First Chalcopyrite Copper Concentrate Leaching using Albion Process™ Technology

Glenn Stieper
Glencore has an operating plant, Sable Zinc, in Zambia that was being un-utilised due to the lack of excess oxide copper/cobalt ores available in the region and wanted to prove up the concept of sulphide copper leaching at a commercial scale using the Albion Process™.

A very cheap retrofit was undertaken on the existing oxide leach circuit and then fed a predominantly chalcopyrite/bornite concentrate (28-30% Cu). After a very short commissioning stage of around ~6 weeks, it achieved recoveries in excesses of 99% out of the leach vessels.

As a greenfield project or an existing plant retrofit at a larger scale, the plant would have purpose designed tanks similar to the images shown on slide 3, or the feed rate would match the tanks existing capacity. Sable Zinc utilised the existing equipment that was not necessarily fit for purpose or matched the capacity requirements. This proves that even with this site’s equipment, the Albion Process™ still managed to achieve very good results.
What Is The Albion Process™?
Albion™ is a combination of Mechanical and Chemical liberation

- **Ultrafine Grinding Technology:**
  - IsaMill™ stirred mill:
  - FeS$_2$ = 80% passing 10 - 14 microns
  - CuFeS$_2$ = 80% passing 12 – 18 microns
  - Ni$_9$Fe$_9$S$_{32}$ = 80% passing 10 – 14 microns
  - ZnS = 80% passing 16 – 20 microns

- **Oxidative Leaching Technology:**
  - Atmospheric pressure leach
  - Well engineered mass transfer
  - Supersonic oxygen injection
  - Sulphate solutions - no chlorides
  - 24 to 36 hours total residence time
Albion Process™ Flowsheet Options

**GOLD RECOVERY**
- CONCENTRATE
- ULTRAFINE GRIND
- ALBION LEACH
- THICKENER
- CIL LEACH
- DORE

**Commercial Scale Applications In:**
- Gold
- Copper
- Cobalt
- Lead
- Zinc

**BASE METAL RECOVERY**
- CONCENTRATE
- ULTRAFINE GRIND
- ALBION LEACH
- IRON PRECIPITATION
- WASH CCD OR FILTRATION
- SX/EW OR PRECIPITATION

- Water
- Oxygen
- Limestone
- Acid
- Limestone

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Albion Process™ – Low Process Risk

All components of the technology are well demonstrated:

**IsaMill™**

- > 130 IsaMills in operation globally

**Atmospheric Leach**

- 6 operating Albion Process Oxidative Leach Plants
- Zinc, lead, gold and copper/cobalt plants

**Oxygenation System**

- >520 HyperSparge™ units installed in Albion Process and other oxidative leach applications
- Extremely successful at high utilisation of oxygen of up to 90+%

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Sable Zinc located in Zambia, Africa had mined & processed lead, zinc for nearly 100 years.

From 2006 to 2014/15 third party oxide copper/cobalt ore was processed & produced grade A copper cathode and cobalt precipitate.
First Refractory Copper Leaching Using Albion Process™

- In 2017, Glencore decided to retrofit the existing leaching equipment into an Albion plant.
- On a very low budget, the plant received:
  - Oxygen plant
  - HyperSparge™
  - Tank insulation
  - Tank Lid
  - Gas dispersion impeller
  - IsaMill™ – in raffinate
First Refractory Copper Leaching Using Albion Process™

- Sable received a parcel of sulphide copper concentrate containing approximately:
  - 30% Copper (predominantly Chalcopyrite, Bornite and lesser amounts of Chalcocite)
  - 19% Total Sulphur
  - 14% Iron
- Being originally designed as whole ore leach tanks, their sizing was excessive compared to the planned feed rate and selected equipment.
- Commissioning took approx. 6 weeks and we managed to achieve a copper leach recovery of >99%
Main commissioning tasks:
- Training local operators in the Albion Process
- Resolving oxygen plant failures
- Upgrade to site laboratory equipment
- Establishing a continuous feeding system

Once the redundant tankage volumes had been filled, the copper rich (>50 g/L) solution went through iron precipitation, washing and then sent through to EW to produce high grade copper cathode for export.

