Andritz MAERZ GmbH
COPPER DIVISION
Furnace systems for the copper industry
Agenda

- Andritz MAERZ and the Andritz Group
- Industries of application and available services
- MAERZ Drum Type Furnaces / Converters
- MAERZ Tilttable Reverberatory Furnaces
- MAERZ Shaft Furnaces and Hearth-Shaft Furnaces
- MAERZ Elliptic Furnaces
- MAERZ Top Blown Rotary Converter Furnaces
- Auxiliary equipment for furnace systems
- Process optimization and development
- Conclusion
<table>
<thead>
<tr>
<th>Agenda</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Andritz MAERZ and the Andritz Group</td>
</tr>
<tr>
<td>• Industries of application and available services</td>
</tr>
<tr>
<td>• MAERZ Drum Type Furnaces</td>
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<td>• Process optimization and development</td>
</tr>
<tr>
<td>• Conclusion</td>
</tr>
</tbody>
</table>
**Andritz MAERZ GmbH**

**Overview**

<table>
<thead>
<tr>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Andritz MAERZ GmbH, Düsseldorf, Germany</td>
</tr>
<tr>
<td>▪ Founded in 1911 by Mr. Johannes Maerz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Business Areas</th>
</tr>
</thead>
</table>
| ▪ Furnaces for the Copper Industry  
  ▪ Primary Industry  
  ▪ Secondary Industry  
  ▪ Processing Industry  |
| ▪ Furnaces for the Steel Industry  
  ▪ Continuous Furnaces  
  ▪ Batch-Type Furnaces |

<table>
<thead>
<tr>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Approximately 60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Our Mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use our expertise for engineering, know-how and process technology in the area of melting, refining, heating and casting technology for ferrous and copper plants all over the world.</td>
</tr>
</tbody>
</table>
## The Andritz Group

### Overview

<table>
<thead>
<tr>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ ANDRITZ AG, Graz, Austria (Group headquarters).</td>
</tr>
<tr>
<td>▪ More than 150 production and service sites worldwide.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key figures 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Order intake: 3,705 MEUR.</td>
</tr>
<tr>
<td>▪ Sales: 3,610 MEUR.</td>
</tr>
<tr>
<td>▪ Net income: 147 MEUR.</td>
</tr>
<tr>
<td>▪ Equity ratio: 18.7%.</td>
</tr>
<tr>
<td>▪ Employees: ~13,700 worldwide.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Products and services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customized plants, process technologies, and services for the hydropower, pulp and paper, metals, and other industries (solid/liquid separation, feed and biofuel).</td>
</tr>
</tbody>
</table>
Andritz Business Divisions

- **37% of Group sales.**
  - Plants and services for the production of all types of pulp (chemical, mechanical, recycled fiber pulps), paper, board, tissue, and Medium Density Fiberboard (MDF); biomass boilers for power generation.

- **33% of Group sales.**
  - Electromechanical equipment and services for hydro-power stations – in particular, turbines, hydropower generators, and turbo generators; pumps.

- **16% of Group sales.**
  - Production and finishing lines for metallic strip, especially for carbon and stainless steel.

- **10% of Group sales.**
  - Plants, equipment, and services for solid/liquid separation for municipalities and industries (e.g. mining, chemical and petrochemical industries, food industry).

- **4% of Group sales.**
  - Plants, equipment, and services for the production of animal feed and biomass pellets, especially wood pellets.
Agenda

- Andritz MAERZ and the Andritz Group
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  - MAERZ Shaft Furnaces and Hearth-Shaft Furnaces
  - MAERZ Elliptic Furnaces
  - MAERZ Top Blown Rotary Converter Furnaces
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- Conclusion
Application in the industry
Handling copper from matte to cathodes

PRIMARY INDUSTRY
- Drum Type Furnaces and Converters (PS-Converters)
- Stationary Reverberatory Furnaces
- Top Blowing Rotary Converter Furnaces

