SKORPION ZINC: LESSONS LEARNT IN THE OPERATION OF THE MODIFED ZINCEX™ SOLVENT-EXTRACTION PROCESS

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ABSTRACT

The first-time application of a purely hydrometallurgical route for the exploitation of an oxide ore to produce special high-grade zinc was realised at Skorpion Zinc using the Modified Zincex™ technology. The essential process comprises leaching, solvent extraction (SX), and electrowinning. The main functions of SX are to provide a barrier against impurities and to upgrade the pregnant leach solution to loaded electrolyte that is sufficiently rich and pure for zinc electrolysis. After several years of successful zinc production, several challenges arose in SX, mainly caused by upstream processes. This paper outlines some of the troubleshooting actions required for the fine-tuning and management of SX in recent years. Organic health, phase entrainment and carry-over, phase continuity, and impurity excursions are discussed.

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Introduction

The Skorpion Zinc Plant

- Located in southern Namibia
- Subsidiary of Vedanta
- Oxide-sillicate Zn deposit
- Commissioned in early 2003
- 150.000 tpa SHG Zinc
- Tecnicas Reunidas Proprietary Zinc SX Process

Introduction

The Skorpion Zinc Plant

- The first industrial SX exploitation of an oxide ore to produce SHG Zinc
- Despite the young technology, very low OPEX and high profitability
- Nominal production since 2007

Introduction

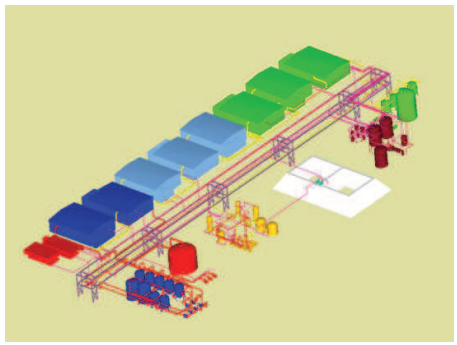
Vedanta

- Principal operations in India, Zambia, Australia
- Acquired operations in Ireland, Namibia (Skorpion Zinc) and South Africa
- One of the largest global Zn producers
- Aluminium, copper, zinc, lead and iron ore

