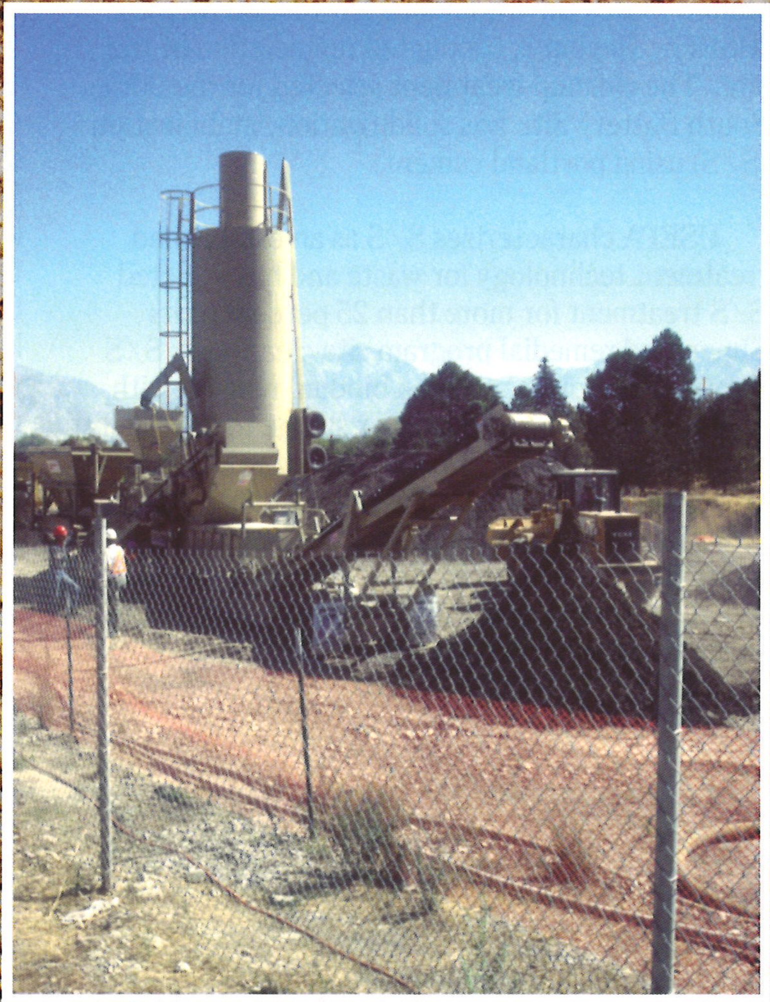
SR341

Solidification/Stabilization of Contaminated Soil



Solidification/Stabilization of Contaminated Soil

90th South Battery Site, West Jordan, Utah

During the widening of 90th Street in West Jordan, Utah, the state department of transportation discovered heavy metal-contaminated soil resulting from lead/acid-battery waste disposal in the street's right-of-way and adjacent property. The Superfund Emergency Response Branch, of the United States Environmental Protection Agency (USEPA), Region 8, conducted remediation of the site. The cleanup treatment selected for the 90th South Battery Site was solidification/stabilization (S/S) using portland cement.

USEPA characterizes S/S as an established treatment technology for waste and has selected S/S treatment for more than 25 percent of its Superfund remedial program site clean-ups. S/S treatment involves mixing a binding reagent with contaminated soil, sediment or sludge to physically, and often chemically, immobilize hazardous substances within the treated waste. Because it is an effective, readily available, and consistent, manufactured product, portland cement has been used as a S/S binding reagent for a greater variety of waste than any other reagent.

Oversize material awaiting processing by impact crusher.

Environmental contamination from industrial operations involving heavy metals has created a significant number of sites requiring remediation. Sites contaminated with waste generated by lead/acid battery reclamation are common within this group. USEPA's response at the 90th South Battery Site is a good example of the use of portland cement to remediate metal-contaminated sites. The S/S treatment prevented future environmental contamination, and the treated soil was beneficially reused as base course under a pavement at a nearby municipal landfill.

