Advanced Thermo-Chemical Sediment Decontamination Processing for United States Urban Superfund Sites

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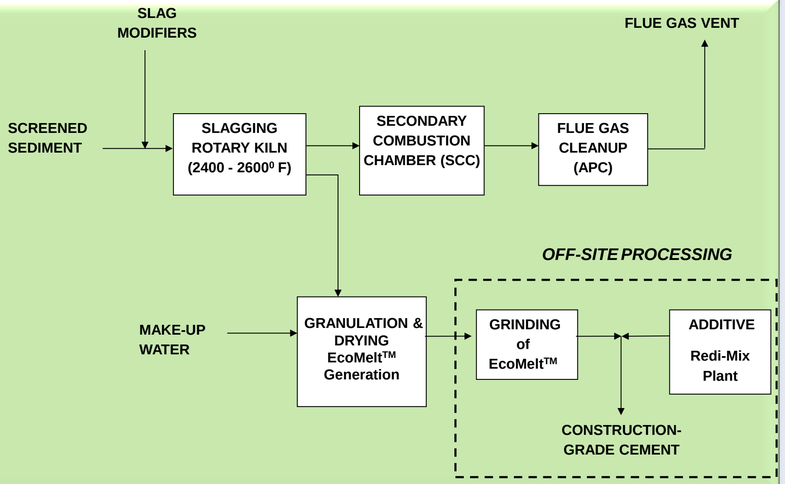
ABSTRACT

Innovative sediment decontamination with beneficial use for end placement after remedial actions at urban Superfund sites has been of global interest since 2005 when full-scale ex-situ low and high temperature demonstrations were conducted by the US Environmental Protection Agency Region 2 (USEPA), the New Jersey Department of Transportation and Brookhaven National Laboratory. Several independent evaluations of these technologies by the US Army Corps of Engineers, stakeholders, and Potentially Responsible Party groups verified their effectiveness and the utility of the applications, but were not comparable to other placement options at the time. The inclusion of a thermo-chemical manufacturing process (Cement Lock™) in the 2014 USEPA Passaic River, New Jersey Focused Feasibility Study and the selection of thermal treatment with beneficial use in the USEPA 2013 Gowanus Canal, New York Feasibility Study are the first times a sediment treatment technology have been considered for regional applications at urban Superfund sediment sites of national importance compared with Confined Aquatic Disposal, long-distance transport to a landfill and/or incineration - a recognition that these technologies can increase the net social and environmental benefits resulting from the action.

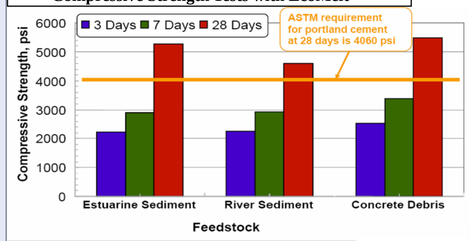
Cement Lock™ Thermo Chemical Treatment Train



- Feed consists of a mixture of de-watered contaminated sediments and modifiers
- Main processing unit is a Rotary Kiln melter: Operating temperature of 2400 to 2600° F using natural gas-fired burners; Feed mixture is thermo-chemically transformed to a lava-like melt; Organic contaminants are disassociated and destroyed; Inorganic contaminants (heavy metals) are immobilized and *locked* within the glassy product matrix; Product is quenched and recovered in a water bath, then dried and finely ground and used as a partial replacement for Portland cement (EcoMelt)™
- Flue-gases are further treated in a secondary combustion chamber to ensure destruction of POHCs
- Down-stream Air Pollution Control (APC) train controls emissions of hazardous air pollutants such as HCl, SO_x, NO_x, fine particulate, and volatile metals

Full-scale Demonstration – Bayonne, NJ (2004-2007) – Passaic River, NJ Superfund Sediment

