Secondary zinc

Carlos Frias* reports on a new deal for the primary zinc industry

Shortage of zinc sulphide concentrates in the market coupled with increased demand from developed and emerging countries is causing price increases that are leading the primary zinc industry to consider alternative sources of zinc under more sustainable and competitive conditions. In this way, feeding secondary zinc oxides to existing smelters represents a new deal for the zinc industry.

In fact, the percentage of secondary zinc oxides in zinc refineries' feedstock is growing in Europe, in Japan and other countries because processing of such zinc secondary materials presents very important advantages, such as:

- Recycled zinc tends to be less expensive than zinc sulphide concentrates
- Zinc secondary materials generally contain no sulphur; hence their use allows increasing roaster throughput without upgrading the acid plant
- Zinc oxides not only avoid generation of costly fatal acid (in some locations), they also consume some acid for make up
- Since secondary zinc oxides contain less iron than concentrate, their use also reduces the cost of iron removal and disposal
- Use of these zinc oxides contributes to feed diversity, thus reducing sensitivity to fluctuations in the concentrate market
- Expanding capacity to treat a range of raw materials to fully utilise installed cell house capacity
- Processing zinc secondaries is less energy intensive than sulphide concentrates.

Galvanised steel manufacture is the segment exhibiting the most growth, and makes up nearly half of total global zinc demand, which is mainly for the construction and automotive industries. Today, over 30% of world zinc comes from secondary materials, and recycling of galvanised steel by electric arc furnaces (EAF) generates large tonnages of dust; more than 6 Mt/y of filter dust waste from EAFs all over the world.

The Waelz process is the most common process to recover zinc from filter dusts from EAFs and represents 80% of the whole dust recycled. The second technology is based on rotary hearth furnaces and another new technology like Primus is being applied industrially and has the advantage of producing pig iron by-product instead of slag.

In Europe and North America, approximately 1.2-1.4 Mt/y of filter dust is produced. In 1997, in the European Union the Waelz process was used on 45% of the total amount of dust; ten years later, in 2007, the amount of dusts processed through Waelz furnaces had risen to 80-90%, totalling around 250,000 t of zinc content. Currently, in the US, the recycling ratio of dusts accounts for 50-55% of total production.

ZINC POWDER PURIFICATION (SIX PROCESS STAGES)	ZINCEX™ PURIFICATION (ONE PROCESS STAGE)
• CHLORIDE REMOVAL • Cu/Cd REMOVAL • Co/Ni REMOVAL • GYPSUM REMOVAL • MANGANESE REMOVAL • ZINC DUST UNIT (5-10% EW overcapacity; 3-5% zinc losses as cements)	• SOLVENT EXTRACTION (~15% lower OPEX and similar CAPEX; 5-10% increase production SHG zinc; 3-5% higher zinc recovery)

Figure 1

In spite of the good prospects, there are some factors that limit use of zinc recycling in primary zinc refineries: the complex composition of the dust leads to treatment difficulties and besides metallic impurities, the halogens (chloride and fluoride) cause problems since they concentrate in the electrolyte and thereby make it unsuitable for direct feed to zinc EW. Chloride attacks the anode,which is made of lead and chlorine gases may be formed and thus be a hazard to worker´s health. Thus, the maximum chloride level might be in the range 50-100 ppm for the production of high quality zinc. Typical zinc sulphide concentrates have a chloride content of 5-10 ppm while washed Waelz oxide contains above 1,000 ppm and unwashed Waelz oxides account for 5-8% chloride.

As a consequence, only washed Waelz oxides can be fed to the roaster in a primary zinc refinery after blending with sulphide concentrates in a proportion not higher than 15-20% of its total capacity, in order to keep the heat balance and the impurities under control. That limitation disappears when the ZINCEX™ technology is used to process washed or unwashed zinc oxides, in such a way that eventually a conventional zinc refinery can be fed with 100% recycled zinc.

SX - the powerful tool

The ZINCEX solvent extraction (SX) system is designed to be a "perfect barrier" for metallic impurities (Cd, Cu, Ni, Co, etc), halogens (Cl, F), alkaline metals (Na, K), and other components like Ca, Mg, Mn, etc.

In the conventional purification process using zinc powder any disturbance in the neutralisation or cementation stages may lead to Fe, Al, As, and Sb release to the zinc tankhouse with very detrimental effects. With ZINCEX any peak of Fe and Al is buffered by the organic phase, while As and Sb are not extracted at all. As a result, the electrolyte quality remains unchanged. Besides, Cl and F anions are not extracted by the organic phase, avoiding any carry to the zinc electrolytic cells.

