Remediation Technology: Solidification/Stabilization

Cement Association of Canada
Association Canadienne du Ciment

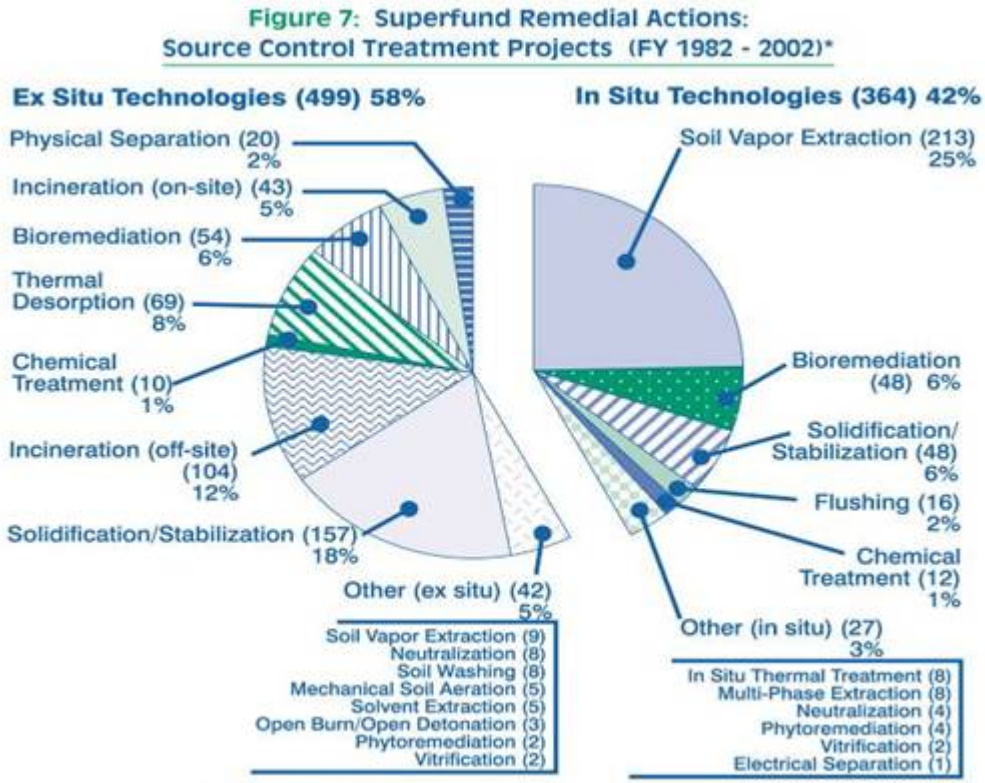
PCA
Portland Cement Association

What is Solidification/Stabilization?

- S/S treatment protects human health and the environment by immobilizing hazardous constituents within treated material.
- Involves mixing portland cement into contaminated media such as soil, sediment, sludge or industrial waste.

- Established treatment technology.
- Selected by USEPA for 24% of Source Control Remedies in the Superfund Program.
- One proven technology treats a wide variety of hazardous constituents.
- Remediation of Brownfield Sites enabling them to be redeveloped.
- Cost effective – treated material can often be used at the site.

USEPA Superfund Remtech Selection Rates



*Includes information from an estimated 70% of FY 2002 RODs.
Sources: 3, 4, 5, 7, 11. Data sources are listed in the References and Data Sources section on page 50.

Table I. Effectiveness of S/S on General Contaminant Groups for Soil and Sludges.[4]

	Contaminant Groups	Effectiveness
Organic	Halogenated volatiles	❑
	Non-halogenated volatiles	❑
	Halogenated semivolatiles	■
	Non-halogenated semivolatiles and non-volatiles	■
	PCBs	◆
	Pesticides	◆
	Dioxin/Furans	◆
	Organic cyanides	◆
	Organic corrosives	◆
Inorganic	Volatile metals	■
	Non-volatile metals	■
	Asbestos	■
	Radioactive materials	■
	Inorganic corrosives	■
	Inorganic cyanides	■
Reactive	Oxidizers	■
	Reducers	■

Key: ■ Demonstrated Effectiveness: Successful treatability test at some scale complete.
◆ Potential Effectiveness: Expert opinion that technology will work.
❑ No Expected Effectiveness: Expert opinion that technology will/does not work.

Solidification/Stabilization of Constituents

- **Inorganic**
  - Portland cement chemically reacts with water.
  - Hazardous constituents are made less soluble or less toxic.
  - Hazardous constituents are encapsulated in cement matrix.
  - Reduction of hydraulic conductivity and surface area.
- **Organic**
  - Physical Binding of Contaminants: Solidification.
  - Decrease Hydraulic Conductivity.

