Solvent Extraction Applied to Mixed Copper and Zinc Bearing Materials

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Abstract

Refined copper produced by means of solvent extraction (SX) accounts for over 20% world production and that technique has become more popular recently as new hydrometallurgical projects dealing with primary copper ores and concentrates are under evaluation or have been implemented in last years in Chile, USA, etc.

The low capital and operating costs of SX plants together with the easy operation and the production of top quality electrolytic metals close to the mine site make the economics of the SX processes very attractive, being suitable and feasible in the range of small to medium capacities, where conventional smelting process is not applicable. In some cases, the alternative of obtaining extremely pure salts may be cheaper than metals production.

Thanks to the commercial success of the Skorpion Zinc integrated refinery in Namibia, producing 150,000 t/y SHG Zn since 2003, a significant expansion of new zinc projects focused on primary and secondary materials is currently underway based on the application of ZINCEX™ solvent extraction technology.

Copper SX and zinc SX are mature and well established commercial technologies, therefore, now is the right time to afford new mining and metallurgical projects dealing with mixed or polymetallic copper and zinc ores and secondary materials. That way, this paper presents relevant design features and technical advances of two industrial projects based on SX applications: (1) Heap leaching of oxidised copper/zinc polymetallic ores to recover both metals in form of the maximum purity cathodes; and (2) Processing of flue dusts and electrofilter solid particles from copper smelters to recycle copper and zinc and rejecting some impurities like arsenic. The preliminary evaluation results have been very positive in both projects, showing clearly the technical advantages and the potential profitability to recover those metals by means of SX techniques.

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Proprietary Technology Development Division

COMPANY PROFILE - CORE BUSINESS

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TECNICAS REUNIDAS:

- Biggest Spanish Engineering & Construction Company
- 6000 Employees
- Listed on the Selective Stock Market IBEX35
- Upstream, Downstream, Natural Gas, Power, Infrastructures, Proprietary Technologies

PROPRIETARY TECHNOLOGY DEVELOPMENT DIVISION:

- Over 40 years developing Technologies for:
  - Non ferrous metals Industry
  - Electrochemistry
  - Energy
  - Nitric Acid, Ammonium Nitrate
  - Fertilizers
  - Environment

PRESENTATION OUTLINE

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1. Solvent Extraction. Reasons for Success
2. SX Applied to Copper/Zinc Materials. Pros & Cons
3. Cases Studied
   - Oxide Cu/Zn Ore Heap Leaching
   - Cu/Zn Dust Recycling
4. Laboratory Tests
5. Conclusions & Final Remarks

SOLVENT EXTRACTION

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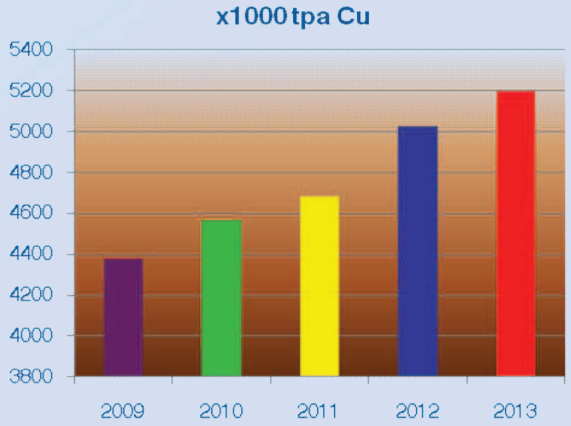
Reasons for Success

- **Innovative Technologies Industrially Proven**
- **Economical Advantages:**
  - **Low Opex**
  - **Similar or lower Capex**
- **Environmental Advantages**
- **Vertical Integration at Mine Site**



- World Copper SX-EW production (icsg)
- Skorpion Zinc SX plant 150,000tpa SHG zinc at lowest OPEX

SOLVENT EXTRACTION FOR Cu/Zn MATERIALS

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Pros & Cons:

