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Antimony & Tin Recovery from Lead Processing

Joseph Grogan, CTO, Gopher Resource | June 2025

Antimony & Tin Relevance to Lead Industry

Important Components In Lead-Acid Battery Alloys

Antimony ♆

- Largest uses are Flame Retardants (50%), **Lead-Acid Batteries (35%),** and Plastics (7%)
- Main forms are antimony metal, antimony trioxide, and sodium antimonate
- Large growth in demand from Solar PV manufacturing
- Around 80k tons/yr production, down from over 150k tons/yr a decade ago
- Main global supply is from China, with 50% of mining and 80% of processing

Tin ♇

- Largest uses are Solder (50%), Chemicals (16%), Tinplate (12%), and **Lead-Acid Batteries (7%)**
- Main forms are tin alloys, pure tin, and chlorides
- Around 350k tons/yr produced
- Main global supply is from China, with 30% of mining and 50% of processing

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Antimony Price

Driver To Diversify Due to Dramatic Global Supply Chain Upset

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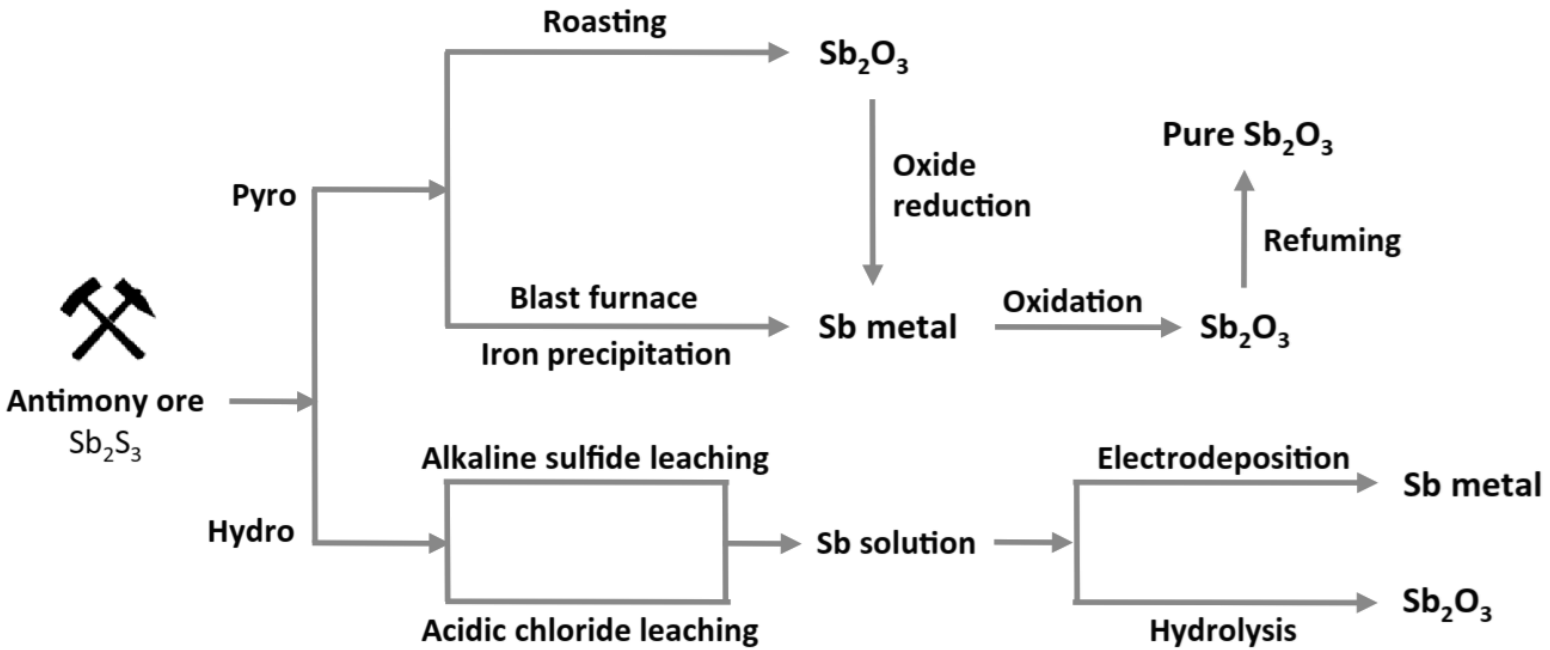
Antimony Processing

