Spectrum

Smelting by submerged combustion

Mount Isa Mines Ltd believes it may have found a much more energy-efficient alternative to the traditional reverberatory furnace.

It has invested more than $4 million in a pilot-plant smelter that uses 'submerged combustion' to produce 5 tonnes of lead per hour from sulfide concentrates.

Called 'Isasmelt', the process is an adaptation of CSIRO's original 'Sirosmelt' technique of submerged-combustion smelting: it uses a specially designed steel lance that is inserted into the molten charge of a furnace.

The lance provides both fuel and oxygen, which burn intensely beneath the surface of the material. This submerged combustion provides heat and the agitation necessary to stir in reductants and feed materials.

Invented by Dr John Floyd of the CSIRO Division of Mineral Engineering (now Professor of Metallurgy at Melbourne University), this new approach not only uses less energy but is also much faster than established processes that use a reverberatory furnace.

In the latter, heat reaches the charge indirectly by 'reverberating' from the roof. Slag floating on top forms an insulating barrier, and there is no agitation to speed the reaction.

Although first developed for smelting low-grade tin ores, submerged combustion is suited to the smelting of copper, nickel, iron, and lead. The novel lances can be used in existing furnaces, and the one furnace can be used for producing concentrates, recovering metal, or cleaning slags.

Mount Isa Mines Ltd is attracted by the projected fuel savings, and also expects enhanced recoveries of lead and silver. In addition, a sintering step can be avoided.

The company hopes to achieve commercial production by their Isasmelt process in the early 1990s. It is also using a 250-kg test rig at Mount Isa to investigate the smelting of copper concentrates, after collaborative work at the Division of Mineral Engineering proved encouraging.

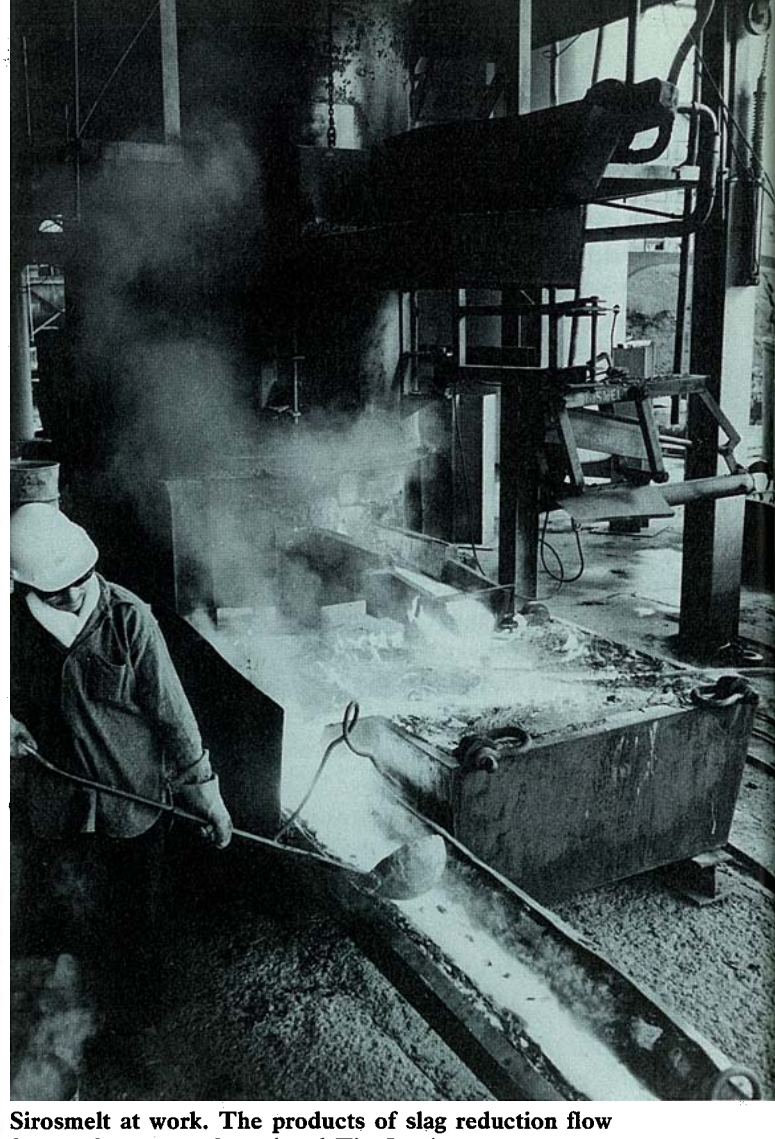
Two other Australian companies, Aberfoyle Ltd and Associated Tin Smelters Pty Ltd, have made agreements with CSIRO to develop Sirosmelt technology — mainly for extracting tin.

Well over half the tin produced in Australia today is mined from low-grade hard rock deposits. Significant amounts of tin are lost during treatment of the hard rock ore to produce the high-grade concentrate (at least 45% tin) that reverberatory furnaces need. Sirosmelt can operate satisfactorily with low-grade concentrates (down to 20% tin), permitting tin recovery to be improved by as much as 15%.

Aberfoyle has worked with CSIRO for a number of years on adapting submerged combustion to extract tin by fuming it as sulfide from low-grade concentrates or ores. The company has achieved this in its 'matte-fuming' process with a 4-tonne-per-hour pilot plant, which may soon be taken to a commercial scale.

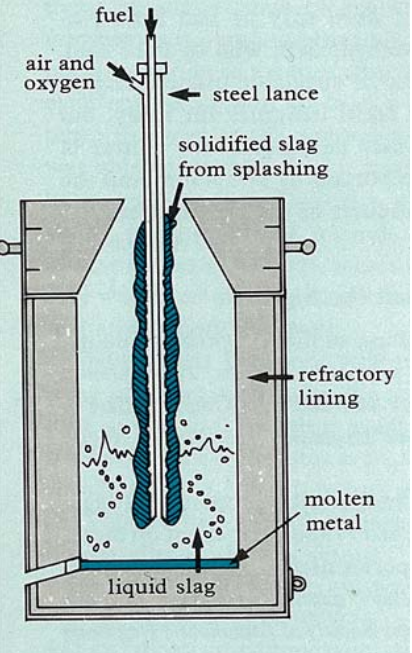
Matte fuming involves continuously feeding crushed sulfide minerals and low-grade tin concentrates into a molten pool of iron sulfide matte covered by a layer of iron silicate slag. Submerged combustion causes tin sulfide to separate off as a fume, which, after oxidation, is collected as a fine dust in a bag filter. The matte, which accumulates copper, gold, and silver, is tapped periodically.

In trials, the collected fumes contained 60%



Sirosmelt at work. The products of slag reduction flow from a furnace at Associated Tin Smelters.

Sirosmelt furnace



Turbulence is the key to Sirosmelt's rapid smelting. It is provided by fuel and air burning within the 'melt'.

tin, more than sufficient for direct feeding to a smelter. The company believes that this adaptation of Sirosmelt should allow more than 95% recovery of tin from a variety of low-grade mill products.

Associated Tin Smelters are applying submerged combustion to the smelting of tin concentrate and the recovery of tin from first-stage smelting slags, which can contain more than 10% tin. Once again, beginning with collaborative work at the Division, the company has begun trials with two prototype smelters of its own.

In slag-reduction trials at the company's Alexandria, N.S.W., centre, a 5-tonne plant achieved a level of tin in the treated slag as low as 0·4%.

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