Pilot-Scale Research in Titanium Powder Production

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www.metafensch.fr
MetaFensch

- MetaFensch, created in 2014, is a French publicly funded research platform dedicated to the melting, casting and atomization of high performance metals.

- Main focus areas of research
  - Recycling
  - Powder metallurgy
  - Energy/resource efficiency (global LCA approach)

- Tools: Semi-industrial/pilot-scale furnaces
  - 50 L Vacuum induction melter
  - Plasma arc melter (cold hearth refiner)
  - EIGA atomizer

- Collaboration on French and EU projects
From lab to production: “Valleys of Death and Darwinian Seas”

- Pilot-scale trials are one aspect (of many, including financing) in order to advance through the TRLs and bridge the gap from idea to industrialization

- Necessary, before an industrial investment, in order to:
  - Characterize/certify the final product
  - Optimize the product as well as the process
  - Refine technical specifications
  - Better estimate CAPEX and OPEX for the industrial operation
  - Reduce risk

- Complex to put into practice due to the:
  - Necessary infrastructure (electricity, industrial gas, cooling, etc.)
  - Costs
  - Questions concerning upscaling, even after pilot trials
Ti powder: Quality and yield

- Crucible-free melting to limit/eliminate foreign particles
  - Feedstock = Electrodes

- Particle size optimization for additive manufacturing
  - Metal/gas ratio
  - Nozzle configuration
  - Studies on sieving and mixing

EIGA : Electrode Induction Melting Inert Gas Atomization
Ti powder: Upscaling and productivity

- Increase electrode size from 50/70 -> 100 -> 150 mm
  - Respond to increasing demand
  - Lower production costs
  - System ready to test electrodes up to 150 mm in diameter

### Performance Data for Different EIGA Models

<table>
<thead>
<tr>
<th>Performance Data</th>
<th>EIGA50-500</th>
<th>EIGA100-1000</th>
<th>EIGA150-1000*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Electrode Dimensions</td>
<td>mm * mm</td>
<td>50 * 500</td>
<td>100 * 1000</td>
</tr>
<tr>
<td>Charge weight (based on TiAl6V4)</td>
<td>kg</td>
<td>4.4</td>
<td>33.4</td>
</tr>
<tr>
<td>Nominal Melt Power</td>
<td>kW</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Melt Rate</td>
<td>kg / min</td>
<td>0.5</td>
<td>1.5</td>
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<tr>
<td>Atomization Time</td>
<td>min</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Total Cycle Time</td>
<td>min</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Argon Flow Rate</td>
<td>m³ / min</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Specific Argon Consumption</td>
<td>m³ / kg</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>Max. Annual Powder Production</td>
<td>MWp</td>
<td>70</td>
<td>250</td>
</tr>
</tbody>
</table>

*Estimated Values

3D schematic of EIGA 100-1000
Ti powder: Raw materials and alloys

- Incorporating recycled materials (including powders) into the feedstock
- Tailored alloys for additive manufacturing processes
- Link between PAM-CHR and EIGA furnace

Plasma arc melter (100-150 mm diameter x 1000 mm length ingots)

- Alternative electrodes (square, etc):
**Conclusion**

- Pilot trials are a complicated, but necessary, step to reduce risk and bridge the gap from lab-scale to industrialization.

- Multiple questions remain in order to optimize Ti powder production, in particular for additive manufacturing applications:
  - Quality and yield
  - Productivity and cost reduction
  - Alloy development and the use of recycled materials

- A 100 mm diameter crucible free atomizer (December 2016) coupled with a plasma arc melter/cold-hearth refiner (spring 2017) will allow the study of these questions and accelerate the deployment of new industrial Ti powder processes.
Merci pour votre attention