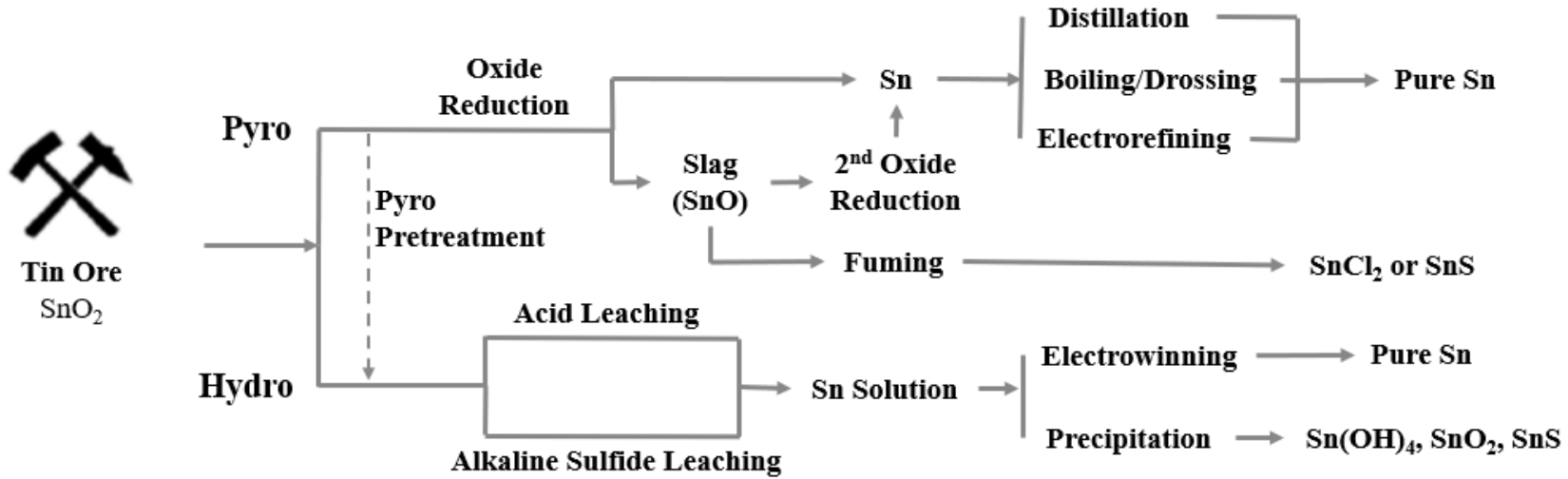
Pyro Processing Is More Common for Ores



Dupont et al., 2016

Tin Processing

Pyro Processing Is More Common for Ores



Antimony Processing of Lead-Bearing Residues

Pyro Processing Is More Common, but Hydro Has Some Advantages

Pyrometallurgy

- More common processing route used to make antimony metal, and afterwards trioxide
- Technologies based around smelting and molten refining, including vacuum metallurgy
- Feedstocks can be wide-ranging materials with varying antimony or tin content
- More accepting of a variety of feed materials

Hydrometallurgy

- Used to make products like sodium antimonate or other salts
- Technologies are leaching-based, predominantly alkaline leaching
- Process can be selective in its recovery of antimony
- More commonly used in secondary by-products than primary ore materials

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Antimony Containing By-Products

Plastics Wastes Are An Untapped Opportunity for Antimony Recovery

Flame Retardants

- Antimony is paired alongside bromine to improve its performance
- Bromine makes antimony recovery difficult
- Development of large-scale antimony recovery from this market has been largely uneconomical
- Flame retardant plastics can have antimony concentration ranges 3 - 7%, or more

Lead-Acid Batteries

- Drosses (refining slags) and dusts are typically internally recycled back to their operations furnaces as rework
- Some drosses sold to 3rd parties for tin and/or antimony recovery
- Dross antimony concentration ranges are 3 - 20%
- Most technology is pyro-based and modified from flowsheets processing primary ores

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SCRUM Process – Antimony & Tin Recovery From Wastes

