

Solidification/Stabilization Treatment at the Brunswick Wood Preserving Superfund Site

By: Brian G. Farrier, U.S. Environmental Protection Agency, Region 4,
Edward C. Hicks, P.E., Black & Veatch Special Projects Corporation,
and Charles M. Wilk, Portland Cement Association

Introduction and Site History:

Solidification/Stabilization (S/S) treatment is being used as a remedy component to treat contaminated soils and sediments at the Brunswick Wood Preserving Superfund Site in Brunswick, Georgia. The United States Environmental Protection Agency (EPA) placed the site on the Superfund National Priorities List in 1997. The remedial action for Operable Unit One (OU1) of the site to address human health risk began in 2008.

The Brunswick Wood Preserving (BWP) site is an 84-acre (34-hectare) former wood treating facility. The company treated wood from 1958 until 1991 when the site was abandoned. The three major types of wood preservatives prevalent at the time were used at the site: creosote, which consists of many polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP, which is associated with dioxin), and chromium/copper/arsenate (CCA).

Wood treating activities were conducted at many areas of the BWP site, including process areas, storage areas, the rail spur that ran along the southern end of the site, and several ponds, or surface impoundments (IM). On its western end, the IM-1 pond was used during the 1960s and later buried, while the IM-2 pond is where creosote processing took place at the time operations ceased in 1991. On the site's eastern end, the IM-4 and IM-5 spray ponds were used for spent creosote disposal. Wood preservative chemicals were released to surrounding soils and surface waters as a result of these wood-treating activities.

After a fire in early 1991, the EPA responded to the BWP site and began a four-year removal action that included many activities: all but a few of the site structures were demolished and removed; sludges were dewatered; wastewater was treated; drums and lab wastes were disposed off-site; poles, lumber, equipment, and scrap metal was recycled or salvaged; and contaminated soils/sediments were excavated and stockpiled on the site in four encapsulated waste cells, each covered by a geomembrane. EPA's removal action costs were approximately \$12 million.



Pugmill Plant On Site



Screening to Remove Oversized Material

In 1997 and 1998, the State of Georgia conducted its own removal action at the BWP site, during which the contents of the three largest cells, primarily soils/sediments impacted by creosote and PCP, were



Pugmill Output Treated Material

of Resource Conservation and Recovery Act (RCRA)-listed hazardous wastes and has selected S/S treatment for 23% of its Superfund site source control remedies. Innovative mixing techniques, developed and applied at full-scale remediation projects in the U.S., have contributed to the versatility of the technology.

S/S treatment operations may be conducted either ex-situ or *in situ*. During ex-situ treatment, the waste material is first excavated then mixed with the S/S binding agent, commonly with excavators or in pugmills. Ex-situ treatment can be performed entirely on the site by a mobile treatment plant transported to the site. During *in situ* treatment, cement is mixed into the contaminated material while it remains in place, commonly with excavators, horizontal rotary soil mixers, or deep soil mixing augers.

disposed off-site. The State's removal action costs were approximately \$18.5 million.

The selected remedy for OU1 at the Brunswick Wood Preserving Site utilizes a containment strategy to encapsulate contaminants remaining on the site. Remedy components include the construction of subsurface barrier walls around the old creosote ponds located on the eastern and western ends of the site, consisting of trenches that will be filled with a soil/bentonite mix and "keyed" into the weathered limestone aquitard located 50-65 ft (15-20 m) beneath ground surface. Engineered caps will be placed over the barrier wall footprints. Groundwater outside each of the cap/wall footprints will be treated *in situ* with chemical oxidation to enhance natural degradation of contaminants. The caps will include subcaps consisting of ~75,000 cu yd (57,000 m³) of solidified/stabilized materials from the creosote impoundments, Burnett Creek, site soils (above the performance standard of 1 part per billion set for dioxin), and the remaining waste cell (which contains CCA-impacted soils). The S/S treatment is being applied to these subcap materials.

S/S treatment technology contributes to "green remediation" and the sustainable development of a contaminated property. While immobilizing hazardous constituents, the technology can also improve the construction properties of the treated material, enabling its reuse. On-site application of S/S treatment can also alleviate the concerns of surrounding communities that are often associated with the off-site transportation and disposal of contaminated materials. Finally, the technology contributes to the conservation of landfill capacity, replacement fill, and fuel used in transportation with its associated air pollutants and green house gases.

