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TECHNOLOGY EVALUATION

Demonstration Bulletin

COGNIS TERRAMET® Lead Extraction Process
Twin Cities Army Ammunition Plant

COGNIS, Inc

Technology Description: The COGNIS, Inc., TERRAMET® lead extraction process uses chemical leaching to remove metals bound to sands and fines in contaminated soil. COGNIS constructed a full-scale TERRAMET® lead extraction unit and was awarded a contract to remediate Site F at the Twin Cities Army Ammunition Plant (TCAAP). Before processing, particulate metal is removed by size and density separation, and sands and fines are separated from each other. TERRAMET® processing of sands and fines is performed separately. After leaching, dissolved and suspended lead present in the liquid phase is recovered, and the leaching solution (leachant) is recycled. Treated soil is transferred to the treated soil pile and is tested to determine the level of contaminants.

The first full-scale application of the TERRAMET® process was implemented at the TCAAP site. Brice Environmental Services Corporation (BESCORP) conducted the pre-leach processing. Combined processing begins when contaminated soil is introduced into a feed hopper (see Figure 1). Up to 15 tons of soil per hour is continuously fed from the feed hopper onto a conveyor belt, where it is weighed by load cells and elevated into a revolving trommel. In the trommel, the contaminated soil is sprayed with water, and particles less than 0.25 in. in diameter, including sands, fines, and some particulate lead, pass through holes near the trommel exit. The resulting slurry flows to the wet classifier, where the fines and sand streams separate. The sand is treated in a density separation process (that is, with two jigs) to remove lead and other dense material. The overflow solids from the density separation process are combined and advanced with a sand screw to the sand leaching unit. Fines are carried to a clarifier, where the mixture is flocculated and allowed to settle. Clarifier underflow is pumped to the fines leaching process. The washed, oversized fraction resulting from the trommel bypass of the leaching process, are subjected to inspection and removal of any remaining ordnance items, and are combined with treated soil.

In the COGNIS TERRAMET® sand leaching process, sands are advanced countercurrent to the leachant in a coarse material washer. Leached sand is removed from the coarse material

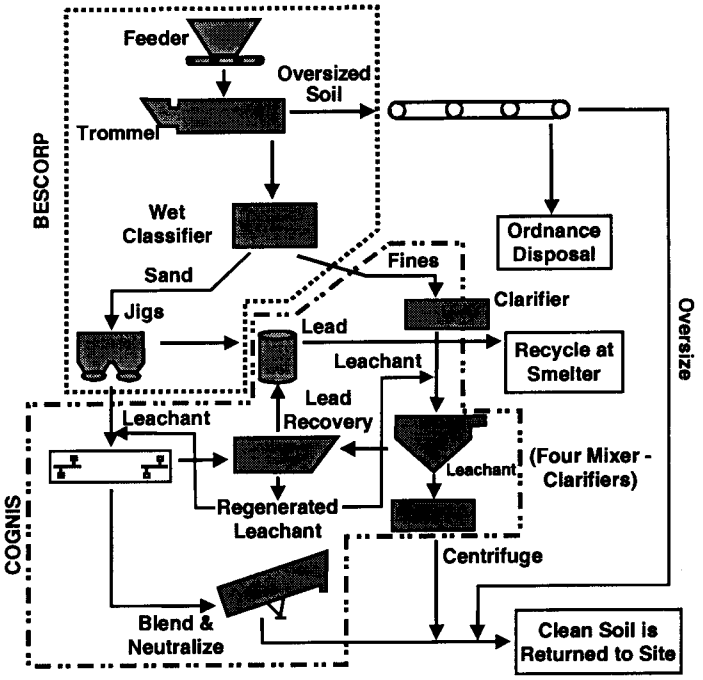

Figure 1. TERRAMET® lead extraction process

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washer by a sand screw; this sand is then neutralized by adding lime. The neutralized sand is added to the washed, oversized material on the conveyor belt and is conveyed to the treated soil pile. Leachant containing lead extracted from the sand is advanced to two cells of the lead recovery system.

In the TERRAMET® fines leaching process, the solids are mixed with the leachant in four mixer-clarifiers. In the first clarifier, fines are advanced with the leachant flow; in the remaining three clarifiers, fines are advanced against the leachant flow. Underflow from the fourth clarifier is composed of treated fines that are then neutralized and dewatered in a continuously operating centrifuge. Centrifuged solids are delivered to the treated soil pile.

Lead-bearing leachant from the fines is passed through a total of four lead recovery cells on which elemental lead is deposited, which regenerates the leachant for reuse. Lead is periodically washed from the cells; the lead is then dewatered and drummed as lead concentrate for transport to a lead smelting facility.

Waste Applicability: The TERRAMET® process is designed to treat soils contaminated with lead. However, the process design can be modified to treat soils contaminated with other metals. Treatability studies on representative material are necessary to determine the composition of the leachant and the amount of residence time required in the clarifiers.

Demonstration Results: The SITE demonstration took place at the TCAAP site from August 2 to 5, 1994, during full-scale cleanup activities. About 400 tons of soil were processed during the demonstration. A primary goal of the TERRAMET® demonstration was to determine process removal efficiencies for lead; however, removal efficiencies for other metals were evaluated as well. Samples of the following were collected: the feed soil, treated and untreated oversized soil, several lead concentrate streams, several sand and fine streams before and after leaching, and liquid streams. The samples are currently being analyzed for lead and other metals and for several soil characteristics such as particle size distribution, load bearing capacity, cation exchange capacity, alkalinity, and moisture content. Samples were also collected so that bioassays could be conducted to determine if the treated soil is toxic to earthworms and whether the treated soils can support plant growth.

Based on preliminary analytical results from the demonstration, lead levels in the feed soil ranged from 380 to 1,800 milligrams per kilograms (mg/kg). Lead levels in untreated and treated fines ranged from 210 to 780 mg/kg and from 50 to 190 mg/kg, respectively. Removal efficiencies for lead in the fines fractions ranged from 65% to 77%. Data for treated sands and oversized soils are not yet available. The COGNIS TERRAMET® and BESCORP processes operated smoothly at a feed rate of 10 to 20 tons per hour with no major problems. Size and density separation using the BESCORP process reduced the lead load to the TERRAMET® leaching process by 39% to 63%. Leaching solution was recycled, and lead concentrates were delivered to a lead smelting facility. The cost of treating contaminated soil at the TCAAP site using the COGNIS and BESCORP processes is about $210 per ton of treated soil ($219 including ordnance removal), based on treatment of 10,000 tons of soil. This estimate includes costs for mobilization/demobilization, site preparation, permitting, treatment, residual waste handling, chemical analyses, and labor.

An innovative technology evaluation report describing the demonstration and its results will be available in the fall of 1997.

For Further Information:

EPA Project Manager:
Mike Royer
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
Building #10 (MS-104)
2890 Woodbridge Avenue
Edison, N.J. 08837-3679
Telephone: (908) 321-6633; Fax: (908) 321-6640

United States
Environmental Protection Agency
Center for Environmental Research Information
Cincinnati, OH 45268

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