New Developments in the Leaching of Zinc Concentrates under Atmospheric and Pressure Conditions

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Vancouver, Canada
Outline

• The Roast-Leach-Electrowin Process
• Direct Leaching of Zinc Concentrates
  – Pressure Leaching
  – Atmospheric Leach
• Treatment of Complex Concentrates
• Concluding Remarks
The Roast-Leach-Electrowin Process

• Zinc Concentrates contain ~50% Zn as ZnS with some Fe, Cu, Cd, Co, Ni, and many minor elements

• Roasting
  – ZnS + 3/2O₂ = ZnO + SO₂(g)
  – FeS + 1.75O₂ = 0.5Fe₂O₃ + SO₂(g)
  – ZnO + Fe₂O₃ = ZnFe₂O₄ (Zinc Ferrite)

• Roaster off gas is captured and used to make H₂SO₄(conc)

• Roaster Calcine is leached with return acid to produce neutral solution for purification

• Leaching
  – ZnO + H₂SO₄ = ZnSO₄ + H₂O
The Roast-Leach-Electrowin Process

- Zinc Ferrites are either treated pyrometallurgically or using strong acid leach

- Pyrometallurgical treatment includes Waelz kiln for zinc recovery or integrated processing with lead concentrates (e.g. Kivcet reactor), iron to slag, zinc to fume

- Strong acid leach
  - \[ \text{ZnFe}_2\text{O}_4 + 4\text{H}_2\text{SO}_4 = \text{ZnSO}_4 + \text{Fe}_2(\text{SO}_4)_3 + 4\text{H}_2\text{O} \]

- Iron is then precipitated as jarosite, goethite or hematite

- Strong acid leach solutions are integrated into neutral leach to ensure zinc recovery

- Neutral zinc solutions are purified and electrolyzed
The Roast-Leach-Electrowin Process

- Zinc solution purification using zinc dust cementation
  - \( \text{CuSO}_4 + \text{Zn} = \text{Cu} + \text{ZnSO}_4 \)
  - \( \text{CdSO}_4 + \text{Zn} = \text{Cd} + \text{ZnSO}_4 \)

- Cobalt and Nickel removed with activators (Cu/As or Cu/Sb)
  - \( \text{CoSO}_4 + \text{Zn} = \text{Co} + \text{ZnSO}_4 \)
  - \( \text{NiSO}_4 + \text{Zn} = \text{Ni} + \text{ZnSO}_4 \)

- Zinc electrowinning
  - \( \text{ZnSO}_4 + \text{H}_2\text{O} = \text{Zn} + 0.5\text{O}_2 + \text{H}_2\text{SO}_4 \)

- Zinc is electrowon from highly purified solution – typically less than 0.1-0.3 mg/L of Ni and Co
Zinc Electrowinning

Cathode

\[ \text{ZnSO}_4 + 2e^- \rightarrow \text{Zn}^0 + \text{SO}_4^{2-} \]

Anode

\[ \text{H}_2\text{O} \rightarrow 2\text{H}^+ + 2e^- + \frac{1}{2}\text{O}_2 \]

Cell

\[ \text{ZnSO}_4 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4 + \frac{1}{2}\text{O}_2 + \text{Zn}^0 \]

M. Pourbaix, Atlas of Electrochemical Equilibria in Aqueous Solutions, Pergamon 1966
Generic RLE Zinc Plant Flowsheet

Typical Present Day RLE Flowsheet

Zinc Conc → Roaster/Acid Plants → Calcine Leach → Calcine Leaching → Purification → Electrolysis → Melting and Casting → Refined Zinc Product