Compressive Strength Tests with EcoMelt™



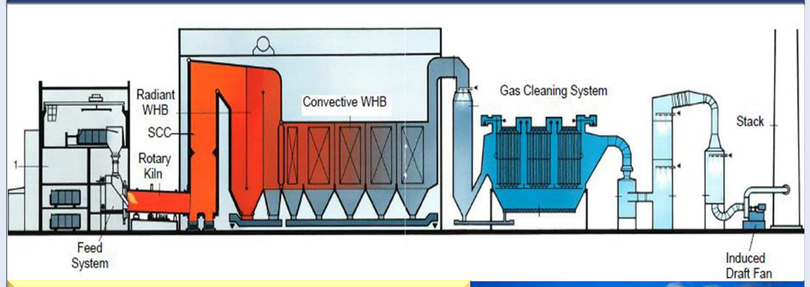
Sediment Treatment Efficiency

TCLP test Results for metals on EcoMelt™ produced from Passaic River sediment

Metal	TCLP Limit (mg/L)	Average EcoMelt™ (mg/L)
As	5	0.5 U
Ba	100	1 U
Cd	1	0.0057
Cr	5	0.0108
Co	--	0.05 U
Cu	--	0.0475
Pb	5	0.5 U
Mn	--	0.070
Hg	0.2	0.0002 U
Ni	--	0.0533
Se	1	0.5 U
Ag	5	0.01 U
Zn	--	0.282

Analyte	Campaign	Input Sediment	Product Ecomelt	Treatment Efficiency, %
		pg/g		
PCBs, Congener Total	Dec 2006	3,297,502	263	99.991
	May 2007	2,217,913	229	99.992
2,3,7,8-TCDD	Dec 2006	968.7	<0.54	>99.969
	May 2007	549.5	<1.0	>99.926
TEQ (D/F+PCB)	Dec 2006	1,163.1	1.48	99.855
	May 2007	697.2	5.7	99.331
		µg/kg		
Benzo[a]pyrene	Dec 2006	845.2	<0.53	>99.965
	May 2007	2,015.0	<1.03	>99.971
Naphthalene	Dec 2006	49.3	<0.42	>99.514
	May 2007	276.5	<1.28	>99.735
		mg/kg		
Mercury (Hg)	Dec 2006	5.23	<0.033	>99.64
	May 2007	4.35	0.014	99.73

Cement Lock™ Manufacturing Process (2015 Foster Wheeler Design)



Sustainability Profile:

- Each ton of Ecomelt produced eliminates 1 ton of CO_2 produced by cement manufacturing industry
- Sharply reduces GHG emissions for long distance transport to landfill
- Uses natural gas for electricity generation
- Eliminates mining and transport of raw materials for cement production
- Additional offsets may be obtained for other contaminants such as dioxins on a case-by case basis

Project Cost

- Processing Costs are significantly below industry norms for thermal treatment
- Costs are off-set by revenues from sale of marketable beneficial use products
- Confirmed Market for EcoMelt™ (Letter of intent to purchase with US Concrete)
- Commercial Scale Plant is feasible for given conditions:
  - Minimum dedication of 300,000 to 400,000 cubic yards of "in-situ" contaminated sediments with a processing fee of $350 to $400 per "in-situ" ton.
  - 100,000 to 125,000 tons/year processed (one treatment train) + O_2 enhancement
- USEPA projections for disposal costs for out-of-region treatment include more than $650 per ton for long haul transportation and treatment/landfill disposition of contaminated sediments

NY/NJ Urban Regional Sediment Processing Facility: The NY/NJ Harbor Perfect Storm

- 6 Mega-site complex Superfund sediment clean ups all on the same critical path and timelines that will require treatment of highly contaminated sediments with a portion that will require thermal treatment
- Co-locate (with other processes) an urban regional ex-situ thermo-chemical processing facility within the NY/NJ corridor for treatment and beneficial use applications - reducing corporate liability compared to long-haul distance transportation and landfill placement

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