AUSMELT TECHNOLOGY FOR LEAD AND ZINC PROCESSING

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ABSTRACT

Ausmelt Top Submerged Lancing (TSL) Technology has gained widespread commercial acceptance in the lead and zinc industries, as an efficient and highly flexible pyrometallurgical reactor with accompanying excellent environmental performance. For the processing of lead and zinc bearing feed materials twenty one (21) Ausmelt furnaces are now in operation, under design or under construction.

With recent increases in the value of both lead and zinc and an ever increasing focus on the sustainable use of resources, interest in the processing of secondary feed material sources as well as metal containing residues has substantially increased. Ausmelt Technology has proven to be well suited to the economic recovery of values from such sources. This has for example culminated in Ausmelt’s commitment to the Whyalla Zinc project as the owner/operator of a facility for the treatment of zinc bearing secondary feeds.

This paper describes Ausmelt’s recent developments in the fields of lead and zinc processing, as well as further investigations into new processing areas, including the direct smelting of zinc concentrates. Ausmelt’s TSL Technology can now be regarded as Best Available Technology (BAT) for metal production.
1 INTRODUCTION

The lead smelting industry has been progressively moving to adopt modern process technologies to improve economic performance and to meet tightening environmental & workplace hygiene standards, and continually meeting expectations of regulatory authorities and local communities. As experienced in other non ferrous metal industries, the drive to improve economic performance has resulted in consolidation within the industry, with many smaller producers forced to close down in recent years, and this has led to the trend of increasing scale of production from the remaining operating plants [1].

Recent improvements in base metal prices have led to an acceleration of this process, in conjunction with the increasing demand for lead resulting in a number of plant expansion and new plant projects. The lead industry is also experiencing a changing feed supply pattern that has increased the need for plants to be capable of processing secondary lead materials. To meet these needs, producers are looking to flexible technologies that can process a range of lead feeds with minimal environmental and workplace impact, with low capital and operating costs.

Competition in the market place to secure concentrates is very tight, especially as the lead and zinc mine output has not been able to match the growth in demand (Figure 1). Consequently expenditure on research and development into other lead and zinc bearing feed sources is increasingly warranted.

![Zinc and Lead demand vs. mining output](image)

Figure 1: Zinc and Lead demand vs. mining output [2, 3, 4]

The deficit is met by the constant supply of recycled scrap. In today’s lead market, approximately 60% of global feeds are scrap materials, a figure which is expected to increase with increased global consumption (Figure 1). Due to the increasing awareness of lead’s toxicity and it’s impact on human health and the environment, lead has been superseded by other less harmful components such at titanium dioxide as a pigment in paints. However there has been considerable growth in the application of lead-acid
batteries, due to the increase in global vehicle fleets and of all recycled lead scrap materials over 85% is now used for the production of lead acid batteries [5]. The ideal life cycle for lead is depicted by Figure 2, also showing the life times of other scrap sources.

Zinc’s share in the Western World’s non-ferrous metals production grew from 10 to 12% in the past 20 years [5], especially due to its use for galvanizing of steel as corrosion protection. The longer life of galvanized products (such as in automobiles) however retards its recycling rate hence explains why recycling makes up only a relatively small proportion of the total feed [6].
This “Cradle to the Grave” (Figure 3) approach by many recyclers worldwide continues to fill the gap between demand and supply and in doing so reduces the environmental impacts on landfills as well as CO$_2$ emissions.

2 AUSMELT’S TSL TECHNOLOGY: BAT FOR LEAD PRODUCTION & TREATMENT OF ZINC CONTAINING MATERIALS

Ausmelt’s TSL Technology is the BAT in the non-ferrous metal production and has found wide application for the processing of primary feeds, wastes and by-products from other industries. In recent times Ausmelt Technology has been at the forefront in the modernisation of the lead industry due to the combination of great flexibility with respect to feed materials that can be treated, low capital and operating costs and impressive environmental performance [1]. Complex residue streams as well as complex end-of-life consumer products can be readily treated using Ausmelt Technology due to its versatile operation. Ausmelt Technology has the capability to accept a variety of feeds, from concentrates, recycled materials through to residues, whilst still meeting stringent environmental standards.