The 90th South Battery Site project involved six steps:

(1) Excavation of soil
(2) Screening and crushing of over sized pieces
(3) Soil pH buffering
(4) Mixing contaminated soil with portland cement and cement kiln dust (the S/S binding reagents)
(5) Soil testing to verify successful treatment
(6) Using the treated soil as a pavement base course.

S/S treatment system from right to left- input hopper, portland cement/CKD (reagent) silo, belt conveyor with reagent feed controls, pugmill, belt conveyor, discharge of treated soil.

Soil Contaminants, Excavation, Screening and Crushing

The contractor excavated about 2500 cubic yards (1900 m^3) of contaminated soil by conventional means. Major contaminants of the soil consisted of heavy metals, including lead and arsenic, and other metals such as aluminum, magnesium and iron. Pieces of plastic battery casings and a material resembling impure lead ingots were also found in the soil. In some places the soil was stained yellow, indicating possible contamination with battery acid.

Treated soil as discharged from S/S treatment system.

Prior to S/S treatment, all particles of both soil and debris had to be graded to less than 1-1/4 inch (32 mm) in size. To meet this requirement, the excavated material was screened through a machine known as a "grizzly." The inlet grate to the grizzly had 5-inch (130-mm) square openings. Debris greater than 5 inches was separated on entry, and the material that passed the grate was screened by a 1-1/4-inch screen. A combined total of approximately 900 cubic yards (700 m^3) of material was retained by the 5-inch grate and 1-1/4-inch screen. A closed-circuit horizontal impact crusher then reduced this material to less than 1-1/4 inch. The crushed material was remixed with the pile of minus-1-1/4-inch material using a front-end loader.

Soil pH Buffering

The pH of the soil ranged from 5 to 7. The low (5) pH of some portions of the soil was possibly the result of contamination by battery acid. To adjust the pH, approximately 5% by weight of limestone fines were mixed into the soil pile with a front-end loader. The pH of the "buffered" soil ranged from 7 to 8.

Mixing with Portland Cement

The buffered soil was then mixed with the S/S binding reagent, a mixture of 75% portland cement and 25% cement kiln dust (CKD) by weight. The soil and binding reagent were mixed together by a continuous-flow pugmill. The binding reagent was added to the soil in amounts ranging from 15% to 17% by weight. Approximately 10% by weight of water was also added for hydration of the binding reagent. The S/S treatment process used a total of 310 tons (280 metric tons) of portland cement and 104 tons (94 metric tons) of CKD.

Soil Testing

To determine the effectiveness of treatment, the contractor tested the treated soil by USEPA's Toxicity Characteristic Leaching Procedure (TCLP). The regulatory TCLP concentration maximum limit for both lead and arsenic is 5.0 ppm each. Wastes with TCLP concentrations greater than the regulatory limit must be managed as a hazardous waste. Waste with TCLP concentrations lower than the regulatory limit may be managed as a non-hazardous (solid) waste.

Treated soil (foreground) to be used as a pavement base course.

The TCLP concentrations for lead in untreated soil at the 90th South Battery Site ranged from 5 to 200 ppm. Samples of the untreated soil contained total lead concentrations between 5000 to 60,000 ppm and total arsenic concentrations up to 1600 ppm. After S/S treatment the TCLP concentrations for lead ranged from below detection limits to 0.72 ppm. For arsenic, the TCLP concentrations were undetectable. Testing indicated that no curing time was necessary to meet regulatory TCLP concentration limits.

Use of Treated Soil

Following treatment, the soil had a loose, crumbly consistency. In this condition it was transported to the Salt Lake County Municipal Waste Landfill. Rather than occupy valuable landfill space, the treated non-hazardous soil was reused as a base course under a paved area at the landfill. This pavement may eventually be used for compost sorting and handling operations. Working time from the discovery of the site contamination to transport off-site of the treated soil was eight weeks.

For more information on the use of portland cement for waste management/remediation applications contact:

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