Perspectives on European Copper Smelting and Refining

International Copper Study Group
Lisbon, 26th April
1. Introduction Aurubis

2. Aurubis Multi-Metal Recycling

3. Challenges

4. Strategy and outlook
Aurubis holds a leading position in the copper value-added chain

<table>
<thead>
<tr>
<th>Category</th>
<th>FY 2016/17</th>
<th>Change vs. prior year</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrate processing*</td>
<td>2,424,000 t</td>
<td>+12 %</td>
<td>No. 2 worldwide</td>
</tr>
<tr>
<td>Copper scrap input</td>
<td>272,000 t</td>
<td>+8 %</td>
<td>No. 1 worldwide</td>
</tr>
<tr>
<td>Cathode output</td>
<td>1,156,000 t</td>
<td>+7 %</td>
<td>No. 2 worldwide</td>
</tr>
<tr>
<td>Wire rod output</td>
<td>719,000 t</td>
<td>-5 %</td>
<td>No. 1 worldwide</td>
</tr>
<tr>
<td>Copper shapes output</td>
<td>190,000 t</td>
<td>+11 %</td>
<td>No. 1 in Europe</td>
</tr>
<tr>
<td>Flat rolled products and specialty wire output</td>
<td>230,000 t</td>
<td>+6 %</td>
<td>No. 1 worldwide</td>
</tr>
<tr>
<td>Sulfuric acid output</td>
<td>2,364,000 t</td>
<td>+14 %</td>
<td></td>
</tr>
<tr>
<td>Gold output</td>
<td>42 t</td>
<td>0 %</td>
<td></td>
</tr>
<tr>
<td>Silver output</td>
<td>1,071 t</td>
<td>+11 %</td>
<td></td>
</tr>
</tbody>
</table>

*Custom smelter production
Aurubis’ strengths include productivity, efficiency, environmental protection and processing expertise.

Metals for progress

Concentrates

Smelting and refining process

Copper cathodes
Nickel sulfate
Selenium
Sulfuric acid

Further processing

Continuous cast shapes
Wire rod
Flat rolled products
Specialized applications for by-metals

Scrap / intermediates

Closing the loop

Scrap collectors
Consumers
Processors and end users
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From copper recycling materials to cathodes

Sampling, material preparation

Kayser Recycling System (KRS)

Submerged lance furnace

Copper alloy scrap

TBRC*

Converter copper (95% Cu)

Copper scrap

Tin-lead rotary furnace

Iron silicate sand KRS-oxide, zinc-bearing

Tin-lead alloy

Anode furnace

Anode casting plant

Anode (~99% Cu)

Copper tankhouse

Cathode (>99.995% Cu)

Nickel sulphate

Anode slime

Precious metal production

Raw materials and recycling materials

Copper products

By-products

*Top Blown Rotary Converter
Aurubis Recycling processes a variety of complex materials into first class products.

**Raw Material**
- Copper scrap
- Residues
- Shredder-materials
- Printed circuit boards
- Copper Iron
- Metal bearing Sludges

**Processing**

**Products**
- Copper cathode Grade A
- Nickel-sulfate
- SnPb Alloy
- Precious Metals
- KRS-Oxide (Zinc oxide)
- Ferro-silicate sand
The KRSplus System features Pb-Sn Alloy Furnace, which can handle a large variety of recycling materials containing 1 to 80% of copper and other metals. It is capable of converting complex black copper phases (60 and 95%) for further refining in the tank house. Additionally, it offers effective recovery of tin.
Aurubis as leading multi-metal recycler: our contribution to a sustainable circular economy

Aurubis multi-metal recovery

Leading Multi-Metal Recycler

- Innovative recycling solutions with state-of-the-art recycling technologies
- Offering closing-the-loop solutions for products customers
- Recycling capabilities for broad portfolio of recycling materials
- High recovery of metals from complex raw materials
- Modern and reliable sampling and analysis
- Industry-benchmark in sustainable processing
- Recycling offers benefit for balanced use of resources and reduced energy consumption, significant contribution to CO₂ reduction
Agenda

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Our market environment: Opportunities and challenges for further development