SECONDARY INDUSTRY
- Tiltable Reverberatory Furnaces
- Combined Hearth-Shaft Furnaces
- Elliptic Furnaces
- Drum Type Furnaces
- Top Blowing Rotary Converter Furnaces

PROCESSING INDUSTRY
- Shaft Furnaces
- Tiltable Reverberatory Furnaces
- Drum Type Furnaces
- MAERZ “Direct-to-Wire®” Technology for FHRC Copper
2. Copper Production Routes

Primary Industry

Primary Copper production

- Copper Concentrate
- Flash
- TSL
- PS Converter
- Anode Furnace
- Casting Wheel
- Electro Refining
- Copper Processing

Andritz MAERZ’s Scope of Supply
2. Copper Production Routes

Secondary Industry

Secondary Copper production

Low Grade Copper Scrap

Hearth-Shaft Furnace

Tilting Furnace

High Grade Copper Scrap

TSL

Anode Furnace

Casting Wheel

Electro Refining

Copper Processing

TBRC

Anode

Cathode

Andritz MAERZ’s Scope of Supply

=
The Copper Industry

Processing Industry

Copper Tube Production

Copper Cathodes →Shaft Furnace →Wire Rod Line →Wire

Andritz MAERZ’s Scope of Supply

Brass Mill

Copper Cathodes and Scrap →Shaft Furnace →Casting Machine →Billets

Copper and Alloys →Induction Furnaces

Heating Furnace →Rolling Mill

Heating Furnace
MAERZ Direct-To-Wire® Technology comprises the following production steps:

**Charging and melting** of copper scrap with a minimum copper content of 92%.

**Refining** (oxidation – deslagging – reduction) of molten copper to FRHC (Fire Refined High Conductivity) copper quality.

**Casting** of FRHC copper into wire rod casting machine.
Services available for the industry

Co-operation with local engineering partners

Co-operation with customers for local supply and quality control

Delivery of Turn-key Furnace Projects

TURN-KEY OR PARTIAL DELIVERY PROJECT

Engineering
- Basic
- Detail

Key Equipment
- Combustion system
- Refining system
- Nitrogen purging system
- Off-gas measurement system
- PLC-visualization
- Critical components:
  - Steel structure
  - Refractory
  - Etc.

Services
- Training
- Commissioning
- After sales service
- Erection
- Optimization
- Development
### Key References

More than 70 Furnace projects realized in the last 30 years...

<table>
<thead>
<tr>
<th>Company</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aurubis</td>
<td>Germany</td>
</tr>
<tr>
<td>Polish Copper KGHM</td>
<td>Poland</td>
</tr>
<tr>
<td>Jiangxi Copper Corp.</td>
<td>China</td>
</tr>
<tr>
<td>XSTRATA Copper</td>
<td>Australia</td>
</tr>
<tr>
<td>OUTOKUMPU</td>
<td>Finland</td>
</tr>
<tr>
<td>UMICORE</td>
<td>Belgium</td>
</tr>
<tr>
<td>Yanggu Xiangguang Copper Smelter</td>
<td>China</td>
</tr>
<tr>
<td>Mopani Copper Mines</td>
<td>Zambia</td>
</tr>
<tr>
<td>KAZZINC</td>
<td>Kazakhstan</td>
</tr>
<tr>
<td>Schwermetall</td>
<td>Germany</td>
</tr>
</tbody>
</table>
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Drum Type Furnaces / Converters Data
(Anode) Refining Furnaces and Pierce Smith Converters

Proven equipment for the primary and secondary copper production
- Furnace capacities between 20 and 630 t realized

Features
- Fire refining of liquid blister copper
- Desulphurization of blister copper
- Continuous launder charging / batch wise ladle charging
- Holding of liquid copper
- Converting of copper matte

Advantages
- Different kinds of fuel used for combustion and refining
- Single aggregate for refining and casting
- Flexible operation by optimized furnace movement
- Less personnel required
- Low production costs
Drum Type Furnaces / Converters Design
(Anode-) Refining Furnaces

