Solidification/Stabilization Treatment of Arsenic- and Creosote-Impacted Soil at a Former Wood-Treating Site

By: Charles M. Wilk and Robert DeLisio

Two methods of mixing cement into the impacted soil were used—in-situ mixing of deep soils, and ex-situ mixing of surface soils.

The S/S-treated soil was reused as base for pavement constructed at the site.

Recent brownfield legislation and initiatives provide significant incentives for the clean-up and redevelopment of commercial properties in prime locations that have been left vacant due to environmental impacts of past industrial practices. One such site is located in Port Newark, New Jersey, one of the largest shipping ports in the New York/New Jersey area. Located within the port, this 3-hectare (8-acre) property was used for wood preserving operations from 1940 to 1991. Preservatives used at the facility included creosote and chromated copper arsenate (CCA). The property remained vacant from 1991 until redevelopment began in 2000.

Redevelopment plans called for remediation of the arsenic- and creosote-impacted soil at the site. Portland cement-based solidification/stabilization (S/S) treatment was selected to address the impacted soil. S/S treatment involves mixing cement into impacted media such as soil, sediment, or sludge, in order to physically and chemically immobilize hazardous constituents within the treated material. The U.S. Environmental Protection Agency considers S/S to be an established treatment technology. S/S technology has been selected for use at 25% of the nation's Superfund sites where the sources of contamination have been addressed. S/S is designated as

areas to a depth of 1/2 of the total depth of impacted soil. Soil removed was staged at the edge of the excavation. Cement was mixed into the remaining lower 1/2 portion of the impacted soil using an in-situ blender. The in-situ blender resembles a rototiller mounted on the end of an excavator arm. The mixing head of the blender is hydraulically rotated. Cement slurry is first mixed in a separate mixer and pumped to the blender by a grout pump. Then the slurry is delivered to the working area of the blender by a jet mounted on the arm of the excavator near the mixing head. After mixing cement into this lowest layer of contaminated soil, the final 1/2 portion of soil was added back into the excavated area and mixed. Using this mixing procedure, the contractor treated an average of 340 cubic meters (450 cubic yards) of impacted soil per day.

An 8% addition (by weight) of cement was added to the deep impacted soil. The target compressive strength for the treated deep soils was set at 170 kPa (25 psi) at 28 days. The actual average compressive strength measured on the treated material was 650 kPa (95 psi) at 7 days. A total of 3,200 metric tons (3,500 short tons) of cement were used to treat the deep soil.

Cost of treating the deep soil—including obstruction removal, stabilization, cement, winterization, environmental and safety control, and mobilization/demobilization—was $1.5 million.

Best Demonstrated Available Technology (BDAT) for over 50 RCRA-listed hazardous wastes. The technology has found increasing use at brownfield remediation projects due to the ability to reuse S/S-treated soil as an engineered fill or pavement base.

Site Impacts & Mixing Methods

Investigations at the site found free-phase creosote in "deep" soils (0.6 to 4 meters [2-12 feet]), and arsenic-impacted surface soils (0 to 0.6 meters [0-2 feet]). Two methods of mixing cement into the impacted soil were used—in-situ mixing of deep soils, and ex-situ mixing of surface soils.

In-Situ S/S Treatment of Deep Soil

Wood preserving activities involving creosote impacted a 0.8-hectare (2-acre) area at the site. Within this area, approximately 18,000 cubic meters (24,000 cubic yards) of soil was impacted with creosote from a depth of 0.6 to 4 meters (2 to 12 feet) below grade.

Treatment of these deeper soils began with stripping the top 0.6 meters (2 feet) of surface soils from the site and staging it for subsequent treatment. In-situ S/S treatment of the deep soils was carried out by mixing cement into the soil in two subsequent mixing lifts. After stripping the surface soils, crews excavated these

Ex-Situ S/S Treatment of Surface Soils and Reuse as Soil-Cement

Wood preserving activities involving arsenic compounds impacted surface soil at the site. This surface soil was treated using ex-situ mixing, which not only treated the soil for contamination but also created a construction material called soil-cement. Soil-cement is a mixture of soil, portland cement, and water compacted to a high density. It has been used in a variety of applications including base course for pavement, slope protection, ditch lining, and foundation stabilization. At this project site, the S/S-treated surface soil was reused as subbase and base course for pavement constructed at the site.

constructed pavement. The target compressive strength for the treated soil was set at 1,700 kPa (250 psi) at 7 days. The actual average compressive strength measured on the treated material was 4,000 kPa (600 psi) at 7 days. Depending on site conditions, the contractor was able to mix and place the treated soil at a rate of 150 to 500 cubic meters (200 to 700 cubic yards) per day.

Approximately 23,000 cubic meters (27,000 cubic yards) of arsenic-impacted surface soil were stripped from the surface of the site up to a depth of 0.6 meters (2 feet). This soil was mixed with cement and mixing water in a mobile pugmill erected at the site. A conveyor scale on the pugmill equipment ensured that 8% (by weight) cement was mixed into the soil. A total of 3,900 metric tons (4,300 short tons) of cement were used in this process.

Using conventional soil-cement techniques for placement, grading, and compaction, the treated soil was reused at the site as subbase and base for subsequently-

Cost of treating the surface soil—including stabilization, cement, screening/crushing, placement, compaction, environmental and safety control, mobilization, and demobilization—was $1.7 million.

Completed Remedy

As a result of the treatment, creosote- and arsenic-impacted soils were successfully treated and contained at the site, and the property was returned to use by the current operator.

The Right Choice

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Authors:
Charles M. Wilk
Portland Cement Association
Skokie, IL

Robert DeLisio
Key Environmental
Pittsburgh, PA

Design Engineer/Quality Control Engineer:
Key Environmental, Inc.
Whitehouse Station, New Jersey and Pittsburgh, PA

Contractor:
Jay Cashman, Inc.
Boston, MA

Owner:
Ciy of Newark, NJ

Photographs:
Key Environmental
Portland Cement Association

Cement Association of Canada
Association Canadienne du Ciment

60 Queen Street, Suite 1500
Ottawa, Ontario K1P 5Y7
613.236.9471 Fax 613.563.4498
www.cement.ca

PCA
Portland Cement Association
5420 Old Orchard Road
Skokie, Illinois 60077-1083
847.966.6200 Fax 847.966.9781
www.cement.org

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