Figure 1 shows a comparison between the conventional purification process and the ZINCEX SX process. It should be noted that only one SX process stage is equivalent to six conventional process stages. The SX process is much simpler and totally automated, requiring low labour and minimum reagent consumption.

On the other hand, the conventional purification system consumes a few kg of zinc powder per tonne of zinc product, and therefore, the zinc tankhouse is 5-10% overdesigned, having zinc losses around 3-5% in the form of zinc cements. No zinc powder is needed in ZINCEX and in consequence electrolytic zinc production and the revenue of the zinc refinery is increased by 5-10% in comparison to the conventional technology using zinc cementation.

In summary, the ZINCEX technology offers

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around 15% lower operating cost and similar capital costs compared with the conventional zinc powder purification process.

The ZINCEX technology developed by Tecnicas Reunidas has been successfully applied for zinc recovery in four industrial plants, and is based on zinc SX, which represents the ideal solution to deal with impure or crude secondary zinc oxides because it guarantees production of SHG zinc quality forever. Currently, a new ZINCEX plant treating unwashed zinc oxides from several waste sources and able to produce 20,000 t/y of SHG Zn is being implemented at Akita Zinc's refinery (Dowa Metals & Mining) at Iijima, Japan.

The conceptual processing scheme (see figure 2) is based on acid leaching of zinc from (washed or unwashed) wastes containing zinc oxides, such as Waelz Oxide, using a combination of acid raffinate and sulphuric acid. This is followed by a solution neutralisation step to remove iron and silica. Next, in the SX stage, zinc is selectively extracted from the other impurities in solution producing an ultra-pure zinc sulphate solution suitable for EW, guaranteeing SHG zinc production and decreasing energy consumption per tonne of zinc.

Another advantage of the Técnicas Reunidas technical approach to zinc secondaries is the capability to recover all valuable metals, including zinc, lead and silver, by means of proper integration of ZINCEX technology and the PLINT technology.

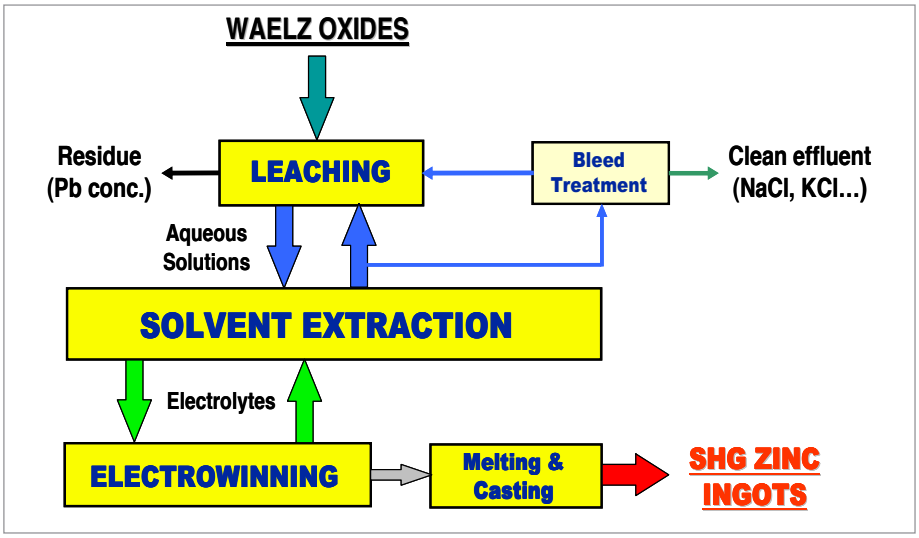

Figure 2

In conclusion, ZINCEX is a proven and commercially available technology, suitable for treating up to 100% secondary zinc oxides in existing primary zinc refineries, ensuring production of SHG zinc quality and decreasing energy consumption.

It is feasible to process any kind of washed or unwashed zinc oxides through the ZINCEX process, presenting very important environmental and economic advantages. Thus this SX technology represents the ideal solution to increase the capacity of zinc smelters in a sustainable and more economic way.

The best process performances are guaranteed by the ZINCEX process: higher zinc quality, lower power consumption, minimum labour and maintenance requirements – offering around 15% lower operating cost and similar investment costs compared with conventional zinc powder purification process. ***IM***