



Processing EAF Dust through Waelz kiln and ZINCEXTM solvent extraction: The Optimum Solution

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Abstract

The Waelz Kiln is the dominant technology accounting for 80% of total crude zinc oxides production worldwide from EAF dust sources. In the Waelz process EAF steel dust is mixed with solid reducing agent and lime or silica, pelletized and then it is fed to the kiln and heated to reaction temperature to volatilize the non-ferrous metals like zinc and lead, while ferrous oxides are also reduced. The main components of the Waelz oxides are volatilized oxides of non-ferrous metals (Zn, Pb, Cd, etc.) and also halogens (mainly chlorides), alkaline metals (Na, K), and some sulphur oxide.

Nowadays, the major part of Waelz oxide is used by primary zinc smelters to produce electrolytic zinc. Because halogens content in the Waelz oxide have a detrimental effect in zinc electro-winning, the zinc smelters normally request a concentration of each Cl and F not higher than 0.1% which requires a washing step. Nonetheless, the ratio of washed crude zinc oxides blended with sulphide concentrates that can be fed to the roaster is usually not higher than 10%. The direct feeding of washed Waelz oxide to the leaching is hardly applied.

The ZINCEXTM Technology developed by Técnicas Reunidas is based on zinc solvent extraction and is a perfect barrier to all metallic impurities contained in crude zinc oxides, and in addition, Mg, Ca, Halogens, Na, K, etc, are fully rejected. As a result, the ZINCEXTM plant can be fed 100% with crude or unwashed zinc oxides, plenty of impurities, representing the perfect solution to deal with Waelz oxides.

This paper describes how the Waelz Process and the ZINCEXTM Technology can be properly integrated to produce and treat Waelz oxides in order to yield SHG electrolytic zinc. Both technologies are fully developed and industrially proven in many industrial references showing very attractive business results such as lower investment and operating cost than others alternative routes.

Processing EAF Dust through Waelz kiln and ZINCEX™ solvent extraction: The Optimum Solution

By J. Ruetten, C. Frias, G. Diaz, D. Martin, F. Sanchez

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<http://emc.gdmb.de/previous-proceedings/proceedings-of-emc-2001/>

The following presentation for commercial use describes the content of this paper.

Processing EAF Dust through Waelz kiln and ZINCEX™ solvent extraction: “The Optimum Solution”

ValoRes GmbH, Germany

TECNICAS REUNIDAS, S.A., Spain
Proprietary Technology Development Division



OVERVIEW:

➤ **WAE LZ OXIDES PROCESSING THROUGH ZINCEX™**

TECHNOLOGY

➤ **INDUSTRIAL CASE STUDY**

➤ **CONCLUSIONS**



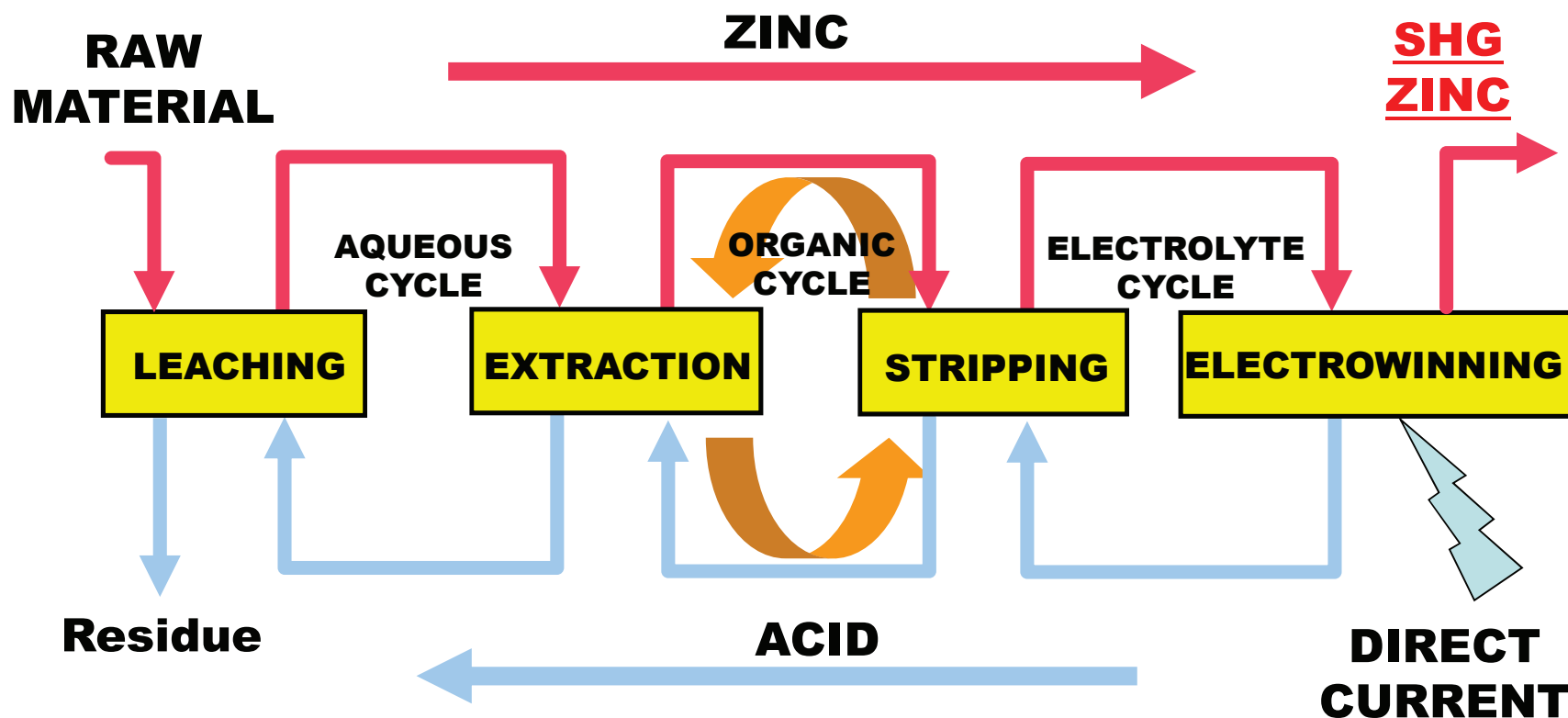
WAE LZ OXIDES PROCESSING THROUGH ZINC EX™ TECHNOLOGY

- ☺ **Feeding Waelz oxides to the ZINC EX™ solvent extraction plant is an ideal solution considering that:**
 - Prior washing of crude zinc oxides is not needed
 - Up to 100 % crude zinc oxides can be fed to the plant without any problem or limitation
 - Production of SHG Zinc quality is always guaranteed
- ☺ **The ZINC EX™ technology is highly flexible and can be adapted to diverse compositions of raw material, e.g. EAF dust (15-25% Zn), unwashed Waelz oxides (50-55% Zn), washed Waelz oxides (60-65% Zn), etc**
- ☺ **The Waelz oxides are leached in a mixed sulphate/chloride media where chloride ions are contained in the feed materials mainly as sodium and potassium chlorides**

WAE LZ OXIDES PROCESSING THROUGH ZINC EX™ TECHNOLOGY

- ☺ **Aim of this hydrometallurgical process is optimizing zinc extraction from Waelz oxides at a minimum cost, and includes the stages:**
 - **Acid leaching**
 - Lead and silver may be recovered using PLINT Process
 - **Zinc solvent extraction:**
 - Extraction
 - Washing
 - Stripping
 - **Zinc electrowinning**
 - **Bleed treatment and ancillaries**
 - Cu, Cd, Ni recovery (if economically attractive)
 - Gypsum sludge precipitation
 - Effluent: Chlorides
1. Bleeding or disposal
 2. Salts crystallisation