The relative simplicity of Ausmelt Technology makes it easy to integrate into existing flow sheets and hence provides an effective solution for operators to continue to operate efficiently in an ever increasing competitive global market. At its core is Ausmelt’s top submerged lance system that is used to inject fuel/air/oxygen into a molten slag bath. Solid feed materials are added via a feedport in the furnace roof. By the accurate control of the oxygen partial pressure, conditions can be created to effectively separate volatile species to fume, valuable non-volatile species to metal, and low value non-volatiles to a stable, environmentally friendly slag, for discard or building material. Also the recovery of heat from the post-combustion reactions is possible for the generation of electricity.

Ausmelt Technology provides an excellent solution to treat lead and zinc bearing feed materials and can be truly regarded as the closer of the material streams as depicted in Figures 2 & 3. It is viewed by the metals industry as a cost effective technology and is in commercial use world wide for the range of base and precious metals [7]. With over 20 Ausmelt furnaces in operation, under construction or under design for the processing of lead and zinc bearing feed materials, Ausmelt Technology has been proven in commercial applications. The various applications utilizing Ausmelt lead and zinc technology are summarized in Table 1.
Table 1: Ausmelt Commercial Lead and Zinc Plants

<table>
<thead>
<tr>
<th>Client</th>
<th>Location</th>
<th>Starting Year</th>
<th>Feed Type</th>
<th>Annual Throughput (t/y)</th>
<th>Product</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Votorantim Metais</td>
<td>Brazil</td>
<td>2009</td>
<td>Pb Conc. + Secondaries</td>
<td>TBA</td>
<td>Pb Bullion</td>
<td>TBA</td>
</tr>
<tr>
<td>Undisclosed</td>
<td>FSU</td>
<td>2009</td>
<td>Pb Conc.</td>
<td>TBA</td>
<td>Pb Bullion</td>
<td>TBA</td>
</tr>
<tr>
<td>Young Poong Corp. (2 furnaces)</td>
<td>Sukpo, South Korea</td>
<td>2008 (F1)</td>
<td>Pb Tailings</td>
<td>120,000</td>
<td>Pb Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Young Poong Corp. (2 furnaces)</td>
<td>Sukpo, South Korea</td>
<td>2008 (F2)</td>
<td>F1 Slag (liquid)</td>
<td>100,000</td>
<td>Pb/Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Yunnan Tin Corporation</td>
<td>Gejiu City, China</td>
<td>2008</td>
<td>Pb Conc.</td>
<td>190,000</td>
<td>Pb Bullion</td>
<td>Coal</td>
</tr>
<tr>
<td>Ausmelt</td>
<td>Whyalla, Australia</td>
<td>2008</td>
<td>Zn Leach Residue</td>
<td>55,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>2007 (F1)</td>
<td>Zn Leach Residue</td>
<td>120,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>2007 (F2)</td>
<td>F1 Slag (liquid)</td>
<td>100,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Young Poong Corp. (2 furnaces)</td>
<td>Sukpo, South Korea</td>
<td>2006 (F1)</td>
<td>Zn Leach Residue</td>
<td>100,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Young Poong Corp. (2 furnaces)</td>
<td>Sukpo, South Korea</td>
<td>2006 (F2)</td>
<td>F1 Slag (liquid)</td>
<td>100,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Hindustan Zinc Limited</td>
<td>Chanderiya, India</td>
<td>2005</td>
<td>Pb Conc.</td>
<td>85,000</td>
<td>Pb Bullion</td>
<td>Light Fuel Oil</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>2003 (F1)</td>
<td>Pb Tailings</td>
<td>100,000</td>
<td>Pb Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>2003 (F2)</td>
<td>F1 Slag (liquid)</td>
<td>80,000</td>
<td>Pb/Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Korea Zinc</td>
<td>Onsan, South Korea</td>
<td>2000</td>
<td>Pb Secondaries</td>
<td>100,000</td>
<td>Pb Bullion</td>
<td>Coal</td>
</tr>
<tr>
<td>Gold Fields*</td>
<td>Tsumeb, Namibia</td>
<td>1997</td>
<td>Low Grade Pb Conc.</td>
<td>120,000</td>
<td>Pb Bullion</td>
<td>Heavy Fuel Oil</td>
</tr>
<tr>
<td>Metaleurop</td>
<td>Nordenham, Germany</td>
<td>1996</td>
<td>Battery Paste/Pb Conc.</td>
<td>200,000</td>
<td>Pb Bullion</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>1995 (F1)</td>
<td>Zn Leach Residue</td>
<td>120,000</td>
<td>Zn/Pb Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>1995 (F2)</td>
<td>F1 slag (liquid)</td>
<td>100,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Mitsui (2 furnaces)</td>
<td>Hachinohe, Japan</td>
<td>1993 (F1)</td>
<td>ISF Slag (liquid)</td>
<td>80,000</td>
<td>Zn Fume</td>
<td>Heavy Fuel Oil</td>
</tr>
<tr>
<td>Mitsui (2 furnaces)</td>
<td>Hachinohe, Japan</td>
<td>2002 (F2)</td>
<td>F1 Slag (liquid)</td>
<td>80,000</td>
<td>Zn Fume</td>
<td>Heavy Fuel Oil</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>1992 (F1)</td>
<td>QSL Furnace Slag (liquid)</td>
<td>100,000</td>
<td>Zn/Pb Fume</td>
<td>Coal</td>
</tr>
<tr>
<td>Korea Zinc (2 furnaces)</td>
<td>Onsan, South Korea</td>
<td>2001 (F2)</td>
<td>F1 Slag (liquid)</td>
<td>100,000</td>
<td>Zn Fume</td>
<td>Coal</td>
</tr>
</tbody>
</table>