Complex Materials → Higher Feasibility Potential

Complex Materials → Difficult Metal Separation

↓

Whole Leaching → High Efficiency

Whole Leaching → High Impurity Content

↓

SX Process

↓

Optimum Results

SX is as selective as flower picking

CASES STUDIED

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1. **Oxide Copper/Zinc Ore Heap Leaching**

2. **Copper/Zinc Dusts Recycling**

…Study of industrial application of mature SX Technologies

OXIDE COPPER/ZINC ORE

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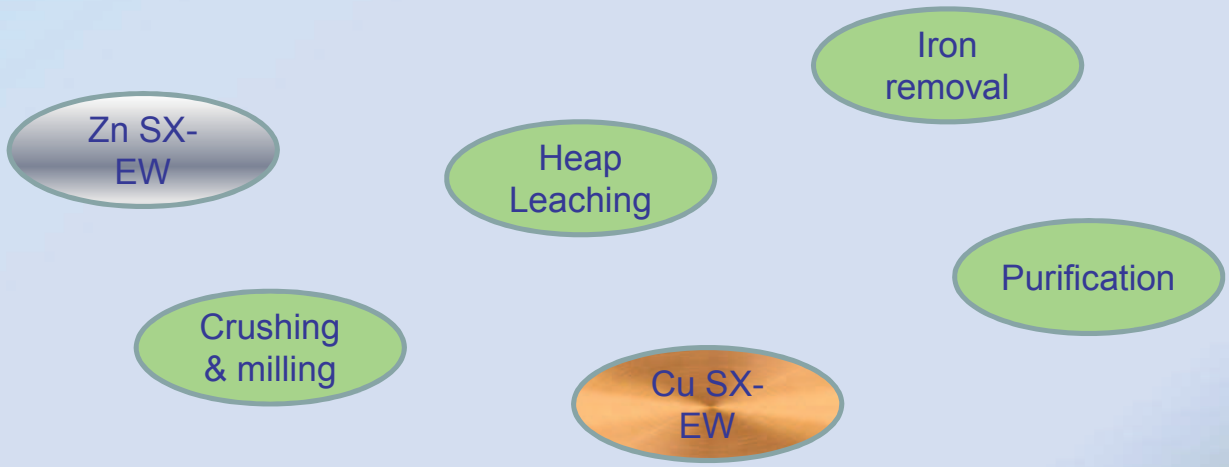
Introduction & Goals:

The study has been accomplished with average composition:

Components	Cu	Zn	Fe	Ca	Mg	Al	SiO2
Content (%)	0.4	1.6	15	21	0.5	2.5	50

Goal: Find Optimal process configuration



OXIDE COPPER/ZINC ORE

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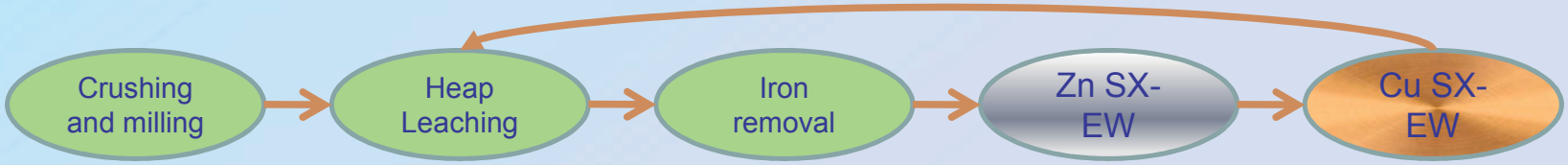
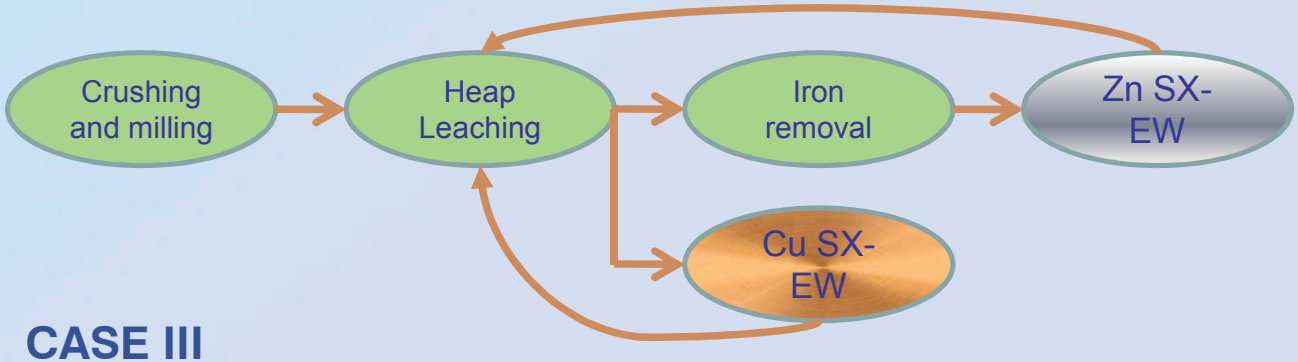
Potential Configurations:

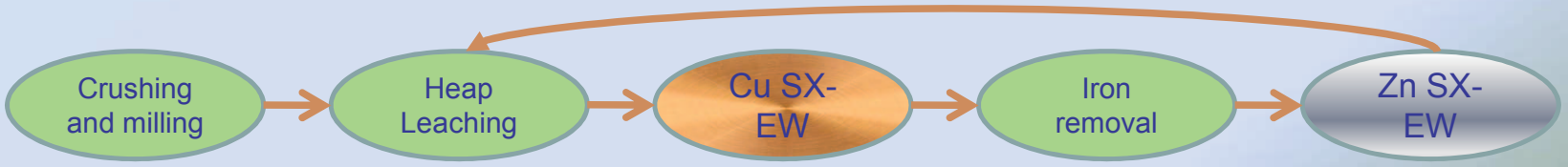
CASE I



CASE II



CASE III



OXIDE COPPER/ZINC ORE

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Developed documents:

1) **Conceptual but Complete Block Diagram**
2) **Gross mass balance**
3) **Determined Parameters:**
    - **Consumables**
    - **Energy**
    - **Wastes & Effluents**

The developed documents were used for comparison purposes

OXIDE COPPER/ZINC ORE

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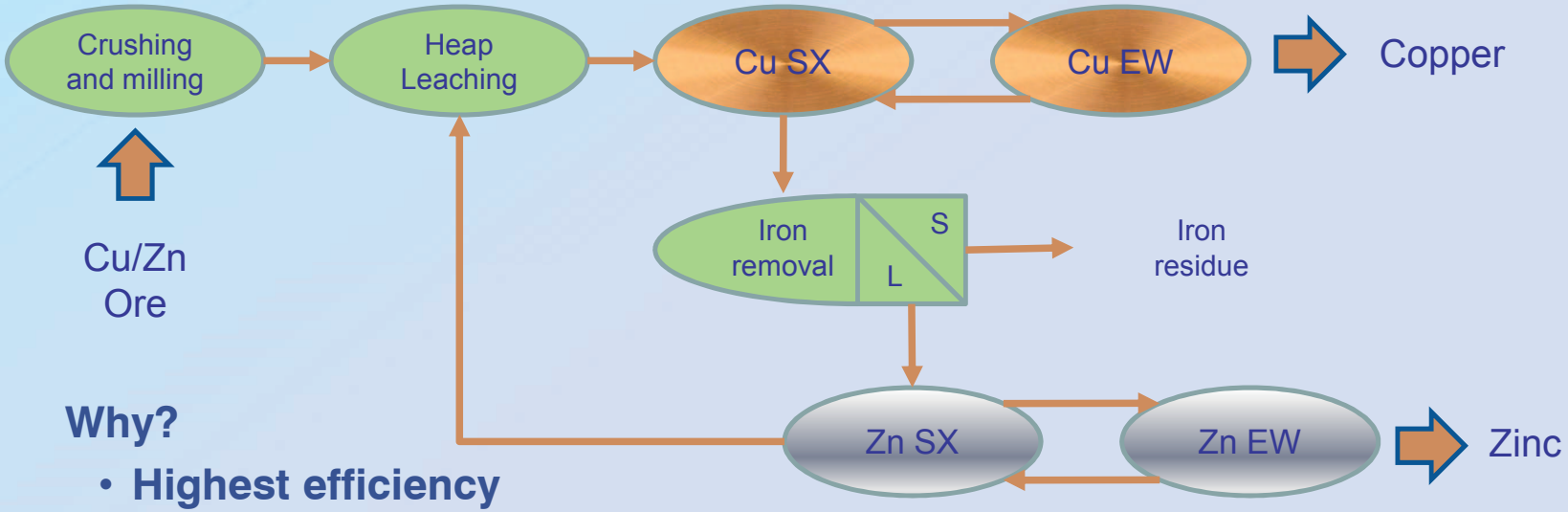
Resulting Best Method: CASE III



