.
- No technological breakthrough is expected in the foreseeable future.
- EU ETS puts pressure on further emission reductions.
- GHG reductions will come in the form of reduced anode consumption and higher energy efficiency.
- Aluminium as a metal is an enabler for GHG savings in other sectors (like transport and buildings).

### Lower emissions

<table>
<thead>
<tr>
<th>Year</th>
<th>CO$_2$e/Kg aluminium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>6.0</td>
</tr>
<tr>
<td>1995</td>
<td>5.5</td>
</tr>
<tr>
<td>2000</td>
<td>4.5</td>
</tr>
<tr>
<td>2005</td>
<td>3.5</td>
</tr>
<tr>
<td>2012</td>
<td>2.0</td>
</tr>
</tbody>
</table>

-70% emissions

### Improved energy-efficiency*

<table>
<thead>
<tr>
<th>Year</th>
<th>kWh/Kg Aluminium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>16.5</td>
</tr>
<tr>
<td>1998</td>
<td>14.5</td>
</tr>
<tr>
<td>2003</td>
<td>13.0</td>
</tr>
<tr>
<td>2010</td>
<td>12.0</td>
</tr>
<tr>
<td>Qatalum</td>
<td>11.5</td>
</tr>
<tr>
<td>HAL4e</td>
<td>11.0</td>
</tr>
<tr>
<td>Pilot</td>
<td>9.5</td>
</tr>
</tbody>
</table>

-17% energy consumption

*Average specific energy consumption from 100%-owned Norwegian smelters