* Not presently in operation
3 THE LEAD SMELTING PROCESS USING AUSMELT TECHNOLOGY

Ausmelt Technology offers an efficient means of processing a wide range of primary concentrates and secondary lead materials to produce lead bullion, especially because the partial oxygen pressure \( pO_2 \) can be readily controlled to achieve the desired process conditions. The complete Ausmelt lead production process for primary concentrates consists of 3 process stages viz. (i) Smelting, (ii) Reduction and (iii) Fuming [1]. Depending on the scale of production all 3 stages can be carried out in a single furnace as a batch operation. Alternatively, multiple, sequential furnaces can be used to enable continuous operation. Depending upon client preference and the availability of existing furnaces it is also possible to integrate one or more Ausmelt processing stages to achieve the most efficient lead production flowsheet to best suit site requirements.

The benefits and features of Ausmelt Lead Technology compared to other lead smelting technologies lie with its submerged lance operation:

- The key to this lead technology is the ability of TSL to manipulate \( pO_2 \) accurately as dictated by the metallurgy of the relevant processing stage.

- Low capital cost relative to other technologies due to simple furnace construction & peripheral system arrangement.

- Low operating cost resulting from a combination of low energy consumption, high availability, minimal maintenance requirements and low manpower needs. The process operates with very high oxygen utilisation during the Smelting stage (> 95%) and can employ high levels of oxygen enrichment to minimise fuel consumption and offgas volume. The process does not require the use of expensive (and difficult to source) coke as a reductant and can utilise the lowest cost available fuel source.

- It has an excellent environmental performance due to low fugitive emissions from the well sealed, stationary reactor and can efficiently recover \( SO_2 \) in the form of sulphuric acid or gypsum from the concentrated process offgas stream.

- High degree of flexibility in terms of feed material blend that can be treated to optimise productivity and economic performance.

- Intense mixing, resulting in high reaction rates and high metal productivity per m\(^3\) of bath, hence a small plant footprint and easy to retrofit into existing operations.

- High annual plant availability due its relative simple operation, which is also well suited to remote locations. For optimum results the lead smelting process does need to be run astutely with the support of metallurgists with a good understanding of lead metallurgy. Ausmelt provides this training as part of it's service package.

Currently Ausmelt has two reference plants processing predominantly secondary lead feed and residues sources, including Korea Zinc’s plant in South Korea and Metaleurop’s plant in Nordenham, Germany. [8 - 12]
A further four Ausmelt plants are in operation or under design for the processing of primary lead feed materials, including HZL’s lead plant in Chanderiya, India. [13]

3.1 Overview of process

To achieve the best results from the overall lead process requires a sound understanding of the intricacies of lead metallurgy, especially to move from the first stage smelting stage to the third stage slag cleaning stage in a single vessel. A thorough understanding of slag phase relationships, the control of $pO_2$ as a function of the slag chemistry and lead activity coefficients, temperature control as well as the process dynamics is required. Figure 4 shows the slag chemistry at the given conditions, showing the importance of the oxygen partial pressure and other components on the slag operating window. As conditions change due to reduction of lead, therefore the process must be adjusted accordingly to ensure optimal conditions are maintained.