Complete Furnace System

Charging Door
Drum Type Furnaces / Converters Design
(Anode-) Refining Furnaces
Drum Type Furnaces / Converters Design
(Anode-) Refining Furnaces

Neutral Position

Refining Position
Drum Type Furnaces / Converters Design
Peirce Smith Converters

MAERZ Peirce Smith Converter
Drum Type Furnaces / Converters Design

Peirce Smith Converters

Converter in Blowing Position

MAERZ Blast Air System
### Drive Unit for 400 t Drum Type Furnace

- **Main Speed**: 0.33 rpm
- **Casting Speed**: 0.0001 rpm
- **Emergency Speed**: 0.025 rpm
- **Total Gear Ratio**: \( i = 4.500 \)
- **Total Teeth Force**: 550 kN
- **Main Motor Power**: 90 kW
### Drum Type Furnaces / Converters References

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>COUNTRY</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KGHM</td>
<td>Poland</td>
<td>2 x 250 t</td>
</tr>
<tr>
<td>Lurgi Metallurgy for Codelco</td>
<td>Chile</td>
<td>3 x 300 t</td>
</tr>
<tr>
<td>Aurubis (Enlargement)</td>
<td>Germany</td>
<td>400 to 450 t</td>
</tr>
<tr>
<td>Mansfelder Kupfer und Messing</td>
<td>Germany</td>
<td>1 x 320 t</td>
</tr>
<tr>
<td>Yanggu Xiangguang Copper Smelter</td>
<td>China</td>
<td>2 x 630 t</td>
</tr>
<tr>
<td>Mopani Copper Mines</td>
<td>Zambia</td>
<td>2 x 400 t</td>
</tr>
<tr>
<td>KAZZINC</td>
<td>Kazakhstan</td>
<td>2 x 200 t</td>
</tr>
</tbody>
</table>
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## Tiltable Reverberatory Furnaces Data

<table>
<thead>
<tr>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting of copper scrap</td>
</tr>
<tr>
<td>Refining of lower grade copper scraps</td>
</tr>
<tr>
<td>Production of anode copper → casting wheel</td>
</tr>
<tr>
<td>Production “Direct-to-Wire” FRHC Copper → rod casting line</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single aggregate for melting, refining and casting</td>
</tr>
<tr>
<td>Different kinds of fuel used for combustion and refining</td>
</tr>
<tr>
<td>Quick and efficient melting</td>
</tr>
<tr>
<td>Flexible operation by optimized furnace movement</td>
</tr>
<tr>
<td>Less personnel required</td>
</tr>
<tr>
<td>Low production costs</td>
</tr>
<tr>
<td>Ease of maintenance</td>
</tr>
<tr>
<td>Environmental friendly process</td>
</tr>
</tbody>
</table>

Proven equipment for secondary scrap recycling
- Furnace capacities between 50 and 500 t realized
Tilting Furnaces Design