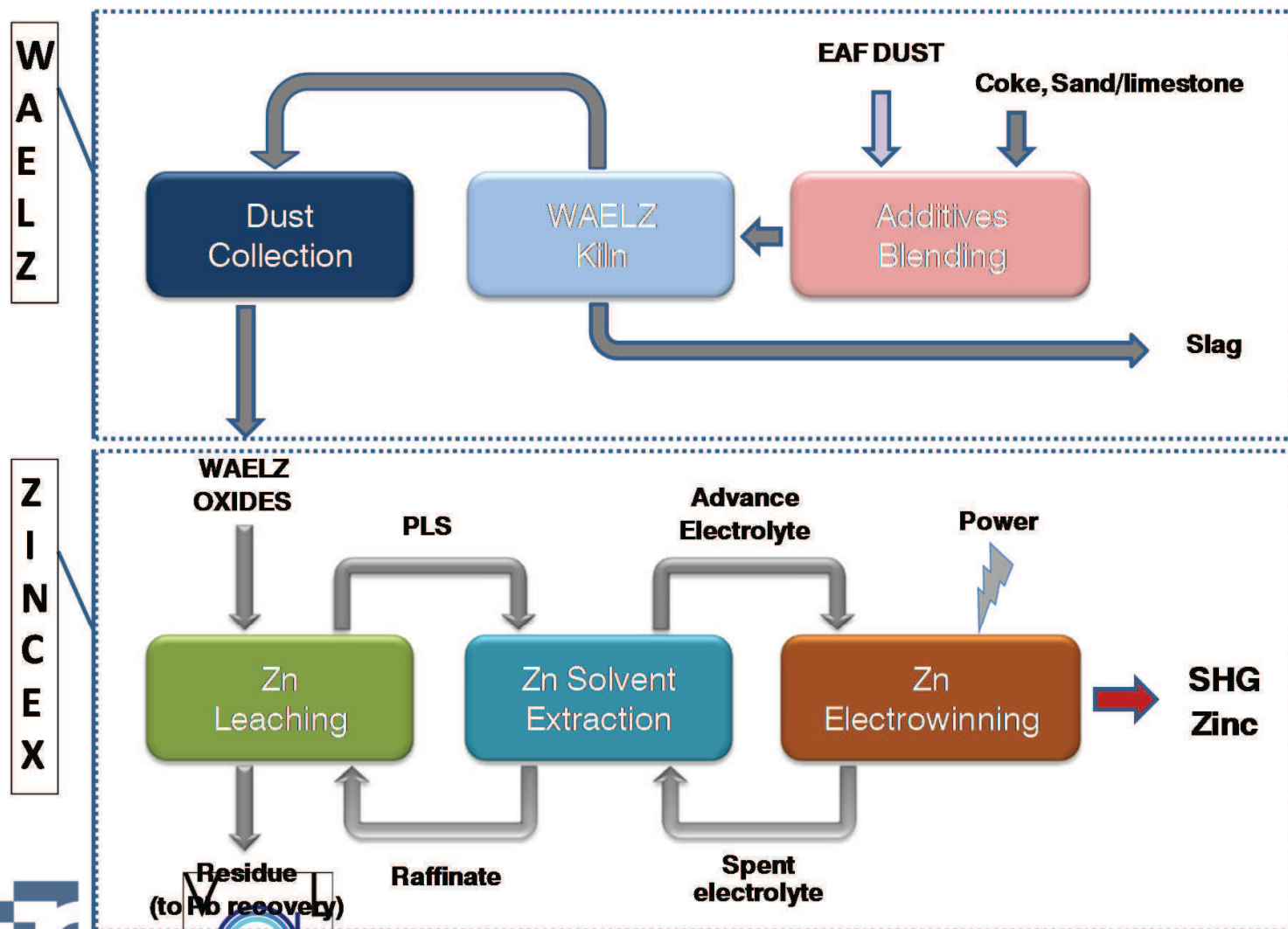
ZINCEX™ PROCESS. CONCEPTUAL FLOWSHEET



INDUSTRIAL CASE STUDY

- ☺ The case study is consisting of an integrated Waelz and ZINCEX™ factory able to process 400,000 t/a EAF dust. Relevant project basis are:
 - A treatment fee of 70 USD/t EAF dust is paid to the Waelz plant to recycle the dusts
 - The nominal capacity of the overall plant will be 100,000 t/a SHG Zinc cathodes
- ☺ A detailed engineering study has been carried out based on real data from industrial plants:
 - To determine reagent and consumable consumption from the mass balances
 - To estimate the operating cost and the investment cost of this integrated process

INTEGRATED WAE LZ KILN AND ZINC EX™ PLANT



TECNICAS REUNIDAS



PRELIMINARY ECONOMICS

☺ Operating Cost Factors

Waelz Plant		ZINCEX™ Plant	
Coke, kg/t EAF dust	190	Sulphuric acid, kg/t SHG Zn	350
Lime, kg/t EAF dust	50	Limestone, kg/t SHG Zn	240
Electricity, kWh/t EAF dust	200	Electricity, kWh/t SHG Zn	3400