Why?

- **Highest efficiency**
- **Lowest Consumption**
- **Less Copper losses**
- **No need of acidic conditions that affect to selectivity**
- **Smooth and more simple**
- **Higher flexibility**

COPPER/ZINC DUSTS RECYCLING

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Introduction & Goals:

The study has been accomplished with average composition:

Components	Cu	Zn	Pb	As
Content (%)	15	9	3	13

Goal: Find Optimal process configuration to:

- **Efficient integration of Zinc-SX in existing Copper-SX plant**
- **Recycle Copper/Zinc dusts**
- **Find synergies for maximum Economical Feasibility**
- **Environmental friendly results**

COPPER/ZINC DUSTS RECYCLING

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Cu/Zn Dusts Production:

- Smelter Furnaces,
- Slag Treatment Furnaces and Converters,
- Brass and Bronze workshops
- Difuse Emissions

COPPER/ZINC DUSTS RECYCLING

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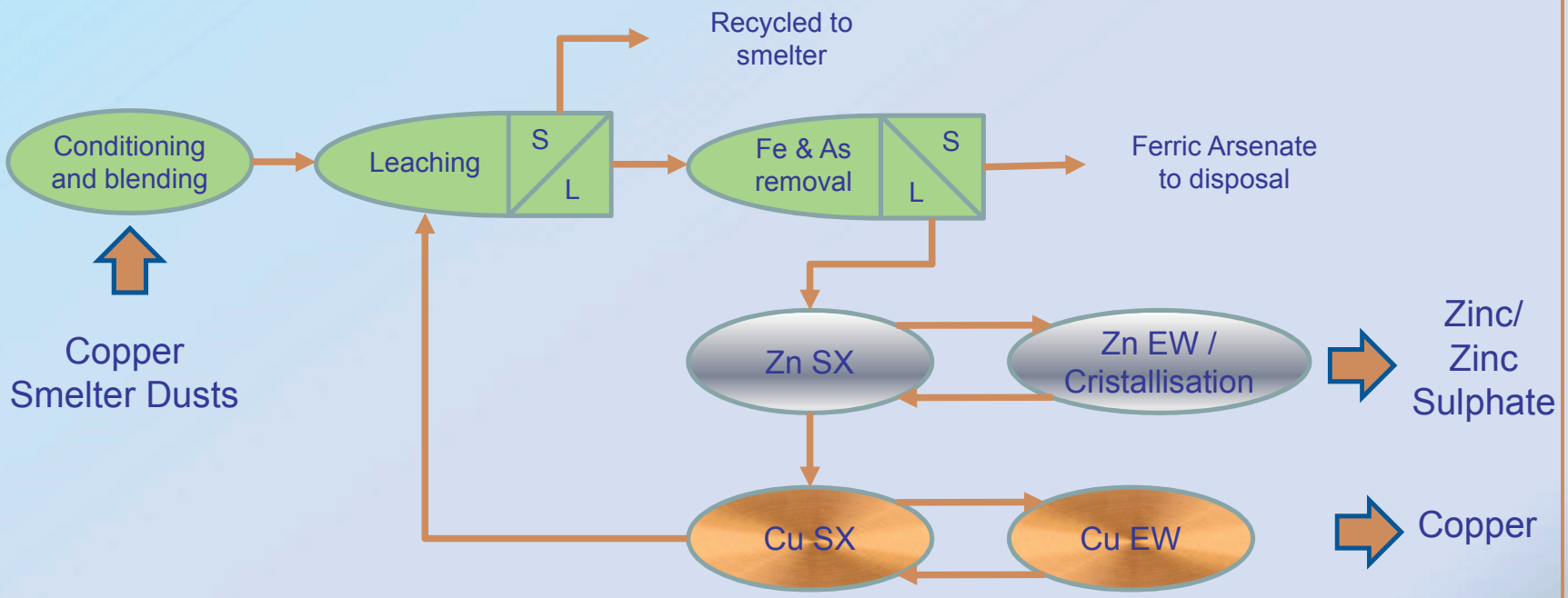
The following configuration is proposed