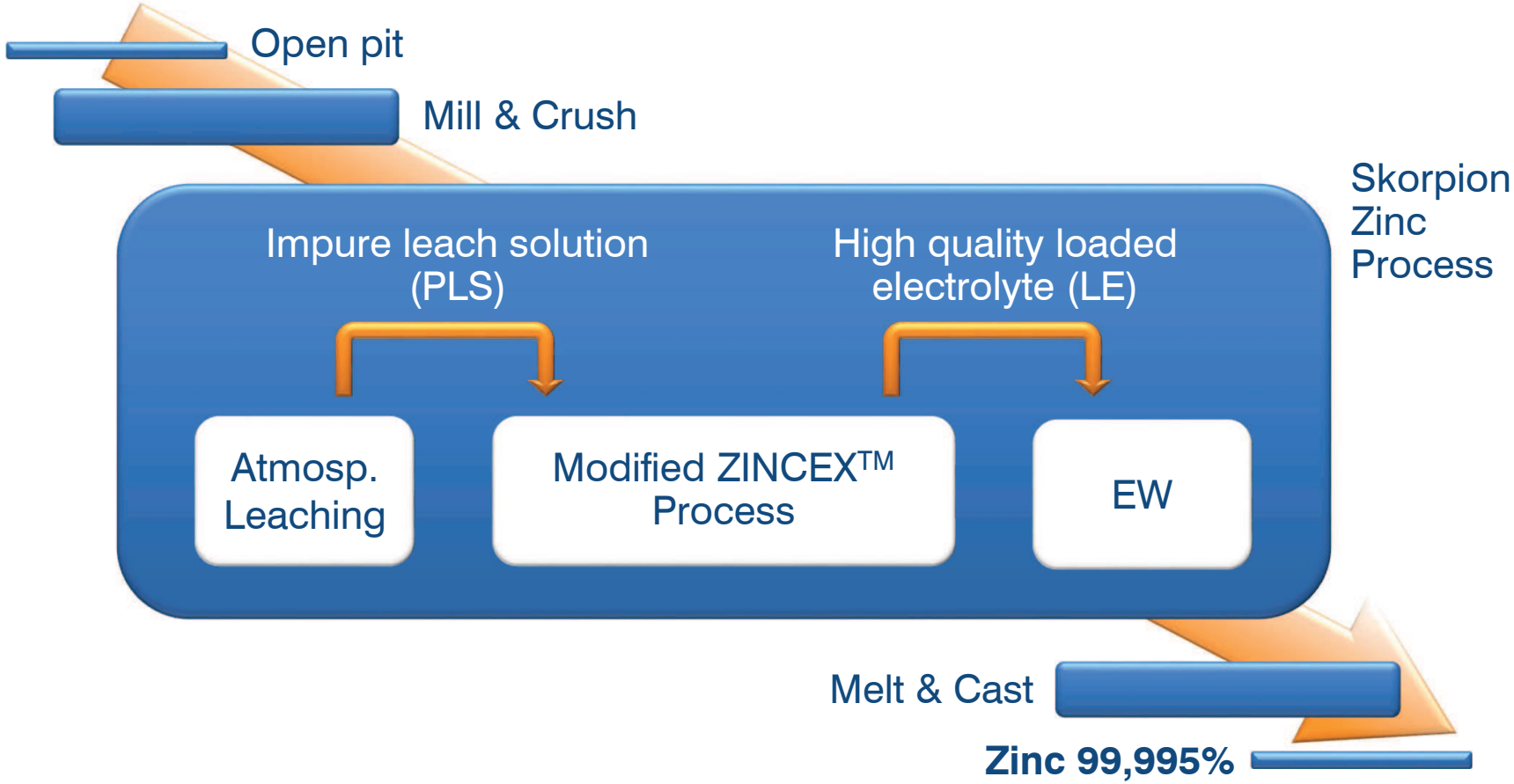
Introduction

Tecnicas Reunidas

- Tecnicas Reunidas (TR) is an international general contractor,
- Engineering, design and construction of industrial facilities.
- TR Hydrometallurgy & Electrochemistry performs industrial projects based on its proprietary technologies (developed at its Technology Centre) like the Modified Zincex™ Process.