Figure 4: Target conditions during the reduction stage of Ausmelt’s TSL lead technology

Figure 5 provides a general outlay of the Ausmelt’s Three Stage Lead Production Technology from concentrates. This general arrangement can be installed for complete plant configurations, or each of the stages can be utilized individually and integrated into existing plant configurations. An example of a complete plant using this lead smelting technology is depicted by Figure 6.
The individual process stages described above can be carried out as batch or continuous operations using Ausmelt furnaces in single (see Figure 6) or multiple vessel configurations.

Other standard types of furnaces can be employed for the Reduction or Fuming Stages respectively, if these are available or preferred. For example an electric furnace can be
used for the Reduction Stage or box fumers for the fuming, although these preferably operate with a liquid slag feed. Ausmelt TSL operates well with both solid and liquid slag feed, constituting an important advantage.

3.2 Single Ausmelt Furnace

For smaller scale lead bullion production, all three unit operations can be carried out using a single Ausmelt Furnace. The size of the furnace required and the maximum throughput achievable is a function of the feed composition, in particular the quantity of slag produced per tonne of bullion and the level of zinc present in the feed. As more slag is produced and the Fuming Stage duty is increased the time available for the Smelting Stage is decreased and hence bullion production is reduced.

3.3 Two Ausmelt Furnaces

To achieve higher throughput, the process stages can be divided between 2 Ausmelt furnaces viz. (i) Furnace 1, continuous Smelting Stage and (ii) Furnace 2, batch Reduction and Fuming Stages. In this configuration Furnace 1 is operated continuously with continual removal of lead bullion through a siphon and periodic tapping of slag, matched to the processing rate of Furnace 2. The Furnace 1 slag is transferred to Furnace 2 where the Reduction Stage is conducted as a batch operation. Once this stage has been completed and bullion removed, the final Fuming Stage commences as the second batch operation in Furnace 2 (for more details on fuming see section 4).

3.4 Other Configurations

Several clients have elected to adopt Ausmelt Technology only for the continuous Smelting Stage in order to take advantage of the high productivity and efficiency of the Ausmelt Smelting process whilst also gaining the benefits of continuous process operation in terms of offgas containment and energy recovery, product composition and thermal stability. As mentioned above other types of furnace can be employed for the Reduction and Fuming Stages; for example an electric furnace can be used for slag reduction, a flowsheet that Ausmelt has developed in conjunction with Gintsvetmet, a Russian engineering institute. This is analogous to the highly successful Ausmelt copper smelting process, where an electric furnace is typically coupled with an Ausmelt smelting vessel to achieve very high process throughputs.

4 AUSMELT TSL TECHNOLOGY APPLIED TO EAF DUST RECYCLING

Ausmelt has extensive experience in the processing of zinc leach residues and zinc slags, which has culminated in commercial plant applications in Korea and Japan [8, 14, 15]. In recent work Ausmelt explored the direct processing of EAF dust with and without the addition of zinc oxide ore in a TSL furnace. The specific aim of the pilot plant study was to investigate the feasibility of smelting EAF dust and producing a discardable slag and a zinc rich fume suitable for sale, or further processing. This builds on past work done by Ausmelt [7, 16, 17]. Ausmelt TSL Technology has shown through various R&D activities as well as industrial applications to be very suitable to process for example electric arc furnace (EAF) dust, which is produced during the production of steel from scrap in an electric arc furnace (EAF) at approximately 15-20 kg of Zn/Pb per tonne of steel product.
This dust is considered a toxic waste in many countries due to the leachable heavy metals (e.g. Pb, Cr, Cd, etc.) it contains but it also has recoverable value due to the zinc (& lead) content (15-25 weight %, in some cases above 25% weight). It is estimated that the world-wide annual production of EAF dust is as high as 5 Million tonnes all of which must be treated/recycled or land filled [7]. The use of Ausmelt Technology creates from this feed in essence only benign saleable products.

4.1 Direct smelting of EAF dust

In order to investigate the direct treatment of EAF dust two process routes were investigated:

- smelting and reduction in a two stage batch process producing zinc oxide fume and a discardable slag (1% Zn) to reproduce the results from EAF trials done previously by Ausmelt, and

- continuous smelting by producing zinc oxide fume with periodic slag tapping producing a slag with 1% Zn.

