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A better flowsheet for lead smelting: the ISASMELT™-Blast Furnace process

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Lead smelting is typically carried out using a sinter plant coupled with a blast furnace. Lead concentrates are fed onto the moving grate of the sinter machine where, after ignition, the sulphides in the concentrates are converted to oxides by means of air injected through wind-boxes, producing a fully oxidised, sintered material. The sulphur in the feed is converted to sulphur dioxide, however, the concentration of sulphur dioxide in the offgas stream is relatively low due to the large volumes of air required on the sinter machine. This means that gas cleaning equipment is large and expensive and it is difficult to produce sulphuric acid from the weak SO₂ gas. It is difficult to seal the large sinter machine and so fugitive gas and dust emissions are not uncommon. The sintering process requires large, recirculating loads of sinter as diluent and coolant and the transport of the hot, dusty, recycle material back through the process creates further challenges in terms of minimising emissions.

A new processing route designed to overcome these difficulties is the ISASMELT™-Blast Furnace process, a process utilising ISASMELT™



Qujing ISASMELT in snow

TSL technology and modified lead blast furnaces. In this process, lead concentrate is fed into the ISASMELT™, which is operated to produce a high lead slag, lead bullion, and sulphur dioxide. The use of oxygen-enriched air in the process results in a low-volume offgas containing a high concentration of SO₂ suitable for sulphuric acid manufacture. The ISASMELT™ furnace

operates under negative pressure thus largely eliminating fugitive emissions. Compared to the sinter plant, the secondary ventilation requirements are significantly reduced, ventilation only being required at the small feed port and the tapping area. The amount of direct bullion produced in the ISASMELT™ furnace varies depending upon the lead content of the concentrate. For example, for a concentrate containing 70 per cent lead, over 80 per cent of the lead in feed reports to direct bullion. For concentrates containing less than 45 per cent lead it is generally preferable to produce a high lead slag only.

The slag that is produced in the ISASMELT™ furnace is intermittently or continuously tapped from the furnace and then cast, solidified, and crushed if required to enable optimum feed sizing to the blast furnace. It can be stockpiled before being fed to the blast furnace, or can be fed directly to the furnace. The de-coupling of the ISASMELT™ and blast furnace allows each furnace to operate at its optimal efficiency and allows maintenance to be performed on either furnace while the other is still operational.

The ISASMELT™ high lead slag typically consists of a molten lead silicate matrix containing solid crystals of zinc ferrite. These crystals form a protective lining for the lance and refractories in the ISASMELT™ furnace ensuring a long campaign life for the furnace before rebricking is required. The lead silicate slag is treated in a similar manner to sinter in the blast furnace, the main difference being that the additional limestone required for efficient blast furnace operation is added directly to the blast furnace.

The lead bullion produced from the ISASMELT™ furnace differs from that produced in the blast furnace mainly in



Aerial view of Qujing plant

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Qujing plant with casting machine

the fact that it contains most the silver in feed but almost none of the antimony and arsenic. This feature allows the possibility of simplifying the lead refining circuit.

The patented ISASMELT™-Blast Furnace process was first installed at the Yunnan Metallurgical Group's Yunnan Chihong's Qujing smelter in Yunnan. This process has now been in operation for over four years at this site. The combination of the ISASMELT™ TSL technology for smelting provides a high intensity environment for the rapid production of lead bullion and lead silicate slag, as well as the full capture of high strength sulphur dioxide, while the blast furnace is very efficient in converting the solid lead silicate slag to lead through the counter-current action of air passing through alternating layers of slag and coke. The net result is a highly energy efficient process for the production of lead, with optimal gas capture.

The success of the ISASMELT™-Blast Furnace process has resulted in YMG, through its subsidiary Yunnan Chihong Zn and Ge Co. Ltd, choosing this process for its Huize lead smelter project in Yunnan Province. The new 'green-field' smelter will combine an ISASMELT™ furnace with a blast furnace to smelt lead concentrates and zinc leach plant residues.

Philip Arthur, Xstrata Technology's General Manager—Pyrometallurgy, said "Xstrata's extensive experience in lead smelting includes operating a two-stage TSL at our own Mount Isa lead smelter for several years. The ISASMELT™-Blast Furnace process has distinct advantages over the two-stage TSL process. We expect it will become the technology of choice for new lead smelters to achieve low emissions and high efficiency. The intense mixing in TSL is ideal for oxidation and produces a high strength gas for sulphur capture, while blast furnaces are more efficient for reduction due to the counter-current flow of reductant gases and feed. The ISASMELT™-Blast Furnace process combines the best of both technologies, decoupling two continuous processes with an intermediate stockpile of solids". ■