Electrolytic Copper Refining
2010 World Tankhouse survey

Tim Robinson, Andreas Siegmund, Bill Davenport, Mike Moats and George Karcas
June 9, 2010
Summary

- Introduction
- Regional trends
- Future projects
- Process technology
- Summary
Eighth in a series of world and regional copper refining surveys since 1987
Previous Surveys
The data of 58 ER plants is tabulated
Previous survey data was included
Timmins to be shutdown
Regional Trends

- Asia
- Europe
- Africa
- Americas
Regional Trends Asia

- Eastern (China) and Southern Asia (India) dominate copper refinery expansion
- Large multiple refining tankhouse sites include Guixi, Tongling, Kunming-YCC (China) and Tuticorin (India)
- Central Asian (Kazakhstan) refining expansion
- Japanese refineries converted from starter sheet to permanent cathode technology
- Conversion of Pasar, Philippines
Asian ER Yanggu
Regional trends Europe

- Large refineries being modernized with PC cells (NA)
- Permanent cathode conversion and modernization (Pirdorp and Pori)
- Consolidation of NA and Belgian copper refineries to form Aurubis, now Europe’s largest refiner
- Other major European refiners include Boliden, Atlantic Copper (FMI) and KHGM (Poland)
- KHGM is still the largest starter sheet refinery operation
European ER  Pori
Africa

- Large ER capacity in Zambia and not so in DRC
- Large ER tankhouses in Zambia being modernized with polymer concrete cells and new electrode handling machines
- ER tankhouse studies for northern Africa
Regional trends Americas

- No new refining capacity
- But a lot of mill capacity in the pipeline for Chile and Peru leading to increasing Pacific concentrate trade
- Major refining locations include:
  - Codelco Norte, Chile
  - Las Ventanas, Chile
Process Technology

- Cathode Technology
- Automatic Cranes
- Electrolytic Cells
- Electrode contact system
- Automated cell voltage monitoring
- Summary
Permanent Cathode Technology

- Over 40% of the respondents use permanent cathode technology as per previous surveys
- First developed by CRL and MESCO in late 70’s
- Isa Process and Kidd Process are now supplied by one source Xstrata technologies (XT)
- Outotec is a ER permanent cathode technology supplier
- Ionic of Canada is pioneering robotic high speed electrode handling machines
- Stripping machine technology suppliers include:
  - MESCO (XT)
  - Outotec (Wenmec)
  - Ionic (XT)
Stripping Machine
Robotic cathode stripping machine
Anode Preparation Machines

- 80% of refineries surveyed used an anode preparation machine
  - Weighing
  - Straightening
  - Lug machining
- Robotic anode preparation machines are being developed and installed
  - Metallo Chimique, Belgium
  - Zijin, China
  - Daye, China
Robotic Anode machine
ER Electrode Handling
Electrode design trends include:
- Higher energy efficiency with designs that include more copper in/on cathode plate hanger bar
- Electrode tracking for process control
- Hooks on electrodes (cast for anodes) for automated crane and rapid pick up (Outotec)
First ER Copper automated crane application was Kunz at Brixlegg in mid 80’s

These cranes give precise location of electrodes in the cells and can increase current and time efficiency (speed)

- cranes use cone or laser method of cell location
- Suppliers in Copper EW include Kunz, Femont and Outotec
- Synchronization of stripping machines and cranes that improves time efficiency
Crane and stripping machine synchronization
Electrolytic Cells

- Over two thirds of surveyed ER plants use Polymer concrete (PC) cells
- Many ER tank houses retrofitting PC cells in Europe
- New capacity in China and India are installing PC cells
- New cell developments include:
  - Longer cell length to minimize tankhouse footprint
  - Higher cell flows
  - Automatic crane locating devices
- Remaining older refineries use lined cells
  - Antimonial lead
  - PVC paraliners
Electrode contact systems

- Typical designs include:
  - Dogbone bar
  - Copper in busbar for current distribution

- Latest designs include:
  - Double double contact systems
  - Anode and cathode equalizer bars
  - Outotec ER design
Recent trend is to install online cell voltage Monitoring (CVM)
- Cell voltage and temperature
- Wireless

Originally developed for electrorefining tankhouses in 70’s but not wireless

MIPAC of Australia also a supplier
Automated online cell voltage and temperature monitoring
ER Development Summary

- More electrode handling automation including robots
  - Cathode Stripping machines
  - Anode handling machines
  - Larger capacity
  - Cranes
- Longer cells
  - More integrated automated ER tankhouse design with cell
- Higher current density operation
- Wireless ER cell voltage monitoring