	Waelz Plant (USD/t EAF dust)	ZINCEX™ Plant (USD/t SHG Zn)
Reagents and utilities	60	350
Labour	12	100
Maintenance	13	25
Contingency	20	50
TOTAL	105	525

PRELIMINARY ECONOMICS

😊 TOTAL OPERATING COSTS:

- Include reagents and consumables, manpower, maintenance and also contingency
- Results corresponding to the integrated Waelz and ZINCEX™ factory are:

- ❑ WAELZ Plant: 400,000 t/y EAF dust x 105 USD/t EAF dust = 42.0 million USD/y
- ❑ ZINCEX™ Plant: 100,000 t/y SHG Zn x 525 USD/t SHG Zn = 52.5 million USD/y
- ❑ TOTAL Opex: 42.0 + 52.5 = 94.5 million USD/y, which is equivalent to:

945 USD per tonne of SHG Zn cathodes

PRELIMINARY ECONOMICS

😊 INVESTMENT COSTS:

- Economic data extrapolated from other similar industrial projects
- Results corresponding to the integrated Waelz and ZINCEX™ factory are:

	Plant Capacity	Capex, Million USD
WAE LZ Plant	400,000 t/y EAF dust	75
ZINC EX™ Plant	100,000 t/y SHG Zn	225
TOTAL		300

PRELIMINARY ECONOMICS

😊 ECONOMIC EVALUATION:

- Zinc price for estimation: 1500 USD/t SHG Zn
- Lead and silver are not valorised
- Results corresponding to the integrated Waelz and ZINCEX™ factory are:

• YEARLY INCOME:

-(1) EAF dust treatment fee: 400,000 EAF dust x 70 USD/t EAF dust = 28 million USD/y

-(2) Zinc metal: 100,000 t/y SHG Zn x 1,500 USD/t SHG Zn = 150 million USD/y

Total income: 28 + 150 = 178 million USD/y

• **Yearly Opex:** 94.5 million USD/y

• **GROSS MARGIN:** 178 – 94.5 =

83.5 million USD/y

PRELIMINARY ECONOMICS

😊 SENSITIVITY ANALYSIS:

- Depending on zinc metal price, which is the main parameter that may affect project profitability, different scenarios can be envisaged
- In the next table is presented the effect of the zinc price on simple pay-back period:

Zinc metal price: (USD/t SHG Zn)	1,000	1,500	2,000	2,500
Gros margin: (million USD/y)	33.5	83.5	133.5	183.5
Pay-back time: (years)	8-9	3-4	2-3	1-2

CONCLUSIONS (1)

- 😊 The integration of the WAE LZ kiln and the ZINCEX™ technology represents the optimum solution to deal with EAF dusts and presents the following technical and economic advantages:
 - Since many years ago, Waelz technology is well established to treat Fe-zinc dusts, so the technical risk is minimum
 - The ZINCEX™ technology is a mature and well established technology able to treat efficiently unwashed Waelz oxides
 - Maximum flexibility with regards to raw materials composition and nature
 - The ZINCEX™ solvent extraction technology is a perfect barrier to all metallic impurities contained in Waelz oxides, and in addition, Mg, Ca, Halogens, Na, K, etc, are fully rejected

CONCLUSIONS (2)

- **Maximum purity: SHG Zn quality production is guaranteed for ever**
 - **Minimum operating costs**
 - **Minimum pay-back period, e.g. less than 3 years for average zinc price of 2,000 USD/t SHG Zn**
 - **Possibility to recover the lead and silver metals contained in the Waelz oxides through the PLINT process**
- 😊 **The positive economic results obtained in this preliminary study will facilitate the way for new business opportunities with regards to EAF dust recycling and Waelz oxides processing aiming to produce added value zinc products**

INDUSTRIAL WELZ+ZINCEX™ PLANTS

- 😊 **AKITA ZINC RECYCLING, Japan**
 - 20-25,000 t/a SHG Zn
 - In operation since Dec. 2010
- 😊 **PORTOVESME, Italy**
 - 52,500 t/a SHG Zn
 - Under construction
 - To be commissioned in mid 2012
- 😊 **HORSEHEAD, USA**
 - 135,000 t/a SHG Zn
 - Engineering design is underway



THANK YOU FOR YOUR ATTENTION!!!