<table>
<thead>
<tr>
<th>Markets for standard copper raw materials</th>
<th>Markets for complex raw materials</th>
<th>Product markets</th>
<th>Societal trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing mine output and rising levels of copper scrap</td>
<td>Increasing metal prices make complex raw materials more attractive</td>
<td>Delayed development of mining projects could lead to cathode deficits</td>
<td>UN Sustainable Development Goals (SDG)</td>
</tr>
<tr>
<td>Smelter capacity increasing worldwide</td>
<td>Mine-specific composition of complex concentrates</td>
<td>Demand for copper products bolstered by mega trends</td>
<td>Global knowledge society</td>
</tr>
<tr>
<td>Competition for standard raw materials</td>
<td>Global e-scrap levels are increasing, collection rates are still low</td>
<td>Growth in application markets increases the demand for metals that accompany copper</td>
<td>Change &amp; disruption</td>
</tr>
<tr>
<td>Volatile treatment and refining charges</td>
<td>Increasing levels of valuable industrial residue</td>
<td>Sulfuric acid markets remain volatile</td>
<td>Using resources responsibly</td>
</tr>
</tbody>
</table>
Specific supply market challenges facing the copper industry

- Primary raw materials are bound to contain more impurities with the arsenic being the key challenge (major quantity of As in minor concentrate quantity)
- There is a tendency visible that the concentrate grade falls
- Changing Fe/Si ratio (slag) and Fe/S ratio (sulphuric acid)
- Finer grained concentrates
- Ever-increasing environmental restrictions in mining, logistics, smelting and refining
- Increasing energy and labor costs
Technology challenges: base metal technologies have been developed for specific feed mixes.

**Lead Metallurgy**
Restrictions: Cu, As, Ni, PGM

**Primary Copper**
Restrictions: S, Fe, Pb, Zn, As, Sb, Bi

**Zinc Metallurgy**
Restrictions: SiO₂, Fe, Cu, Pb

**Secondary Copper**
Restrictions: S, Pb, Sb, …
Base metal copper: Aurubis has an optimal starting point for multi-metal strategy

Base metals and their accompanying elements
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Our strategic focus: Strengthening the copper business

Smelting and refining

Processing

Synergy ...

... enables Metal production

Markets for complex raw materials

Markets for standard copper raw materials

Technology markets

Markets for semi-finished copper products

Strengthening the leading position: competitive costs & structural optimization
Our strategic focus:
Development of the multi-metal business

Expansion of the multi-metal business:
Outstanding expertise & innovative solutions for the industrial sector

- Smelting and refining
- Markets for complex raw materials
- Markets for standard copper raw materials
- Technology markets
- Markets for semi-finished copper products

Processing

synergy ...

... enables

Metal production
Future Complex Metallurgy (FCM) project: important step for multi-metal growth

- Hamburg and Olen: > 180 jobs
- Production start: FY 2020/21
- Capex: approx. € 320 million
- Additional raw material input
- EBITDA increase: € 80 million beginning in FY 2022/23

- Expansion for complex raw materials
- New and optimized processes
- Synergies
- Shorter throughput times for precious metals
- Production of numerous metals
- Lower sales of intermediate products

Figures according to a preliminary feasibility study
Outlook: optimized multi-smelter network to improve “multi-metal” resource efficiency

Requirements
» deep metallurgical process know-how
» large scale optimization networks

» higher flexibility in raw materials
» solution to mines
» resource efficiency
OUR STRATEGY:
Growth, Efficiency and Responsibility
Aurubis’ Sustainability Strategy is based on three pillars: Economy, Environment, People

Aurubis Sustainability Strategy

» Was developed in 2013 in a group-wide process

» Focuses on the balance among the Economy – Environment – People in the individual phases of the Aurubis value chain:
Raw Materials – Processes – Products

» Eight main areas of action were identified and targets were formulated

The Sustainability Strategy pursues targets in eight main areas of action
Strategic focus “Growth”: Aurubis will report on a broader metal portfolio in the future

- Copper
- Gold
- Silver
- Lead
- Nickel
- PGM: Platinum, Osmium, Iridium, Ruthenium, Rhodium, Palladium
- Tin
- Minor metals: Selenium, Tellurium, Rhenium, Antimony, Bismuth