In both experiments the effect on zinc recoveries, reductant coal requirements and operating temperatures between the two processes was evaluated; the results are summarized in Table 2. Previous work has indicated that the zinc in slag half life of 25 minutes is achievable for the pilot plant under the conditions selected within the zero order rate controlling regimes for zinc reduction. For the usual halide content within the EAF dust the slag produced had Cl<0.01% and F<0.5% whereas in the fume the Cl was <6% and the F ~0.5%, depending on the location and time of fume sampling.

Table 2: Inputs and Outputs for direct smelting of EAF dust in an Ausmelt Furnace

<table>
<thead>
<tr>
<th>Input</th>
<th>Zn</th>
<th>Pb</th>
<th>Fe</th>
<th>Cu</th>
<th>S</th>
<th>SiO₂</th>
<th>CaO</th>
<th>MgO</th>
<th>MnO</th>
<th>Al₂O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAF Dust (1)</td>
<td>21.6</td>
<td>1.3</td>
<td>29.5</td>
<td>0.1</td>
<td>0.5</td>
<td>5.6</td>
<td>9.3</td>
<td>2.7</td>
<td>2.2</td>
<td>0.7</td>
</tr>
<tr>
<td>EAF Dust (2)</td>
<td>25.8</td>
<td>1.9</td>
<td>24.2</td>
<td>0.2</td>
<td>0.5</td>
<td>4</td>
<td>7</td>
<td>2.5</td>
<td>2.2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Fume (1)</td>
<td>56.7</td>
<td>5.3</td>
<td>1</td>
<td></td>
<td>2.4</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fume (2)</td>
<td>59.7</td>
<td>5.9</td>
<td>0.3</td>
<td></td>
<td>1.5</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slag (1)</td>
<td>0.1</td>
<td>0.05</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Slag (2)</td>
<td>0.7</td>
<td>0.1</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

(1) Trial 1 and (2) Trial 2

4.2 Direct smelting of EAF dust with zinc oxide ore

During this pilot scale examination, a trial comprising of two cycles was conducted to evaluate the use of Ausmelt Technology for processing EAF dust/Zinc Oxide Ore to produce a zinc rich fume product and discard slag. The main aims of the pilot trial work were:

- To use Ausmelt technology to treat the Zinc Oxide Ore / EAF dust blend and confirm technical viability of the zinc fuming operation.
• To produce a quantity of fume for subsequent leach test work and product assessment.

The process was operated in two stages with changing slag conditions for a typical campaign presented by Figure 7:

• A Smelting Stage in which the blend of feeds were to be smelted at about 1300°C under sufficiently reducing conditions to fume zinc and maintain about 3-4wt% Zn in slag. Oxygen enrichment at levels of up to 40 vol% O₂ was employed for this stage.

• A Reduction Stage in which the feed blend was stopped and reductant coal addition was maintained for 30-45 minutes to reduce the zinc in slag to less than 1 wt% Zn with an ideal target of 0.5wt% zinc in slag. During this stage slag temperatures were to be maintained at 1350°C. Discard slag was tapped at the conclusion of this stage retaining sufficient bath for a further cycle.

Figure 7: Typical conditions during the reduction step showing change of ZnO in slag

Two cycles were performed to establish repeatable process control and to produce the required quantity of fume of which the summary of operation are (temperature ranges are provided with averages around 1300°C for Cycle 1 and 1350°C for Cycle 2):

• Cycle 1: (i) Smelting Stage: The operating temperature varied from 1270°C-1364°C. The feed rate was between 200 kg/h and 250 kg/h while the oxygen enrichment used
was 40%. (ii) Reduction Stage: The operating temperature ranged between 1266°C-1327°C.

- Cycle 2: (i) Smelting Stage: The temperatures ranged between 1288°C-1357°C. Oxygen enrichment was at 40%. (ii) Reduction Stage: The operating temperature ranged from 1294°C-1371°C.

The various inputs and produced outputs for this pilot test are summarized in Table 3. It is clear from the data that the ore also serves as a fluxing agent in order to produce the required metallurgical conditions for optimal furnace operation and fuming [16, 18-20].

