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Reclamation of Lead from Superfund Waste Material Using Secondary Lead Smelters

Center for Hazardous Materials Research

Process Description: This process involves incorporating lead-contaminated Superfund waste with the regular feed to a secondary lead smelter. Since secondary lead smelters already recover lead from recycled automobile batteries, it seems likely that this technology could be used to treat waste from lead-acid battery contaminated Superfund sites. Such sites are very widespread and constitute a significant problem in site remediation. The overall process involves acquiring the waste material, transporting it to a secondary smelter, blending it with typical feeds, and smelting it to reclaim usable lead. A schematic of this process is shown in Figure 1.

- *Material Acquisition, Pre-processing, and Transportation*
  The first step in reclaiming lead from Superfund wastes is acquiring and transporting the material to one of the smelters. Pre-processing includes screening to remove soil, large stones, or non-contaminated debris that cannot be processed through a secondary smelter. Larger debris (>12 in.) is also removed because large material tends to remain unburnt in reverberatory furnaces.

- *Blending with Typical Furnace Feeds*
  Material is blended with typical feed prior to processing through the furnaces. Typical blend ratios range from 10% to 50% by weight, based on treatability tests and other factors, such as lead, sulfur, iron, or ash content.

- *Smelting Process*
  Smelters typically contain tandem reverberatory/blast furnace processes. The lead-containing material that is to be reclaimed is first charged to the reverberatory furnaces. They process the feed material into slag, which typically contains 60% to 70% lead, and a soft (pure) lead product.The reverberatory furnace slag is enhanced by processing it through a blast furnace. Iron and limestone are added as fluxing agents to enhance furnace production. The blast furnaces are tapped continuously to remove lead and intermittently to remove the slag. The blast slag, is transported to an offsite landfill for disposal.

- Lead produced in the blast and reverberatory furnaces is transferred to the refining process where metals are added to make specific lead alloys. The lead is then pumped to the casting operations where it is molded into ingots for use in the manufacture of new lead-acid batteries.

Waste Applicability: In general, the study demonstrated that secondary lead smelters can treat lead contaminated wastes from Superfund sites provided that the waste is reduced to the right size (less than 1/4 in.) and is not fed too quickly (at more than 50% of the smelter feedrate). Waste feed combinations of between 1% and 45% lead can be successfully fed to the secondary smelter.

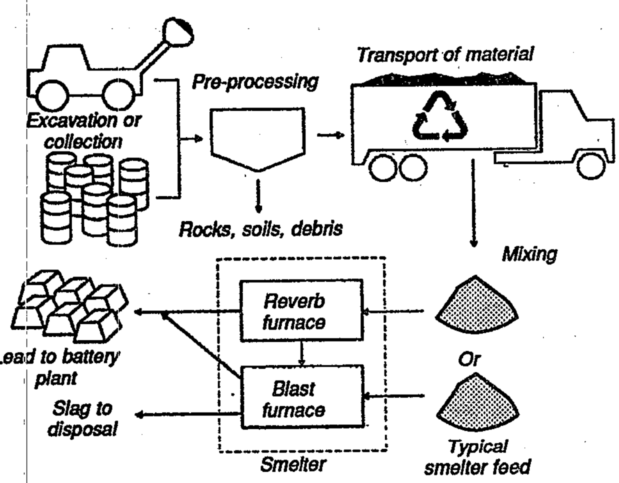

Figure 1. Schematic of reclamation process.

Test Results: Materials from three Superfund sites, a construction site, and a bridge sandblasting operation were processed during this project. Table 1 presents a summary of the materials tested and the evaluations. The feed rates are presented as weight ratios of test material to total furnace feed.

Project personnel collected samples and data to assess the furnace performance, characterize the input material, and characterize the furnace outputs. Table 2 shows the parameters that were measured and how they were obtained.

Lead was reclaimed from all test materials over a range of efficiencies, from an estimated 70% for the abrasive blasting material to 99.5% for NL Industries material.

The cost for remediating lead-acid battery sites using this technology ranged from \$35/ton to \$375/ton based on a variety of factors such as lead concentration, market price for lead, distance from the smelter, percent of test material that becomes incorporated into the final slag, iron content, BTU value of the test material, and sulfur content.

Table 1. Summary of Demonstration Sites

Source:	Tonolli Site	Hebelka Site	Demolition Waste	NL Industries Site	PennDOT
Site Type:	Integrated battery breaker, smelter, and lead refiner	Automobile junk and salvage yard	Not applicable	Integrated battery breaker, smelter, and refiner with onsite landfill	Bridge blasting operation to remove lead paint
Length of Test:	5 days	1 day	2 days	Preliminary, 4 days; full, 3 mo	1 day
Material Type:	Rubber and plastic battery cases	Rubber and plastic battery cases with some soil	Demolition debris coated with lead paint	Lead slag, debris, dross, ingots; battery case pieces, baghouse bags, pallets, cans	Iron shot bridge-blasting material
Amount Processed:	84 tons	8 tons	4 tons	Preliminary test: 370 tons full-scale test: 1200 tons	6 tons
Percent Test Material in Feed:	10%	17%	5%	20% to 50%	13%
Lead Concentration:	3.5%	14.7%	1%	Preliminary, 57%; full, 30% to 50%	3.2%
Pre-Processing:	None	Reduced to less than 1/4 in. in a hammermill	Reduced in size with a pallet shredder	Large pieces removed for processing in the blast furnace	None
Difficulties Encountered:	Attempted to process in reverb, but material was too large	None	Initial feed ratio was too high	Reverb could not process 100% waste material	Material was too moist to process in reverb furnace

Table 2. Input, Output, and Operating Parameters

Input Material Characterization	Furnace Performance Parameters	Furnace Output Parameters
Total lead (S)	Test material in the feed (M)	Lead production rates (M)
Sulfur (S)	Air flow (M)	Slag production rates (M)
Silica (S)	% oxygen enrichment (M)	Slag viscosity (O)
Calcium (S)	Fuel usage (M)	% lead in the slag (S)
Moisture content (S)	Lead inputs (S)	% sulfur in the slag (S)
Density (M)	Iron inputs (S)	Back pressure (M)
Particle size distribution (M)	% test material in feed (M)	Sulfur dioxide emissions (M)
BTU value (S)		Calcium sulfate sludge (S)

(S) = Sample (M) = Measurement (O) = Operator observation

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