Charging of the furnace

Hydraulic Cylinder
Tilting Furnaces Design

**Process steps**

1. Melting & Charging
2. Oxidation
3. Deslagging
4. Reduction
5. Casting
Tilting Furnaces Main References

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>COUNTRY</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southwire Company</td>
<td>USA</td>
<td>1 x 400 t</td>
</tr>
<tr>
<td>Southern Peru Copper</td>
<td>Peru</td>
<td>2 x 330 t</td>
</tr>
<tr>
<td>ASARCO</td>
<td>USA</td>
<td>1 x 305 t</td>
</tr>
<tr>
<td>Nassau Recycle Corp.</td>
<td>USA</td>
<td>3 x 300 t</td>
</tr>
<tr>
<td>Sumitomo Electric Ind.</td>
<td>Japan</td>
<td>1 x 100 t</td>
</tr>
<tr>
<td>La Farga Lacambra</td>
<td>Spain</td>
<td>1 x 55 t</td>
</tr>
<tr>
<td>LG Metals</td>
<td>South Korea</td>
<td>1 x 100 t</td>
</tr>
<tr>
<td>Sun Jin Metals</td>
<td>South Korea</td>
<td>2 x 55 t</td>
</tr>
<tr>
<td>Hüttenwerke Kayser</td>
<td>Germany</td>
<td>1 x 350 t</td>
</tr>
<tr>
<td>Kyshtym Electrolytic Plant</td>
<td>Russia</td>
<td>1 x 350 t</td>
</tr>
<tr>
<td>Jiangxi Copper Corp.</td>
<td>China</td>
<td>1 x 350 t</td>
</tr>
<tr>
<td>Novgorod Metallurgical Plant</td>
<td>Russia</td>
<td>1 x 180 t</td>
</tr>
</tbody>
</table>
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- Process optimization and development
- Conclusion
Shaft & Hearth- Shaft Furnaces Data

Proven equipment for anode scrap and cathode re-melting

- Furnace melting rates between 10 and 65 t/h realized

Features

- Continuous melting
- Shaft furnaces → melting for rod casting and brass mills
- Hearth-shaft furnaces → transfer to (drum-type) refining furnace via launders
  - Production of anode copper → casting wheel
  - Production “Direct-to-Wire” FRHC Copper → rod casting line

Advantages

- Quick and high efficiency melting
- Optimized thermal efficiency
- Preheating of charging material
- Different kinds of fuel used for combustion and refining
- Flexible regulation of melting rate
- Less personnel required
- Low production costs
- Ease of maintenance
Shaft Furnace Design

Furnace Layout

Furnace Shell

Gas Manifolds
Hearth-Shaft Furnaces Design

Furnace Layout

Hearth Area

Hearth Area
<table>
<thead>
<tr>
<th>COMPANY</th>
<th>COUNTRY</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aurubis</td>
<td>Germany</td>
<td>1 x 50 t/h</td>
</tr>
<tr>
<td>UCA</td>
<td>Belgium</td>
<td>1 x 14 t/h</td>
</tr>
<tr>
<td>Sun Jin Metals</td>
<td>South Korea</td>
<td>1 x 20 t/h</td>
</tr>
<tr>
<td>Sarkuysan</td>
<td>Turkey</td>
<td>1 x 15 t/h</td>
</tr>
<tr>
<td>MKM</td>
<td>Germany</td>
<td>1 x 30 t/h</td>
</tr>
<tr>
<td>Mueller Copper Tube</td>
<td>USA</td>
<td>1 x 20 t/h</td>
</tr>
<tr>
<td>KM Europa Metal AG</td>
<td>Germany</td>
<td>1 x 45 t/h</td>
</tr>
<tr>
<td>XSTRATA Copper</td>
<td>Australia</td>
<td>1 x 65 t/h</td>
</tr>
<tr>
<td>Yanggu Xiangguang Copper</td>
<td>China</td>
<td>1 x 40 t/h</td>
</tr>
<tr>
<td>Schwermetall</td>
<td>Germany</td>
<td>1 x 10 t/h</td>
</tr>
</tbody>
</table>
Agenda

• Andritz MAERZ and the Andritz Group
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• Conclusion
### Elliptic Furnaces Data

**New development for primary and secondary industry**

- Furnace capacity between 20 and 50 t

---

**Features**

- 100% liquid blister or 100% solid scrap input
- Production of anode copper or FHRC Copper

---

**Advantages**

- High thermal efficiency for melting similar to a tilting furnace
- High metallurgical efficiency for refining similar to a drum–type furnace
- Decrease of metallurgical treatment times
- Decrease of media consumption
- Flexible operation by optimized movement and adjustment of furnace shape according to the process step
- Single aggregate for melting, refining and casting
- Different kinds of fuel used for combustion and refining
Elliptic Furnaces Design

Furnace Layout Off-Gas Side

Furnace Layout Cross Section

Furnace Layout Burner Side
Elliptic Furnaces Design

Comparison of the mixture of the copper melt for Anode Rotary Furnace, Reverb Furnace and Elliptic Furnace in refining position.