H₂SO₄ → Tail Gas → Air

Optional: additional stages to recover In, Ge

Pb/Ag Residue → Iron Removal → Iron Residue → Residue Treatment

Cd → Impurity Products and Residues

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R(PL)E + Pyro Treatment

- **Flowsheet for Pyrometallurgical Treatment of Leach Residue**

```
Roasting & Acid Plant → Calcine Leaching → Purification → Electrowinning

98% Sulphuric Acid

Leach Residue to Smelter

Purification Residues

Zinc

Return Acid

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Direct Leaching of Zinc Concentrates

• Zinc Concentrates Leached in Spent Electrolyte under Atmospheric or Elevated Pressure Conditions
  – ZnS + 0.5O₂ + H₂SO₄ = ZnSO₄ + S + H₂O

• Advantages (from M. Collins, Sherritt)
  – Not necessary to tie Zn and Acid Production
  – No emissions of sulfur dioxide
  – Flexibility in feeds (Fe, Cu, Pb, Si)
  – Possible By-product Recovery (S, Cu, Pb, Ag, Au, Ga, Ge, In)
  – Flexible Plant Size (not tied to roaster unit production rate)
  – Commercially Proven
Direct Leaching of Zinc Concentrates

• Zinc Pressure Leaching
  – Developed by Sherritt and Cominco (now Teck) and installed in 1981 in Trail, Canada
  – Now used in a number of zinc plants all over the world
  – Conditions are ~150 C and 12 atmospheres of pressure

• Atmospheric Zinc Leaching
  – Developed over many years by a number of groups
  – Key technology is ultra fine grinding to improve reactivity
  – Atmospheric temperature and pressure
Zinc Pressure Leach Process Flowsheet

- Zinc Sulphate Solution
- Iron Oxide and/or Lead-Silver Residue
- Sulphur Concentrate
- Sulphide Cake
- Elemental Sulphur

- Spent Electrolyte
- Oxygen

ZINC CONCENTRATE

PRESSURE LEACH

FLOTATION

MELTING & FILTRATION

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Zinc Pressure Leach History (M. Collins, Sherritt)

• 1954: Bjorling reacts pure zinc blende with acid under oxygen overpressure but reports that reaction is too slow to be practical

• 1957-1959: Forward and Veltman (UBC/Sherritt) report zinc concentrate containing acid soluble iron amenable to direct pressure oxidation
  – At 140 C, Zn extraction of 50-70% due to wetting of unleached sulfides by elemental sulfur
  – Preferred conditions: 110 C, 140-400 kPa O₂, 2-4 h, -44 um, 97% Zn extraction

• 1962-1963: Cominco piloted low T continuous process. 6 h retention time, 96% Zn extraction. Not pursued due to improved fertilizer markets and high CAPEX

• 1965: Further pilot by Dowa Mining for Iijima Refinery - discontinued
Zinc Pressure Leach History (M. Collins, Sherritt)

- **1968**: Sherritt developed process for leaching above the MP of sulfur. Use of excess zinc concentrates with recycle of unleached sulfides after sulfur removal. 150 C, 2 h, 96-98% Zn Recovery (70% extraction in single pass)

- **1971**: Process modified through introduction of surfactant (lignin sulfonate/Quebracho) to prevent sulfur wetting. 150 C, 1 h, +96% Zn extraction. Also demonstrated in two-stage countercurrent form (98-99% Zn Extraction)

- **1977**: Sherritt and Cominco joint pilot of ZPL at 150 C, 118 kg/h concentrate feed rate, 1 m³ autoclave.
1980-1981: first commercial ZPL plant commenced operation at Trail, BC (Cominco, now Teck)

Integration with roast-leach plant
150° C single stage, low acid process, with recovery of elemental sulphur by melting and hot filtration
30 000 t/y Zn (design)
48 000 t/y Zn by 1997
1980: Sherritt commenced process development studies and commercial plant design based on mini-pilot plant operation (10 and 30 L autoclaves)
Process Development Timeline, cont’d

1983: start-up of Kidd Creek commercial ZPL plant at Timmins, ON (now Xstrata Copper, Kidd Creek Division)

Integration with roast-leach plant

150° C, single stage, low acid process