Gopher Resource Won the 2023 BCI Innovation Award for Its New Technology

INNOVATION AWARD
In honor of Sally Breidegam Miksiewicz

BATTERY COUNCIL INTERNATIONAL

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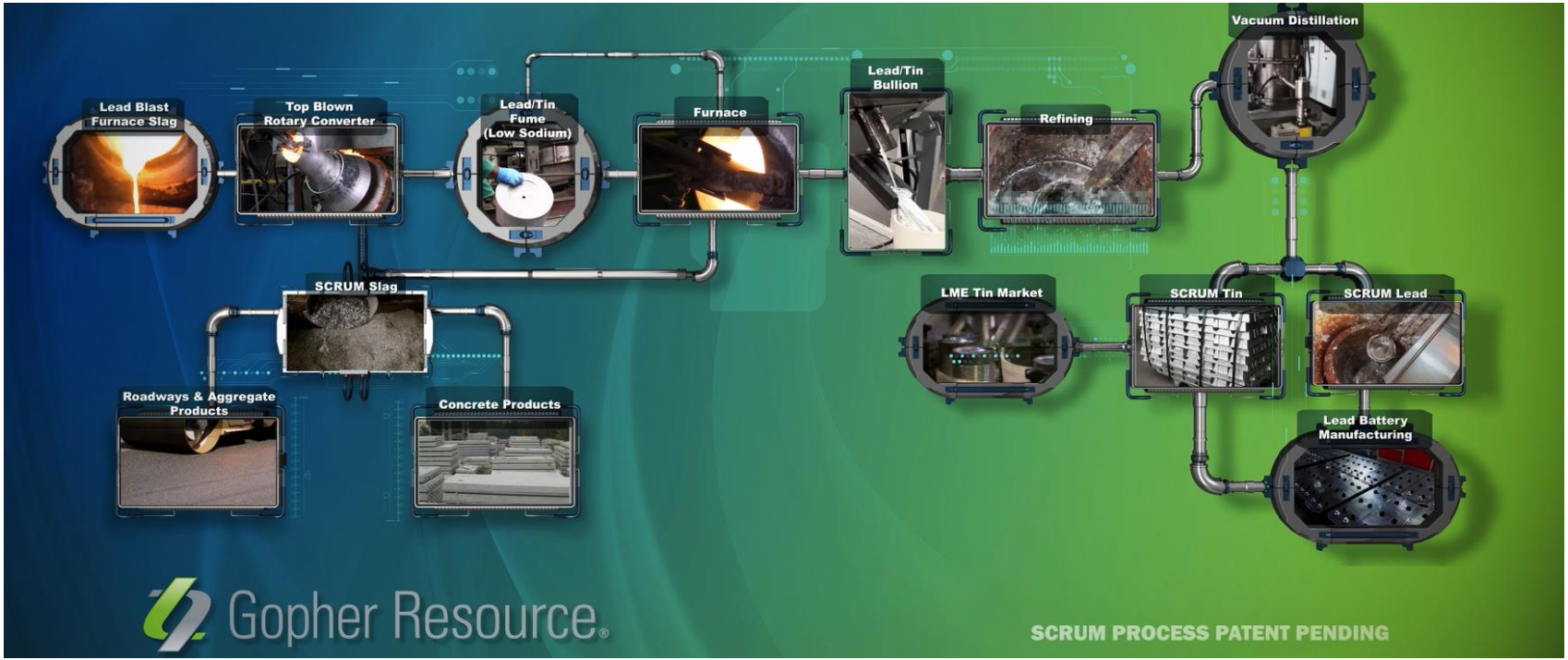
SCRUM Process – Antimony & Tin Recovery From Wastes

SCRUM Allows for Maximum Value Recovery from By-Products and Wastes



Closing Remarks

- Antimony is mostly recycled from the lead-acid battery market, of which some of the recycled volume is then entering into other markets (*e.g.*, flame retardants and solar PV cells)
- Antimony is not recycled from flame retardants in appreciable quantities
- Large amounts of Tin are lost to lead-acid battery end slags
- Abundant opportunities for collaboration to improve critical metals supply to the lead-acid battery industry
- Answers could be in joint development of projects and even economies of scale in processing lower volume/value materials

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Thank You!

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