Production of Premium Quality Titanium Ingots

Combination of Different Melting Process Technologies and Digitized Production Management
Outline

- Target Capacity and Process Definition e.g. VAR Ingots (DM)
- Combination of Melt Process Technologies
  - Electron Beam Cold Hearth Furnace for primary melting of electrodes
  - Titanium VAR Furnace for Re-melting of primary melted EB electrodes and/or welded sponge electrodes
- Work Shop Requirements
- Furnaces in Operation
- IMAS Titanium Digitalization Approach - Industry 4.0
- Final Products
- Summary and Conclusion
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Capacity Estimation VAR Double Melt Process Heat #1
Target Capacity VAR Double Melt Process Heat #2 /Final Ingot
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EB Cold Hearth Electrode and Ingot Production

1. Weighing & Intensive Blending
2. Feeding & Hearth Melting (1x)
4. Withdrawal Casting
5. Dip Sampling
6. Machining Optional:
7. VAR Re-Melting (1-2x)
Sponge Electrode and VAR Ti Ingot Production


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Work Shop Requirements

Use what you have!!!
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Ti VAR Furnace in operation & produced Titanium Ingots

- 1st Test Melt Titanium Ingot
  Dia 520 mm x 990mm / 950 kg weight

- Regular DM Titanium Ingot
  Dia 520 mm x 2.100 mm length / 2.000 kg weight

4t Ti VAR @24kA for max. ingot
Dia 660 mm x 2.600mm/4.000 kg weight
Definition of Specific Work Shop Design & Logistical Requirements

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Digitalization Approach Industry 4.0 IMAS Titanium Data Processing Software

Software
System Design Concept

Weighing & Blending
Compacting
Electrode Assembling
Plasma Welding
Stub Welding
VAR Melting
Machining Brushing

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IMAS Titan Digitalization Approach Industry 4.0

IMAS Titanium
will be customized to the individually applicable Industry 4.0 requirements e.g.

- Material, Grade and Equipment Management,
- Production/Delivery Planning and Tracking
- Optional Overall Equipment Efficiency (OEE) benchmarking function
- Preservation of Titanium process know how (Recipe Management)
- Company/Customer Information Exchange (Shared Data Base)
### Final Products

#### FORGINGS

<table>
<thead>
<tr>
<th>Bars</th>
<th>Smooth forgings of circular cross section</th>
<th>Smooth forgings of variable circular cross section</th>
<th>Smooth forgings of square cross section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cubes, blocks</td>
<td>Discs, discs with holes</td>
<td>Rings</td>
<td>Plates</td>
</tr>
<tr>
<td>Hollow cylinders</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### RING PRODUCTS

**PARAMETERS AND DIMENSIONS OF RING PRODUCTS**

<table>
<thead>
<tr>
<th>Seamless rings (forged and rolled)</th>
<th>Welded rings</th>
</tr>
</thead>
<tbody>
<tr>
<td>diameter: 200–6000 mm</td>
<td>diameter: 140–2600 mm</td>
</tr>
<tr>
<td>height: 25–1150 mm</td>
<td>height: 30–450 mm</td>
</tr>
<tr>
<td>weight: 1–12000 kg</td>
<td>cross-section: up to 5500 mm</td>
</tr>
</tbody>
</table>

Rings manufacturing from any grades and alloys, including Cu, Al, Ti and Mg in accordance with Russian and international standards.

Types of profiles

Possible delivery of both blank parts and products with final processing.

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Ti-VAR Process Simulations
Research & Development, CD-Lab 2019-2026

Proposal approved and Project with focus on (Ti) VAR already started

• Process Modelling as the key tool for a better understanding of the process (trouble-shooting, shorter start-up phase, optimized production, yield, etc.)

• Broader knowledge and deeper insights on the process to improve process parameters for a safe and repeatable operation

• Optimized Process control and valuable input for various design issues due to full understanding of the physical phenomena

• Cooperation with Ti-Producers to validate the developed model

Metallurgical Applications of Magnetohydrodynamics

Proposal for the Foundation and Support of a Christian Doppler Laboratory on
Summary, Conclusion & Outlook

- **Methodical approach** to define, implement and operate most modern Titanium production plants based on detailed feasibility and engineering studies.
- Material portfolio has been remarkably strengthened by in-house made Premium Quality Titanium ingots.
- **Production management software** as a holistic digitalization tool to manage, control and optimize the production of Titanium materials for most demanding industries.
- **Process Modelling** in Ti-VAR as the key tool for a better understanding of the process and to be validated with industrial production results.
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Thank You!