20,000 - 25,000 t/y zinc

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Process Development Timeline, cont’d

1991: start-up of Ruhr-Zink commercial ZPL plant at Datteln, Germany

Integration with roast-leach plant
150° C, single stage, high acid process
Reduction residues processed along with fresh con
50,000 to 55,000 t/y Zn from sulphide
Process Development Timeline, cont’d

1993: start-up of HBMS commercial ZPL plant (now subsidiary of HudBay Minerals Inc.)

Replacement of roasters
150° C, two stage countercurrent process
96 000 (design) - 115 000 (current) t/y Zn
Dissolution of Zn from Sphalerite
\[ \text{ZnS} + \text{H}_2\text{SO}_4 + 0.5 \text{O}_2 \rightarrow \text{ZnSO}_4 + \text{H}_2\text{O} + \text{S}^0 \]

Dissolution of Cu from Chalcopyrite
\[ \text{CuFeS}_2 + 2 \text{H}_2\text{SO}_4 + \text{O}_2 \rightarrow \text{CuSO}_4 + \text{FeSO}_4 + 2 \text{S}^0 + 2 \text{H}_2\text{O} \]

Both reactions catalyzed by Fe in solution
\[ \text{ZnS} + \text{Fe}_2(\text{SO}_4)_3 \rightarrow \text{ZnSO}_4 + 2 \text{FeSO}_4 + \text{S}^0 \]
\[ 2 \text{FeSO}_4 + \text{H}_2\text{SO}_4 + 0.5 \text{O}_2 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O} \]
Zinc Pressure Leach Process Chemistry

Reaction of Galena:
\[
PbS + H_2SO_4 + 0.5 O_2 \rightarrow PbSO_4 + H_2O + S^0 \\
\rightarrow PbFe_6(SO_4)_4(OH)_{12}
\]
lead precipitate type depends on acid concentration

Dissolution of Fe from Pyrite:
\[
FeS_2 + H_2O + 3.5 O_2 \rightarrow FeSO_4 + H_2SO_4
\]
Zinc Pressure Leach Process Chemistry

Precipitation of Ferric Iron as:

Hematite: \( \text{Fe}_2(\text{SO}_4)_3 + (3+x) \text{H}_2\text{O} \rightarrow \text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} + 3 \text{H}_2\text{SO}_4 \)

Jarosite: \( 3 \text{Fe}_2(\text{SO}_4)_3 + 14 \text{H}_2\text{O} \rightarrow 2(\text{H}_3\text{O})\text{Fe}_3(\text{SO}_4)_2(\text{OH})_6 + 5 \text{H}_2\text{SO}_4 \)

Basic Iron Sulphate: \( \text{Fe}_2(\text{SO}_4)_3 + 2 \text{H}_2\text{O} \rightarrow \text{FeOHSO}_4 + \text{H}_2\text{SO}_4 \)

Solubility and form of precipitate depend on acid concentration and presence of jarosite-forming species such as Pb, K, Na and Ag

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Role of Iron in Zinc Pressure Leaching:

Iron in solution facilitates oxygen transfer and thus enhances leach kinetics, but must be removed from solution prior to purification and electrowinning.

Iron is effective in collecting impurity elements as it is hydrolyzed and precipitated.
Neutralization and Fe Removal:
Zinc Hydroxide or Basic Zinc Sulphate Preparation:
\[ \text{ZnSO}_4 + \text{Ca(OH)}_2 + 2 \text{H}_2\text{O} \rightarrow \text{Zn(OH)}_2 + \text{CaSO}_4 \cdot 2\text{H}_2\text{O} \]
\[ 3\text{ZnSO}_4 + 2 \text{Ca(OH)}_2 + 4 \text{H}_2\text{O} \rightarrow \text{ZnSO}_4 \cdot 2 \text{Zn(OH)}_2 + 2 \text{CaSO}_4 \cdot 2\text{H}_2\text{O} \]

Acid Neutralization:
\[ \text{H}_2\text{SO}_4 + \text{Zn(OH)}_2 \rightarrow \text{ZnSO}_4 + 2 \text{H}_2\text{O} \]

Iron Hydrolysis and Precipitation:
\[ \text{Fe}_2(\text{SO}_4)_3 + 3 \text{Zn(OH)}_2 \rightarrow 2 \text{FeO(OH)} + 3 \text{ZnSO}_4 + 2 \text{H}_2\text{O} \]
Zinc Pressure Leach History (M. Collins, Sherritt)

• 1997: Cominco installed larger autoclave at Trail (75,000 t/a Zn)

• 2003: Startup of the Kazakhmys ZPL plant in Kazakhstan (150 C, 2-stage leach, greenfields, 100,000 t/a Zn)

• 2009: Startup of Shenzhen-Zhongjin Lingnan Nonfemet Co. ZPL plant in Shaoguang City, Guangdong Province, China.

• 1971: Process modified through introduction of surfactant (lignin sulfonate/Quebracho) to prevent sulfur wetting. 150 C, 1 h, +96% Zn extraction. Also demonstrated in two-stage countercurrent form (98-99% Zn Extraction)

• 1977: Sherritt and Cominco joint pilot of ZPL at 150 C, 118 kg/h concentrate feed rate, 1 m³ autoclave.