Feasibility and Mix Design Tests

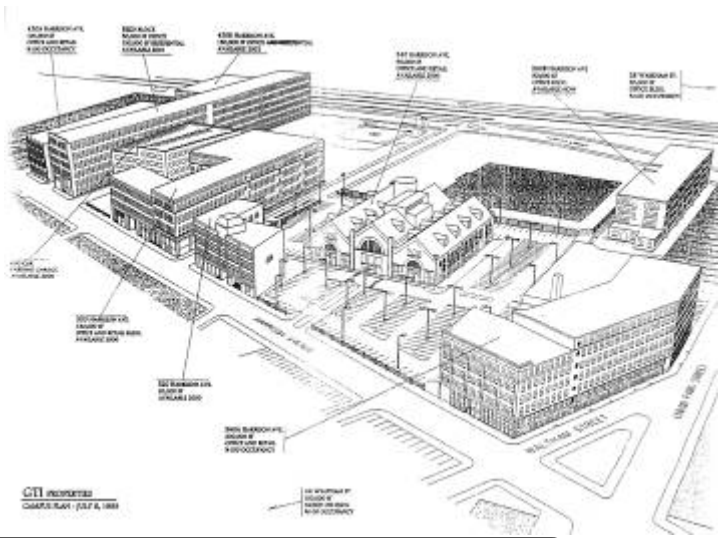
Chemical

- Toxicity Characteristic Leaching Procedure (TCLP)
- Synthetic Precipitation Leaching Procedure (SPLP)
- Acid Neutralization Capacity
- Multiple Extraction Procedure
- Equilibrium Leach
- Dynamic Leach

Physical

- Paint Filter Test (PFT) – free liquids
- Liquid Release Test (LRT)
- Moisture Content
- Density
- Hydraulic Conductivity – material movement
- Unconfined Compressive Strength – measure of free liquids & durability
- Freeze-Thaw & Wet-Dry Durability

Brownfield Site, Boston, MA



- Former Electric Generation Site
- Flyash Fill Contaminated Site with As, Pb & Petroleum Products
- Remedy- On-site Ex-situ S/S treatment
- Reuse of treated material saved $500,000 USD

Former Western Steel Site, Vancouver, BC

- The sources of the waste were from on-site settling ponds used for containment of electric arc furnace dust.
- 50,000 tonnes of Pb, Cd, Zn contaminated soil and sediment.
- Leachable concentrations of metals exceeded regulatory limits.
- Characteristic waste treated to non-hazardous enabling disposal

Treatment Results - TCLP

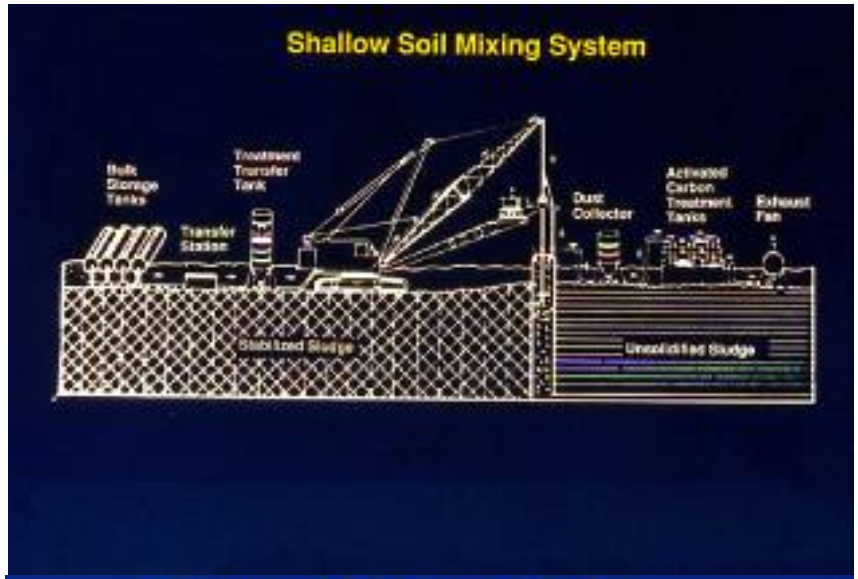
	Untreated (mg/L)	Regulatory Limit (mg/L)	After *Treatment* *(mg/L)*	Percentage *Reduction* *(%)*
Cd	1.2	0.5	*<0.05*	*-98%*
Pb	14	5	*<0.1*	*-99%*
Zc	250	500	*<0.05*	*-99%*

Former MGP Site, Augusta, GA

- In-situ Auger Mixing
- Coal Tar Contamination
- Site - 1.8 hectares
- S/S of Soil Below Groundwater Table
- Depth - 9 meter

In-situ Cement-based S/S Mixing Process

- Soil Mixing
- Conventional foundation improvement Equipment



Former MGP Site, Cambridge, MA

- In-Situ Treatment
- Coal Tar Contamination
- Depth- 9 meter

Former Battery Breaking Site- Brandon, MB

- The City of Brandon. 10,000 meter^2 site, occupying almost a city block, was home to a local company that broke up lead cell batteries.
- Cement-based S/S successfully remediated 600 tonnes of contaminated soil.
- Result - stable, non-hazardous material accepted by the local landfill.
- City of Brandon is eager to see this property back in service, location is very central and
- An optimal location for their police and fire services.