Description of the process



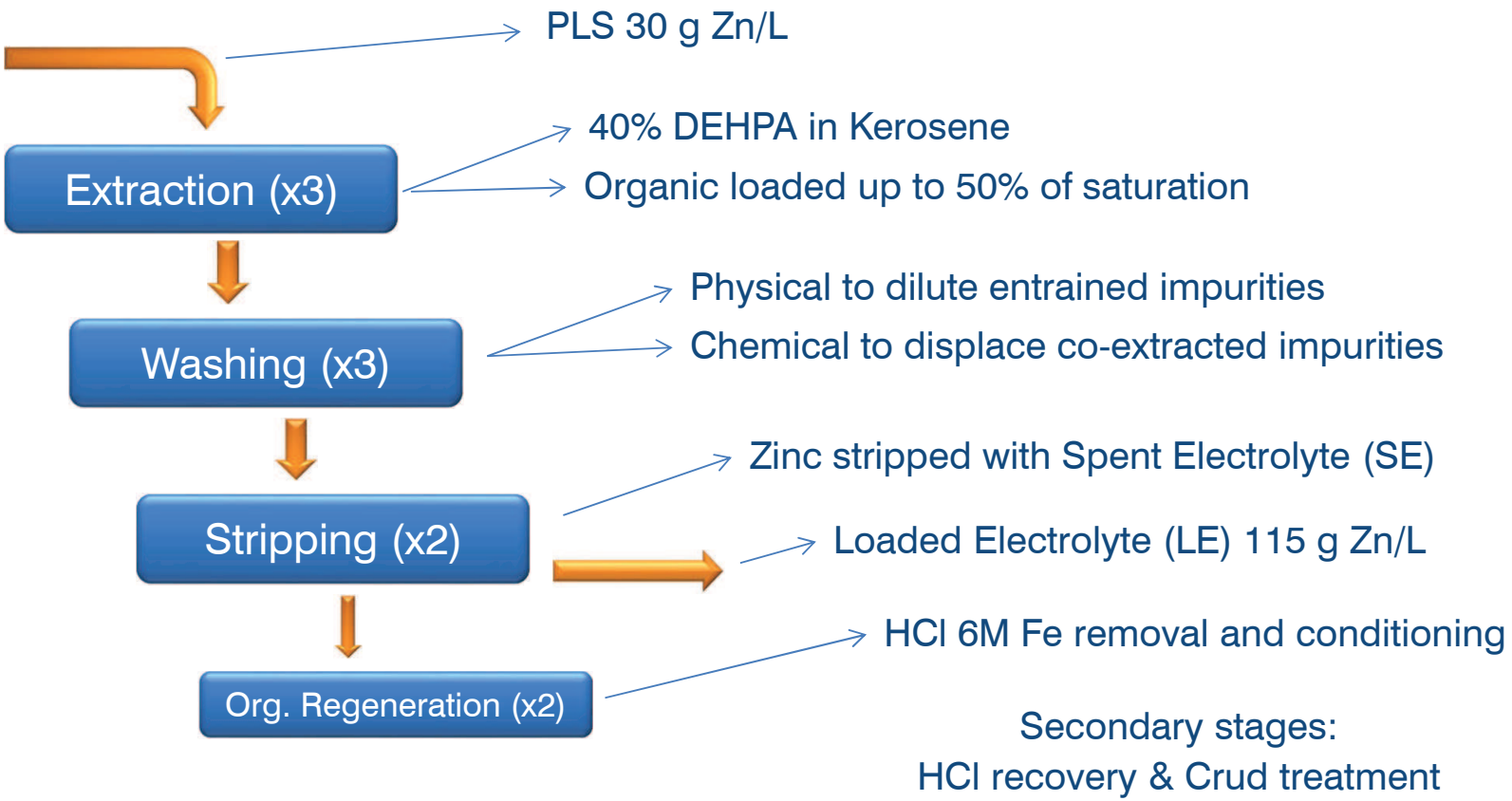
Description of the process

The Modified ZINCEX™ Solvent Extraction Process

- First Commercial Technology for zinc by solvent extraction
- Robust, Reliable and Flexible
- Mineral, Concentrate (sulfate or oxide) or Secondary
- Also materials with high content of Mn, Cl, F, Mg, etc ...
- SHG Zn guaranteed for life
- High recoveries of zinc (≈ 98%)
- **Low operating costs (≈ -15% x Conventional Technology)**
- **Investment costs are similar or lower**

Description of the process

The MZP as implemented at Skorpion



Operational improvements in the process

Aspects subjected to improvement

- Organic Losses (OL) through
  - Evaporation (82% of total OL / mainly Kerosene)
  - Cruds (17% of total OL / 45% DEHPA content)
  - Entrainment (1% of total OL / 40% DEHPA content)
- Phase disengagement time
- REE build-up in the organic (modify loading capacity)
- Control of entrainment
- Impurity excursions to tankhouse

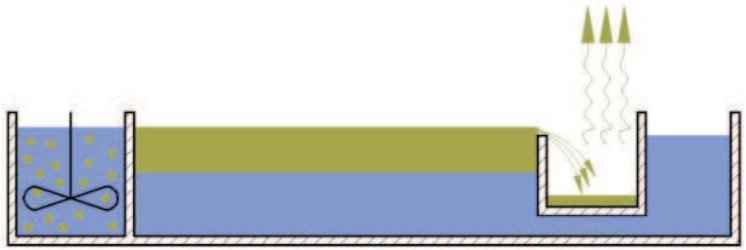
Operational improvements in the process

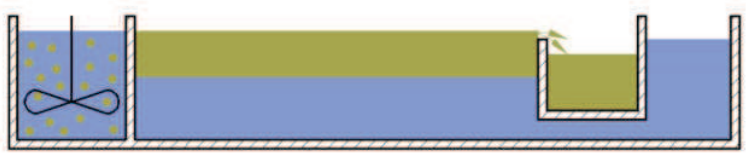
OL - Evaporation

- Main factors
  - Large area settlers
  - In covered buildings but not enclosed
  - Site low humidity and elevation