# Process Selection: ZPL Applications

<table>
<thead>
<tr>
<th>Zinc Pressure Leach Flowsheet</th>
<th>Typical Application / Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Acid Single Stage</strong></td>
<td>• Integration with roast-leach-electrowin</td>
</tr>
<tr>
<td></td>
<td>• Elemental sulphur recovery</td>
</tr>
<tr>
<td><strong>High Acid Single Stage</strong></td>
<td>• Integration with roast-leach-electrowin</td>
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<tr>
<td></td>
<td>• Elemental sulphur recovery</td>
</tr>
<tr>
<td></td>
<td>• Lead-silver recovery</td>
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<tr>
<td><strong>Two Stage Countercurrent</strong></td>
<td>• Replacement of roasting-calcine leach operations</td>
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<tr>
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<td>• Grassroots zinc refinery</td>
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<td></td>
<td>• Elemental sulphur recovery</td>
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</table>

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ZPL Single Stage Process Flowsheet

ZINC CONCENTRATE

Spent Electrolyte

PRESSURE LEACH

Oxygen

Leach Residue

Zinc Sulphate Solution to Neutralization, Purification, Electrowinning

FLOTATION

Iron Oxide and/or Lead-Silver Residue

Sulphur Concentrate

MELTING & FILTRATION

Sulphide Cake

Elemental Sulphur

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Zinc Pressure Leach Sulphur Recovery

HBMS Sulphur Flotation Con, Sept 1993

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Two-Stage Countercurrent Zinc Pressure Leach

ZINC CONCENTRATE

LOW ACID PRESSURE LEACH

Oxygen

Leach Residue

Spent Electrolyte

HIGH ACID PRESSURE LEACH

Oxygen

To Neutralization, Purification & Electrowinning
Two-Stage Cocurrent Zinc Pressure Leach

LOW LEAD-SILVER ZINC CONCENTRATE

LOW ACID PRESSURE LEACH

SPENT ELECTROLYTE

OXYGEN

FLOTATION

IRON RESIDUE

TO NEUTRALIZATION, PURIFICATION & ELECTROWINNING

HIGH LEAD-SILVER ZINC CONCENTRATE

HIGH ACID PRESSURE LEACH

UNLEACHED SULPHIDES

SULPHIDES

OXYGEN

MELTING & FILTRATION

ELEMENTAL SULPHUR

LEAD-SILVER RESIDUE
Atmospheric Leach

- As for pressure leaching, direct reaction of concentrate
- Pressure leaching and atmospheric leaching rely on Fe in solution

$$\text{ZnS} + \text{Fe}_2(\text{SO}_4)_3 \rightarrow \text{ZnSO}_4 + 2 \text{FeSO}_4 + \text{S}_0$$

$$2 \text{FeSO}_4 + \text{H}_2\text{SO}_4 + 0.5 \text{O}_2 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$$
Atmospheric Leach: Process Development

• 1970s: Process Patents for sphalerite direct leach in atmospheric tanks
  • E.g. Cominco US 3 976 743, reducing conditions
  • Dutrizac batch test studies with ferric sulphate

• 1980s: Vielle-Montagne and Ruhr-Zink Reduction Leach for goethite and hematite processes

• 1980s: Vielle-Montagne patent with atmospheric leach stage using oxygen
  US Patent 4 676 828
Atmospheric Leach: Process Development

- 1990s: Union Miniere patent with 1 or 2-stage atmospheric leach with oxygen, leads to Korea Zinc plant
  - Process co-developed with Korea Zinc
  - Implemented at Onsan facility to expand Zn production by 50,000 t/y
  - Current direct leaching capacity at Onsan 260,000 t/y Zn

- 1990s: Outokumpu (now Outotec) patents, Kokkola plant
- 2000s: Outotec process: Kokkola expansion, Odda (Boliden), Zhouzhu commissioning
Atmospheric Leach: Cominco

Atmospheric Leach Conditions

- **Temperature** 80 - 95°C
- **10 - 20 g/L H2SO4 and 35 - 45 g/L Fe2+ in product solution**
- **Non-oxidizing conditions; no oxygen added**
- **Approx. 70% Zn extraction from concentrate**

\[
\text{ZnFe}_2\text{O}_4 + \text{ZnS} + 4\text{H}_2\text{SO}_4 = 2\text{ZnSO}_4 + 2\text{FeSO}_4 + \text{S} + 4\text{H}_2\text{O}