Processing was a great success and very easy to operate, even on a very low budget and in a remote location.
Future for the Albion Process™ in Africa

- With the success of the first chalcopyrite Albion leach campaign, larger scale green field and retrofit projects in the region are preparing feed stocks for the Sable Zinc plant.

- A lot of African copper and copper/cobalt oxide deposits are transitioning into sulphide ores at depth and see Albion as a cheap, proven and very easy to operate solution.

- The Albion Process is also suitable for low grade middling base metal concentrates giving many different processing options within flotation circuits to maximize value.
GPM Gold – The Success of a Technology

Albion Process™ Refractory gold plant installed 2012

- BFS and Pilot Plant completed 2011 by Core Resources
- Gold recoveries of 95%+ (up from 20% recovery without Albion Process™ treatment).
- Low skill workforce
- Plant tolerates highly variable throughput, sulphur grades and climate
- 100,000 tpa concentrate, producing 120,000 ozpa gold
- Plant production at up to 130% of nameplate design
GPM Gold – The Success of a Technology

Process Plant Overview

- **Au recovery without Albion** = 20%
- **Au recovery with Albion** = 95-98%

Diagram:
- PRIMARY MILLING → BULK FLOTATION
- BULK FLOTATION → CYANIDE LEACH (CIL) PLANT
- CYANIDE LEACH (CIL) PLANT → TAILINGS STORAGE
- IsaMill GRINDING PLANT
- OXYGEN PLANT
- LIMESTONE PLANT
- OXIDATIVE LEACHING PLANT
GPM Gold – The Success of a Technology

3 Years of Stable Gold Recoveries!
Variable Sulphur Grades (<10% to >30%)

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GPM Gold – The Success of a Technology

Variable Throughput (100 – 350 tpd)
GPM Ramp Up – Relative McNulty Curve

Series 1-2 Performance

% of design production rate

Months since end of 6-month commissioning

Series 1
Series 2
Series 3
Series 4
GPM Gold Production
General Albion Activities

- Currently running a Copper/Zinc Albion leach pilot plant in Kazakhstan.

- Skid mounting completed of a 1tpd Albion leach demonstration plant to enable easy transport and setup globally.

- Jacobs Engineering Group recently completed a paper comparing Albion leaching to POX leaching – the general outcomes was that Albion was 40% cheaper. Paper due out in August 2018.
Advantages in refractory copper of the Albion Process™

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Albion Process™</th>
<th>POx</th>
<th>BIOX</th>
<th>Roaster</th>
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<tr>
<td>Demonstrated high recoveries</td>
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<td>✓</td>
<td>✗</td>
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<td>Guaranteed by technology provider</td>
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<td>Simple equipment + low skills required</td>
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<td>Short commissioning and ramp up period</td>
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<td>Can treat high carbonate material</td>
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<td>Tolerates variable feed rate and quality</td>
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Operations – Albion Process™ Plants

Commodity - Zinc
Location – Germany
Client – Nordenham, Glencore
Bulk lead/zinc conc 35,000 tpa zinc cathode
>99 % zinc recovery
Commissioned 2011

Commodity - Zinc
Location – Australia
Client – MRM, Glencore
Bulk lead/zinc conc 150,000 tpa of cleaned zinc conc
Commissioned 2014

Commodity - Gold
Location – Las Lagunas, Dom Republic
Client – Panterra
Complex arsenopyrite/gold tailings
80,000 ozpa gold (>80% Rec, up from 35%)
Commissioned 2012

Commodity - Zinc
Location – Spain
Client – Asturiana de Zinc, Glencore
Bulk lead/zinc conc 4,000 tpa zinc cathode >99 % zinc Rec
Commissioned 2010
Albion Process™ – Technology Access

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Thank You