- Mixture rate of the copper melt during the refining period after 23 seconds:

- Reverberatory Furnace: 4.0%
- Anode Rotary Furnace: 19.2%
- Elliptic Furnace: 53.9%
Agenda

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## Top Blown Rotary Converter Furnaces Data

### Recycling and waste treatment in primary and secondary industry

<table>
<thead>
<tr>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling of all kind of residuals in anode copper production</td>
</tr>
<tr>
<td>- Dry anode slime, different types of slags</td>
</tr>
<tr>
<td>- Copper Scrap</td>
</tr>
<tr>
<td>Separation of precious metals</td>
</tr>
<tr>
<td>Exchangeable furnace units</td>
</tr>
<tr>
<td>Rotation speed of up to 15 min$^{-1}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>High thermal efficiency</td>
</tr>
<tr>
<td>High metallurgical efficiency</td>
</tr>
<tr>
<td>Decrease of metallurgical treatment times</td>
</tr>
<tr>
<td>Flexible operation by wide range of feedstock</td>
</tr>
<tr>
<td>Single aggregate for melting, refining and casting</td>
</tr>
<tr>
<td>Construction based on proven MAERZ equipment</td>
</tr>
<tr>
<td>Quick exchange of the furnace unit for relining</td>
</tr>
</tbody>
</table>
Top Blown Rotary Converter Furnaces Design

- Drive Unit
- Tilting Frame
- Exchangeable Furnace Vessel
- Rotating Roller Drive
- Inner Wheel
- Outer Wheel
- Tilting Roller Drive
- Roller Frame

Large Top Blown Rotary Converter for Copper Scrap
Top Blown Rotary Converter Furnaces Design

TBRC for Precious Metals Plant with Auxiliaries
<table>
<thead>
<tr>
<th>COMPANY</th>
<th>COUNTRY</th>
<th>CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aurubis</td>
<td>Germany</td>
<td>1 x 40 t</td>
</tr>
</tbody>
</table>
Agenda

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Auxiliary equipment for furnace systems

Supplying the necessary auxiliary equipment

- Stationary and movable connecting launders
- Launder burner systems for different fuels
- Charging equipment for copper scrap and other feedstock
- Process visualization and automatization
- Scale stations for ladle weight measurement
- Ladle transportation systems

Charging Equipment

Launder Systems

Ladle Scales and Burners
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The metallurgical process is defined and established by the chemistry of the available feed materials and the product specifications. The operation must provide effective removal of impurities to produce the required product quality.

Examples

- Installation of purching elements (Nitrogen or Nitrogen - Hydrogen)
- Installation of optimized tuyere systems

Nitrogen purching

Purging equipment

Tuyere system
Conversion cost must be minimized by the effective use of technology to control the costs of material handling, direct processing, and disposable by-products.

### Examples

- Increase of furnace capacity
- Increase of refractory lifetime
- Alternative fuels or reductants and optimized burner controls
- Increase of melting capacity

**FEM Simulations**

**Cooling Elements**

**Burner optimization**
Process Optimization and Development

Quality Improvement

A predictable and repeatable product quality is required. Even with different feed material the quality has to stay identical.

Examples

- Process control systems
- Visualization of the process
- Monitoring of the process parameters
- Use of metallurgical improvement

Movement visualization
Temperature visualization
Process optimization
Co-Operation with Mettop

Experience and know-how in furnaces for the copper industry

Metallurgical process improvements for the copper industry

Individual core competences
- Conception
- Layout
- Commissioning
- Operation
- Improvement

Common offer of products and services
- Single-source supply
- Extensive process knowledge
- Exploitation of hidden synergies
- New fields of innovation

Co-Operation with Mettop
Agenda

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Professional solution

Process

CUSTOMER BENEFIT

Refractory Material

Engineering

Know How & Service

Company presentation March 2009
Thank you for your attention

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Fax.: +49 211 38 425 64
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