- Solutions
  - Heat exchangers on PLS feed line → Constant Temperatures
  - Enclosed tanks for organic during settler cleaning
  - Fill the organic overflow launders

Results: OL through evaporation reduced from double to design value





Operational improvements in the process

OL - Cruds I

Larger crud formation than expected
→ Mainly related to upstream processes.

Pinned bed clarifiers improved Total Suspended Solids (TSS) in the PLS to closer to the design.

Current DEHPA loss: 0,55kg/Zn ton

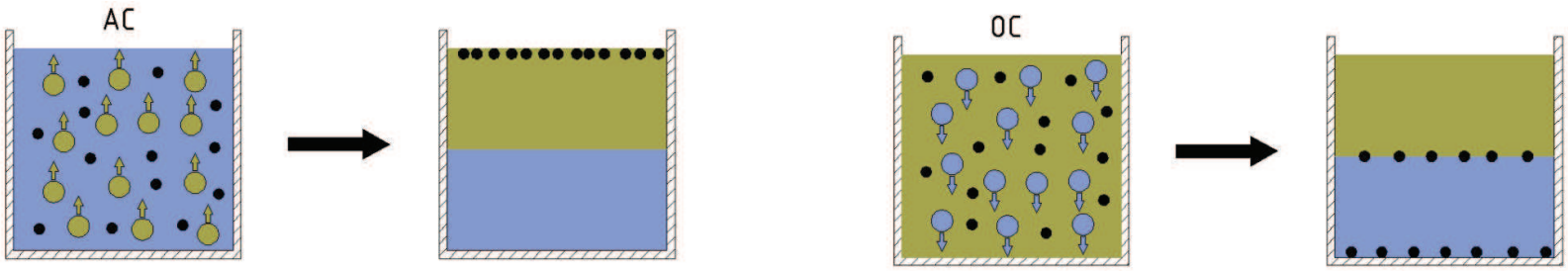
Operational improvements in the process

OL - Cruds II

W1 phase continuity was inverted from AC to OC after persistent excursions of floating crud.

The crud reported to the interface and settler bottom:

- → Easier to treat than floating crud
- → Less loss of organic
- → Higher (but not severe) aqueous entrainment



Operational improvements in the process

OL - Cruds III

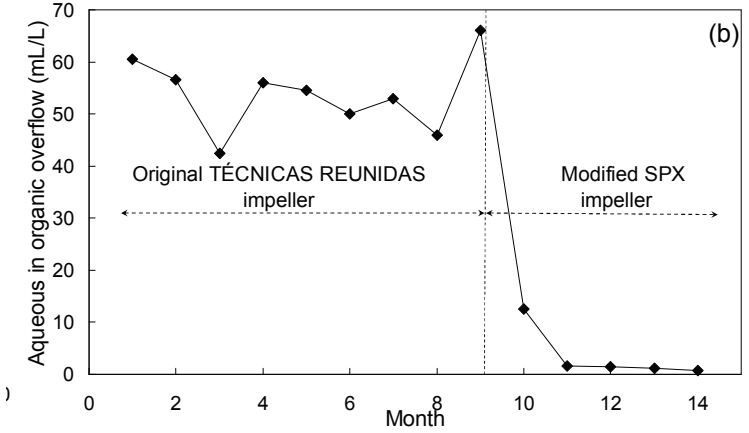
Extraction stage E2 experienced an emulsion in the organic overflow and spontaneous continuity phase inversions

Continuity change from OC to AC
→ Stable but more cruds

Reduce impeller clearance to design
→ Reduction of emulsion but E2 still bottleneck

Replacement of impeller to lower shear action
→ Significant reduction of emulsion and aqueous entrainment

Phase inversions still not well understood



Operational improvements in the process

Phase disengagement time

"A balance must be attained between high and low intensity mixing"

An increase to 46 vol.% of DEHPA concentration resulted in slower phase disengagement and limited organic inventory availability.