\]

Atmospheric Leach: CANMET

- **J. Dutrizac and co-workers, CANMET, 1970s to 2000s**

- **Ferric sulphate and chloride leaching of sphalerite**
- **Effect of Temp., PSD, Fe in sphalerite**

Figure 5 - $1 - (1 - \alpha)^{1/3}$ versus time curves for the dissolution of zinc from the -208 +147 $\mu$m sized Santander sphalerite as a function of time at different temperatures.
Atmospheric Leach: Union Minière Process Concept

Concentrate

ROASTING

Calcine

NEUTRAL LEACH

Spent

Solution to Purification and Electrowinning

ATMOSPHERIC LEACH

Ferrite Residue

Solution

IRON REMOVAL

Spent

O₂

Fe Precipitate, S°

Solution

Fe Precipitate

Note: All or part of the ferrite may be treated in the atmospheric leach

Simplified diagram, based on US Patent 5, 858,315

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Atmospheric Leach Conditions

- $\text{mol Fe in Ferrite} : \text{mol Reactive S}^{2-} \text{ in Concentrate} \geq 0.2$; preferably $\geq 0.3$ to enhance zinc extraction rate
- Temperature 85 to 90°C
- Oxygen addition
- Single stage or two-stage countercurrent process
- 4 – 16 h retention time (batch) per leach stage
- All or part of ferrite residue may be fed to atmospheric leach
- 95% Zn extraction in single stage, 98% in two-stage
Atmospheric Leach: Union Minière Process Variant

Based on US Patent 5, 858,315

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### Atmospheric Leach: Outotec


<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Direct Leaching Capacity t/y Zn</th>
<th>Start-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boliden</td>
<td>Kokkola, Finland</td>
<td>50 000</td>
<td>1998</td>
</tr>
<tr>
<td>Boliden</td>
<td>Kokkola, Finland</td>
<td>50 000</td>
<td>2001</td>
</tr>
<tr>
<td>Boliden</td>
<td>Odda, Norway</td>
<td>50 000</td>
<td>2004</td>
</tr>
<tr>
<td>Zhuzhou</td>
<td>Zhuzhou, China</td>
<td>100 000</td>
<td>2009</td>
</tr>
</tbody>
</table>

**Korea Zinc Direct leaching capacity at Onsan 260 000 t/y Zn**
Atmospheric Leach: Outotec Reactor

Series of agitated overflow vessels in cascade

Atmospheric conditions (reactor connected to atmosphere via gas scrubber)

~20 m in height and 900 m$^3$ capacity:
~300 kPa hydrostatic pressure at tank bottom, due to reactor height and slurry density (~150 kPa average in vessel)

Atmospheric Leach: Outotec

Direct leach tanks at Boliden Odda Kokkola Refinery
photograph and schematic from Outotec OKTOP Reactor brochure, 2009.

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Atmospheric Leach: Outotec Process Conditions

- Concentrate particle size ~15 to 25 µm
- Premix vessel with additives, to limit frothing of concentrate upon contact with electrolyte
- Leaching temperature 100°C
- Oxygen addition
- Ferrous iron oxidation catalyzed by 0.5 to 2 g/L Cu
- 10 to 50 g/L H$_2$SO$_4$, 5 to 15 g/L Fe in solution
- Single stage or two-stage countercurrent process
- 20 to 30 h retention time
- Zn extraction 96 to 99%
Atmospheric Leach: Kokkola Plant Zn Extraction

From M. Lahtinen, ”Zinc Concentrate Atmospheric Leaching”, COM 2008 Short Course, 47th Annual Conference of Metallurgists, August 24 to 27, 2008, Winnipeg, MB, Canada
Atmospheric Leach: Outotec Generic Flowsheet

Based on M. Lahtinen, "Zinc Concentrate Atmospheric Leaching", COM 2008 Short Course, 47th Annual Conference of Metallurgists, August 24 to 27, 2008, Winnipeg, MB, Canada
ALBION PROCESS (MIM-XSTRATA-Glencore - ?)

- Fine grinding (P80 < 7 μm), atmospheric leach using Hyperspargae oxygen injection (different than OKTOP)
- ISAMILL used to obtain fine grind
- San Juan de Neiva (Spain)
  - 9000 tpa of Pb-Zn Concentrate from McArthur River
  - 98.6% Zn recovery
  - 28 h residence time
  - ZnS + 0.5O₂ + H₂SO₄ = ZnSO₄ + S + H₂O