Former Wood Preserving Site Port Newark, NJ

- Arsenic and Creosote
- 18,000 m^3
- In-situ and Ex-Situ Mixing Methods
- Reuse of treated material

Former Wood Preserving Site Port Newark, NJ

Port Newark reuse of treated soil as pavement base

Naval Construction Battalion Center, Gulfport, MS

- Agent Orange Storage
- Dioxin-Contaminated Ditch Sediment
- Treated using Road Reclaimer
- Capped with RCCP

NY/NJ Harbor Dredge Reuse

- Millions of Cubic Meters
- S/S treatment and reuse as engineered fill
- Jersey Gardens Mall
- Bayonne Golf Course

NY/NJ Harbor Dredge Bayonne Golf Course

New Bedford Harbor, MA

- Treatment of Harbor Sediment
- <50 ppm PCB-Contaminated Sediment
- Reuse of treated material as fill for bulkhead

Sydney Tar Ponds Project, Sydney, NS

STP Project Schedule

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Design Engineering	■	■	■							
Environmental Assessment		■	■							
Dismantle Domtar Tank	■	■	■							
Preventive Works:										
Rerouting Coke Ovens Brook	■	■								
Demolition Cooling Pond	■	■								
Relocate Victoria Road Water Main	■	■								
Battery Point Coffer Dam	■	■	■							
Long-Term Projects:										
Eliminate PCBs & Tar Cell			■	■	■	■	■			
Treat & Contain Coke Ovens			■	■	■	■	■	■	■	■
Treat & Contain Tar Ponds			■	■	■	■	■	■	■	■

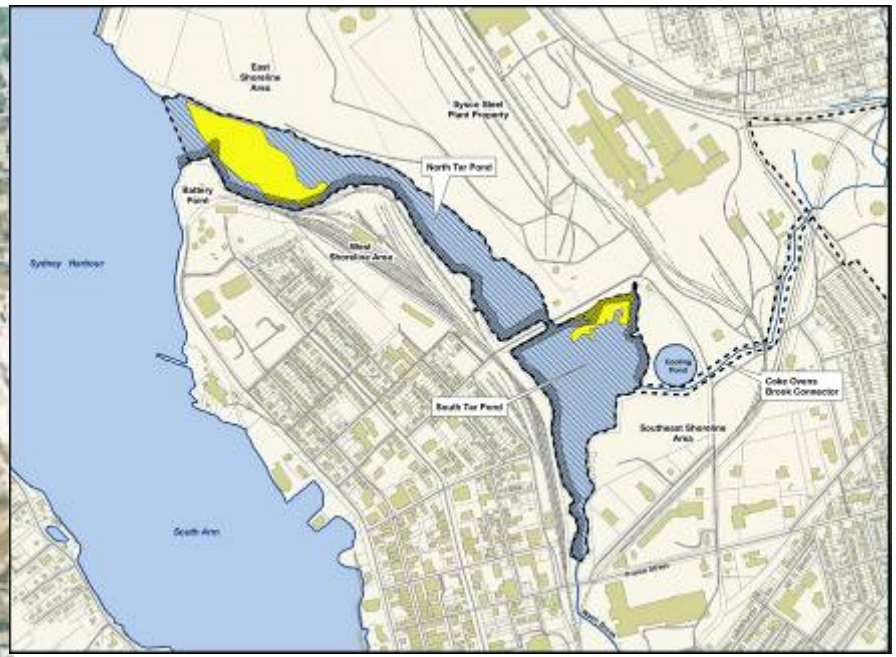
STP Cooling Pond

- Built in 1912
- Rec'd Wastewater from Cooling Process in Steelmaking
- 122 meter diameter
- 4 meters deep
- Sidewalls- Plank and Board Cribwork design
- Interior- Wood Staves and Tarpaper Liner

STP Cooling Pond Project

- Contaminants incl. Steel scale, oil, grease, from steel rolling process.
- Exceedances- TPH, Toluene, Antimony, Copper, Lead & Tin
- Wastewater settled out contaminants
- Water recirculated to steel mill.
- Overflow water spilled into Coke Oven Brook by design
- Sediment 50,000 tonnes
- Surface water 20,000 m^3
- Wood 470 m^3

Sydney Tar Ponds Overview



- The 31 hectare North and South Tar Ponds remain of Muggah Creek estuary.
- Nine decades of coke production resulted in 700,000 tonnes of contaminated sediment.
- Navigable depths now only a metre or two deep

SYSCO, Sydney, NS

STP Project

- >50 ppm PCB Sediment Remedy- Incineration (45,000 tonnes)
- <50 ppm PCB Remedy- In-situ S/S (655,000 tonnes)

Amoco Facility East Chicago, IL

- Refinery Waste Lagoon Closure
- In-situ Mixing
- Double Walled Sheet Pile & Cement-Bentonite Grout Wall

STP – Proposed Site Reuse

- Public green space.
- Sports fields.
- Golf course.
- Light commercial - industrial park.

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