United States
Environmental Protection
Agency

EPA/540/MR-97/507
September 1997

EPA

SITE
SUPERFUND INNOVATIVE
TECHNOLOGY EVALUATION

Demonstration Bulletin

Molecular Bonding System® for Heavy Metals Stabilization

Solucorp® Industries Ltd.

Technology Description: The patent-pending Solucorp® Molecular Bonding System (MBS®) utilizes a solid-phase chemical stabilization process to reduce the leachability of heavy metals in soils, slags, and other solid wastes. Arsenic (As), cadmium (Cd), chromium, copper, lead (Pb), mercury, and zinc are rapidly converted to less-soluble metallic sulfides. The technology was applied ex situ during the demonstration but may be utilized with standard in situ mixing equipment; this bulletin discusses only ex situ applications.

Soil is excavated, then pretreated by screening to remove debris larger than two inches in diameter. As with other ex situ technologies, wet or clayey soils may need to be dried to improve material handling characteristics. The MBS agent, a proprietary chemical mixture, is added to the pugmill where it is blended with the soil (Figure 1). Moisture also may be added at the pugmill, to increase the moisture content of the soil to 15 to 25 percent to promote uniform mixing. Treated soil exits on a conveyor and is stockpiled.

Leachability of target metals in the treated soil is determined using the Toxicity Characteristic Leaching Procedure (TCLP) or other appropriate test, such as the Synthetic Precipitation Leaching Procedure (SPLP). Depending on chemical feed and water requirements, the volume expansion of the treated soil may range from 3 to 16 percent. The total metal concentrations in and the physical characteristics of the soil are not significantly changed by treatment. Hydrogen sulfide gas formed during the process is collected and vented through drums of specially coated carbon; a packed tower scrubber, which is more efficient, may replace the carbon if air emission standards are more stringent.

Waste Applicability: The MBS process is designed to reduce leachable heavy metals concentrations from soils or solid wastes. Certain metals present in reduced forms (e.g., As) may require treatment with an oxidizing agent to improve treatment effectiveness. As with other ex situ processes, this technology is most cost-effective for treatment of contaminants in shallow soils because the soils are readily accessible. However, excavation to greater depths, or use of in situ mixing may provide cost-effective applications of the MBS technology at certain sites. Soils or wastes with high chloride content (in excess of 15 to 20 percent) cannot be effectively treated with this technology.

Demonstration Results: The U.S. EPA National Risk Management Research Laboratory (NRMRL) Superfund Innovative Technology Evaluation (SITE) Program conducted a demonstration of the Solucorp MBS process at the Midvale Slag Superfund Site in Midvale, Utah, during the Spring of 1997. Three waste streams, contaminated with As, Cd, and Pb, were treated: Soil/Fill (SF), Slag Pile B (SB), and Miscellaneous Smelter Waste Without Brick (SW). Approximately 500 tons of each waste/soil was treated. A second test of 500 tons of SW was performed independently by Solucorp using a higher purity sulfide component in the MBS formula, after the initial demonstration of SW resulted in TCLP leachable Cd concentrations exceeding the regulatory limit of 1 mg/L. For the SW retest, Science Applications International Corporation (SAIC) performed sampling and provided oversight and analytical support under contract to Solucorp. All procedures were identical to those used by SAIC during the initial demonstration that was performed for EPA-NRMRL. EPA-NRMRL provided independent oversight and review of the SW retest results.

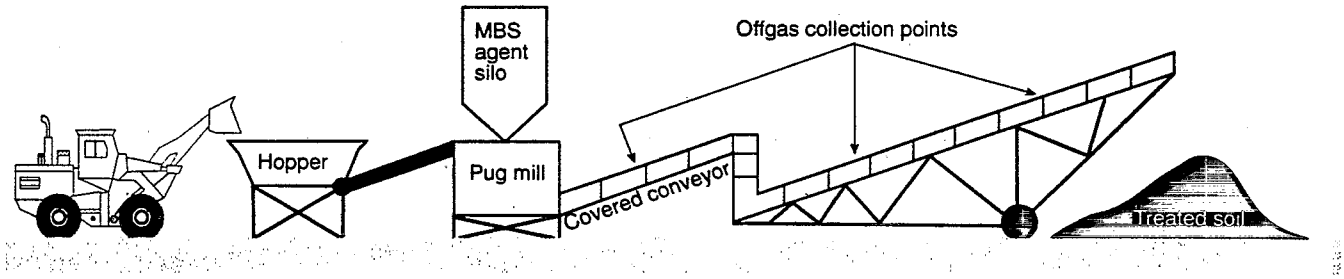

Figure 1. MBS® soil remediation process.

Printed on Recycled Paper

Because EPA-NRMRL's Quality Assurance Program has not yet reviewed the demonstration results, this bulletin presents preliminary results only. The key finding from the Solucorp MBS demonstration is that the mean TCLP leachable Pb concentration in each of the three wastes/soils was reduced to less than the TCLP regulatory limit of 5 mg/L. Table 1 presents the mean TCLP leachable Pb concentrations in the untreated and treated wastes/soils.

Table 1. Mean TCLP Leachable Pb Concentrations, mg/L

Waste/Soil	Untreated	Treated
SF	28	0.18
SB	17	0.70
SW	36	2.68
SW (Retest)	15	0.33

Other demonstration results include:

- The mean TCLP leachable As concentrations increased slightly with treatment, but were below the TCLP regulatory limit of 5 mg/L in each of the untreated and treated wastes/soils.
- The mean TCLP leachable Cd concentrations were below the TCLP regulatory limits of 1 mg/L in both the untreated and treated SF and SB; the mean TCLP Cd concentrations in the untreated and treated SW were 2.1 and 1.1 mg/L, respectively. In the SW retest, mean TCLP Cd values decreased from 0.5 to 0.01 mg/L.
- SPLP As, Cd, and Pb concentrations were below their respective regulatory limits in the treated and untreated SF, SB, SW, and SW retest.
- The mean volume increases in the treated SF, SB, SW, and SW retest were 16, 4, 13, and 14 percent, respectively, as compared to the excavated, untreated waste/soil.
- Other than dilution effects, total metals concentrations were not affected by the treatment process.
- Process throughput of untreated waste/soil averaged 52, 59, 56, and 61 tons/hour for the SF, SB, SW, and SW retest, respectively.
- Treated wastes/soils passed EPA's Multiple Extraction Procedure (As, Cd, and Pb); however, no conclusion could be drawn regarding the effect of treatment on long-term stability because there was no change in the measured leachable metal concentrations from the treated to the untreated wastes/soils.

Total costs for treatment of approximately 2 million tons of SF, SB, and SW were estimated assuming a system capacity of 10,000 tons per day. Based on scale-up from the demonstration and information from Solucorp and other sources, costs were estimated at approximately $16/ton of waste/soil at the Midvale Slag Site.

The EPA will publish an Innovative Technology Evaluation Report (ITER) and a Technology Evaluation Report (TER) in the fall of 1997. These reports will address final test results in detail, including a complete analysis of analytical and geophysical results, estimated processing costs, and observations on process reliability and operating conditions made during the demonstration.

For Further Information Contact:

Thomas J. Holdsworth, SITE Project Manager
U.S. Environmental Protection Agency
National Risk Management Research Laboratory
26 W. Martin Luther King Dr.
Cincinnati, OH 45268
(513) 569-7675

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

Official Business
Penalty for Private Use
$300

EPA/540/MR-97/507

BULK RATE
POSTAGE & FEES PAID
EPA
PERMIT No. G-35