LABORATORY TESTS

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Very satisfactory results:

A proper design of the ZINCEX™ Technology can separate perfectly Copper and Zinc in the PLS.

- Composition Cu/Zn PLS

Components	Cu	Zn	Fe	PH
Content (%)	19 g/l	6 g/l	6 ppm	3.3

- Final SX test results: Only ppb of Copper in Zinc Electrolyte

Washing of the Organic Phase		Before	After
Organic Phase	Cu (g/l)	0.2	<<0.001
Aqueous Phase	Cu (g/l)	0	3.0

CONCLUSIONS

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- **Available:**

  Cu-SX & Zn-SX are mature and well established commercial technologies

- **Flexible:**

  Solution for new mining and smelting projects dealing with mixed or polymetallic copper and zinc materials

- **Attractive:**

  Low CAPEX and OPEX; Production of top quality electrolytic metals close to the mine site

- **Suitable:**

  Feasible in the range of small to medium capacities where conventional smelting process is not applicable

CONCLUSIONS

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- **Alternative:**

  Possibility to obtain extremely pure salts which can be more profitable

- **Efficient:**

  Deal with pregnant solutions containing copper and zinc (and other impurities) is based on the fine performance of the ZINCEX™ technology

- **Assurance:**

  Perfect separation and fully selective extraction of zinc versus copper even in solutions containing 3 more times copper than zinc

FINAL REMARKS

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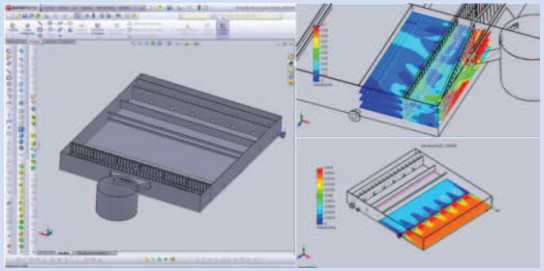
- **Tecnicas Reunidas is amenable to study the feasibility of new projects based on this proprietary Technological approach.**

- **A complete Hydrometallurgical Technology Centre is available for demonstration purposes and taylored experimental studies on suggested customer samples.**



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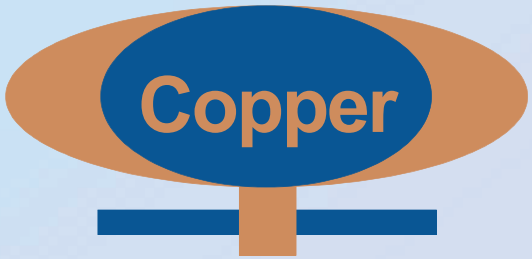

THANK YOU FOR YOUR ATTENTION