A systematic approach reduced DEHPA concentration to specification (40 vol.%)

Operational improvements in the process

REE build-up in the organic

Rare-Earth Elements present in the ore, steadily accumulate in the organic phase.

REE take “gaps” in the extractant. High amounts of REE change physical properties of the organic affecting to separation times.

DEHPA concentration is kept at 42% to maintain the zinc transfer.

Initiatives to recover REE for possible added by-product value are under investigation by Skorpion and Tecnicas Reunidas.

Operational improvements in the process

Control of entrainment

A balance must be attained between high and low intensity mixing.

Two after-settlers → Smaller organic-removal columns

Excluding the top carbon layer, the reactivity of the carbon is uniform
→ only the top carbon layer is now replaced

Entrainment can be controlled increasing the depth of dispersed phase.
→ Tecnicas Reunidas developed a new type of interface control valve.

Entrained organic is maintained within the target

Operational improvements in the process

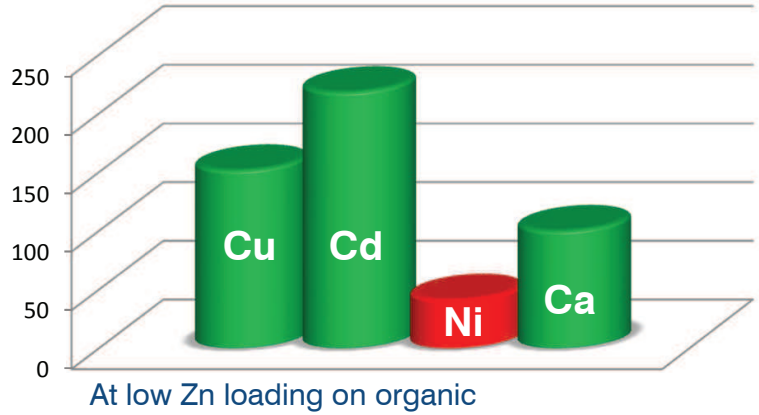
Impurity excursions

The EW process is sensitive to trace impurities.

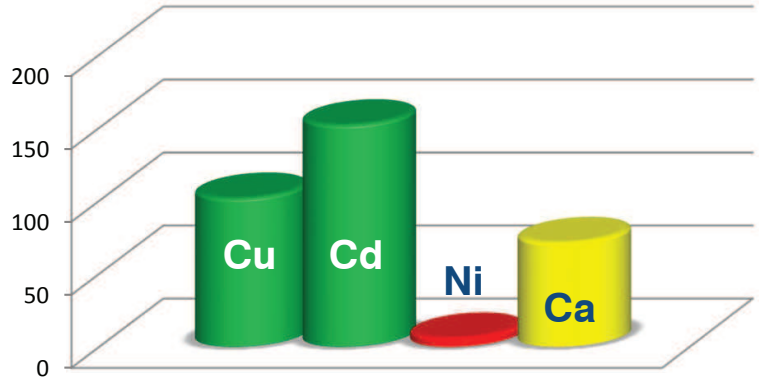
SX acts as an impurity barrier by selectively extracting zinc.

Skorpion monthly measures the selectivity of the organic for zinc versus impurities.

Organic selectivity of Zn over…



At low Zn loading on organic



At high Zn loading on organic

Conclusions

- MZP has proved successful to Skorpion Zinc SX
- High SX flows due to low PLS grades occasionally became bottleneck.
- PBCs has reduced TSS in the feed improving organic consumption.
- Temperature control, continuous monitoring of the organic phase, impeller redesign of the E2 mixer contribute to adequate zinc transfer.
- No SX fires have been reported at Skorpion Zinc. All operators have been trained for an eventual fire situation.
- Skorpion and Tecnicas Reunidas continuously cooperate for process improvements.

Skorpion Zinc

TECNICAS REUNIDAS

THANK YOU

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