Treatment at BWP

S/S treatment at the BWP site was applied to volumes of: 11,000 cu yd (8,400 m³) of surface soils above the dioxin standard of 1 ppb, 55,000 cu yd (42,000 m³) of pond sediments, 8,000 cu yd (6,000 m³) of materials from the remaining waste cell,

S/S Treatment

S/S treatment involves mixing a binding agent, commonly portland cement, into contaminated soil, sediment, sludge, or waste. The treatment protects human health and the environment by immobilizing hazardous constituents within the treated material. Successful treatment is accomplished through physical changes to the treated material, and often, chemical changes to the hazardous constituents themselves. S/S has been used to treat a large variety of hazardous constituents in many different forms of waste and contaminated media.

The EPA has identified S/S treatment as the Best Demonstrated Available Technology (BDAT) for a variety



Treated Material Placed as Subcap



Consistency of Treated Material During Placement

and 600 cu yd (500 m³) of Burnett Creek sediments, for a total volume of approximately 75,000 cu yd (57,000 m³).

These materials were excavated and staged for treatment. An excavator was used to pre-blend the staged material with a 10% addition by weight of fly ash. The pre-blended material was then run through a 2-inch (50-mm) screen to remove oversized material. After screening, the material was processed through a pugmill used to mix in portland cement. A 10% addition of cement by weight was used. Water was added to the material during pugmilling to result in a damp soil-like consistency. The treated material was loaded directly from the pugmill into off-road dump trucks and transported to the former impoundment pond locations for placement and spreading with a bulldozer.

The objectives for the S/S treatment of contaminated material were to reduce the mobility and toxicity of the contaminants of concern and to reuse the treated material on the site as part of the capping system for the contaminated pond areas on the eastern and western ends of the site. The S/S treatment reduced the permeability of the material for use in the cap while improving its structural properties, which will contribute to the long-term protectiveness of the remedy and facilitate possible future site redevelopment.

Performance standards for the S/S treatment included: unconfined compressive strength (UCS) of at least 100 psi (0.70 MPa) at 28 days, hydraulic conductivity of less than 1×10^{-6} cm/sec by falling-head permeability test, and no significant increased leaching of contaminants of concern by Synthetic Precipitation Leaching Procedure (SPLP). Quality control tests include UCS tests on every 500 cu yd (400 m³) treated and permeability and leachability tests on every 1000 cu yd (800 m³) treated. Full-scale mixing began after an initial pilot scale session lasting several weeks, which verified the

achievement of performance standards using the mix design.

Reuse of S/S-Treated Material in Capping System

The remedy includes the construction of caps over the former impoundments (IMs) on the eastern and western ends of the site. The caps will extend significantly beyond the footprints of these former ponds. The footprints were established by an informal groundwater standard of 1000 ug/L of total semi-volatile organic compounds (SVOCs) to capture groundwater contamination within the barrier walls.

The capping system consists of subcaps, geosynthetic clay liners, and a 2.5 foot (0.76 m) thick vegetative soil layer. S/S treated material was used as the construction material for the subcaps. Freshly mixed S/S-treated material was discharged from the pugmill into dump trucks and transported to the former impoundment areas where the material was dumped and then spread/compacted by bulldozer. Successive layers of the material were placed to form subcaps at least 3 feet (0.9 m) thick over the pond footprints themselves. A geosynthetic clay liner will be installed on top of the subcaps, and a 2.5-foot (0.76-m) soil layer will be placed on top of the geosynthetic clay liner as a vegetative soil cover.

The use of S/S treatment technology in the remedy contributes to the future redevelopment options of the property. The strength of the capped areas resulting from the cement-treated subcaps will support the replacement of a former rail spur across the western wall/cap, while the eastern wall/cap will accommodate a potential concrete parking area. On-site management of the 75,000 cu yd (57,000 m³) of S/S-treated material avoided nearly 4,200 dump truck roundtrips for transport of the material for off-site disposal and of replacement fill.



Treated Material After Curing

Additional Information

For more information contact:

Brian G. Farrier, Remedial Project Manager, USEPA Region 4 at
farrier.brian@epa.gov

Edward C. Hicks, P.E., Project Manager, Black & Veatch Special
Projects Corporation at hicksec@bv.com

Charles M. Wilk, Program Manager, Waste Treatment, Portland
Cement Association at (847) 972-9072 or cwilk@cement.org

Project Credits

Environmental Engineering and Remediation Design:

Black & Veatch Special Projects Corporation, Atlanta, Georgia

Solidification/Stabilization Contractors:

Garrett Consulting, Incorporated, Dallas, Georgia

Greenleaf Environmental Services, Buford, Georgia

Solidification/Stabilization Mix Design:

Shaw Environmental & Infrastructure, Baton Rouge, Louisiana

Regulation and Oversight:

United States Environmental Protection Agency, Region 4,
Atlanta, Georgia



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

An organization of cement companies to
improve and extend the uses of portland
cement and concrete through market
development, engineering, research,
education, and public affairs work.



Cement
Association
of Canada Association
Canadienne
du Ciment

www.cement.ca