Table 3: Analyses of inputs and outputs (weight %)

<table>
<thead>
<tr>
<th>INPUT</th>
<th>Zn</th>
<th>Pb</th>
<th>Fe</th>
<th>SiO₂</th>
<th>CaO</th>
<th>Al₂O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Bath Slag</td>
<td>0.7</td>
<td>0.1</td>
<td>36.5</td>
<td>19.6</td>
<td>10.3</td>
<td>3.1</td>
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<tr>
<td>Zinc Oxide Ore</td>
<td>38.9</td>
<td>4.6</td>
<td>3.4</td>
<td>22.5</td>
<td>6.1</td>
<td>0.4</td>
</tr>
<tr>
<td>EAF Dust</td>
<td>23.0</td>
<td>1.8</td>
<td>27.0</td>
<td>3.2</td>
<td>8.4</td>
<td>0.8</td>
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<tr>
<td>Reductant Coal</td>
<td>0.7</td>
<td>5.9</td>
<td>0.3</td>
<td>3.5</td>
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<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Slag</td>
<td>0.5</td>
<td>0.05</td>
<td>27.0</td>
<td>30.2</td>
<td>8.7</td>
<td>6.8</td>
</tr>
<tr>
<td>Fume</td>
<td>71.2</td>
<td>7.2</td>
<td>0.1</td>
<td>0.8</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Figure 8 summarizes the fuming kinetics of the two cycles of the pilot scale test also summarizing the two cycles of this pilot scale work.

Figure 8: Change of weight% Zn and %Pb with time for the two cycles
During the trial work performed on the Zinc Silicate ore/EAF dust blend, Ausmelt successfully demonstrated the treatment of the blended feed and the production of a zinc fume product of consistent high quality with Zn values in the range 68.8-72.8%. At the same time a slag with a 0.5 wt% Zn content and negligible Pb content could be produced.

4.3 Hydrometallurgical treatment of TSL flue dusts created from EAF dusts

Korea Zinc have commercially pioneered the use of Ausmelt TSL technology to innovatively close material cycles within their production facilities [21, 22], industrially realizing solutions that have been reported on by Ausmelt in the past [16, 17]. Korea Zinc recently discussed the treatment of EAF dust in their TSL reactors [17]; similar to what had been proposed by Ausmelt [16]. It was reported to be an ideal low-cost solution to the treatment of EAF dust. Figure 9 depicts the process characterized by the washing of feed and product fumes to create leachates that have to be treated. Central to the process option is TSL technology producing benign slag for construction and other useful purposes. This is the most elegant way to sluice out iron units from system eliminating the more cumbersome production of iron precipitates from the hydrometallurgical route.

This process route is required since it is directly linked to conventional sulphate electrolysis. Process options such EZINEX and ZINCEX [7] are less sensitive to halides due to their nature and hence do not require the washing steps shown in Figure 9. Ausmelt has been investigating these as more efficient than that proposed by Korea Zinc [7]. Waste heat boilers can provide steam for the hydrometallurgical plant as well as feed to electricity generation, which makes the solution depicted by Figure 9 even more economically attractive and energy efficient.

4.4 Ausmelt’s Whyalla plant

Ausmelt has recently begun modifications on its existing demonstration plant at Whyalla in Australia, which was originally designed for the AusIron® process [7], is now being converted to process residues and EAF dusts, to produce zinc fume. The Whyalla furnace is an elliptical bi-lance system and is expected to start up around the end of December 2007.
4.5 Direct Zinc Concentrate smelting

Ausmelt has been investigating the economics as well as the use of Ausmelt technology in the direct smelting of zinc sulphides. In these studies a comparison has been made with the classical RLE (Roasting-Leaching-Electrowinning) route. Recently Ausmelt has carried out numerous pilot plant trials involving the direct smelting of zinc sulphide concentrates in our pilot plant for ongoing research and development.

5 CONCLUDING REMARKS

This paper discusses various smelting technologies pioneered by Ausmelt over many years.

Continuing developments by Ausmelt not only in relation to the furnace technology but also in new process applications as well as promoting synergies between technologies is enhancing Ausmelt’s reputation as innovator.

Not only is Ausmelt establishing its own residue treatment plant in Whyalla but various new process control and furnace innovations will permit Ausmelt to remain at the forefront of lead and zinc processing.

6 REFERENCES


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