  - PbS + 0.5O₂ + H₂SO₄ = PbSO₄(s) + S + H₂O
  - Mild pyrite and S (<5%) Oxidation
  - Zinc Ferrites also leached
- Nordenham (Germany)
  - 36,000 tpa of concentrate from McArthurur River
  - 98.8% Zn recovery
<table>
<thead>
<tr>
<th>Parameter</th>
<th>San Juan de Neiva</th>
<th>Nordenham</th>
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</thead>
<tbody>
<tr>
<td><strong>Feed Rate - tph</strong></td>
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<tr>
<td>MRM Concentrate</td>
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<tr>
<td>Neutral Leach Residue</td>
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<td><strong>Concentrate Composition</strong></td>
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<tr>
<td>Zinc - %</td>
<td>47.2%</td>
<td>47.2%</td>
</tr>
<tr>
<td>Lead - %</td>
<td>8.17%</td>
<td>8.17%</td>
</tr>
<tr>
<td>Iron - %</td>
<td>5.4%</td>
<td>5.4%</td>
</tr>
<tr>
<td>SiO₂ - %</td>
<td>4.3%</td>
<td>4.3%</td>
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<tr>
<td>Copper - %</td>
<td>0.8%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Sulphur - %</td>
<td>47.2%</td>
<td>47.2%</td>
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<tr>
<td><strong>Tank Size – m³</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>280</td>
<td>800, 280</td>
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<tr>
<td><strong>Leach Recovery - % w/w</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>98.6</td>
<td>98.8</td>
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<tr>
<td><strong>Conversion to elemental sulphur</strong></td>
<td></td>
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<tr>
<td></td>
<td>&lt;5</td>
<td>&lt;5</td>
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<tr>
<td><strong>Leach acid demand – kg/tonne</strong></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>488</td>
<td>470</td>
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<td><strong>Leach oxygen demand – kg/tonne</strong></td>
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<td>209</td>
<td>214</td>
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<td><strong>Residue Composition</strong></td>
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<td>Sulphur - %</td>
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<tr>
<td>Zinc - %</td>
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<td>Lead - %</td>
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<td>SiO₂ - %</td>
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<tr>
<td>Copper - %</td>
<td>0.20</td>
<td>0.20</td>
</tr>
</tbody>
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Atmospheric Leach Reactors

XSTRATA ALBION

Outotec OKTOP
Other Developments

• **PARTOX™ Process** for treatment of Cu-Zn-(Pb)-Ag-Au Ores or Concentrates (Dreisinger et al, Pb-Zn 2005, Japan)
  - Partial Pressure Oxidation (to minimize pyrite oxidation) followed by SX-EW for Cu and Zn and Cyanidation (or ?) for Au/Ag recovery
  - Piloted by Farallon Resources for Campo Morado (Mexico), now Nyrstar

• **BioZinc™** (BHP Billiton)

• **GEOCOAT® Process** (Geobiotics)

• **HydroZinc™** (Teck)

• **SKORPION Zinc** (150,000 tpa of Zn by SX-EW) (Reunion Mining, Anglo American, Vedanta)
BHP Billiton’s BioZINC™ Process

D. Ashman
Hydro 2003 Short Course
Skorpion Zinc (Namibia)

World’s first acid leach – SX – EW for Zn at a large scale (150,000 tpa Zn)
Conclusions

• Roast-Leach-Electrowinning is Standard Zn Technology

• Direct Leaching Using Pressure or Atmospheric Oxygen Leaching Well Developed
  – Expand existing plants
  – Establish Greenfields plants.

• Adaptation of Technology for Treatment of Complex Ores and Concentrates is Possible

• Zinc SX-EW is now well established as large scale Zn recovery technology
Thank You!

Any Questions?