

Table 1: Technology Overview – Summary Technical Details

Technology Provider	Technology	Scale+	Comp. treated	Related comp treated	Validation project experience**	Applicability Ranking++	Additional Remarks	Others
AMEC'	GeoMelt®	F	Agricultural chemicals including pesticides, herbicides, solvents, heavy metals	Agricultural chemicals including pesticides, herbicides,		DA	GeoMelt large-scale vitrification systems had a demonstrated process rate of approximately 90-tons per day for in-situ applications.	
AMEC'	GeoMelt®	F	PCBs	PCBs		DA	GeoMelt large-scale vitrification systems had a demonstrated process rate of approximately 90-tons per day for in-situ applications	
AMEC'	GeoMelt®	F	Agricultural chemicals including pesticides, herbicides, fertilisers, acids, caustics, and solvents	Agricultural chemicals including pesticides, herbicides, fertilisers, acids, caustics		DA	GeoMelt large-scale vitrification systems had a demonstrated process rate of approximately 90-tons per day for in-situ applications	
AMEC'	GeoMelt®	F	Radioactive elements (principally Pu & U), barite bricks, steel, and concrete			DA	Large-Scale GeoMelt Remediation of Pu-contaminated soil at South Australian nuclear test range.	
AMEC'	GeoMelt®	F	Radioactive elements (principally Pu & Am), phosphates, and heavy metals			DA		
AMEC'	GeoMelt® In-Container Vitrification (ICV) TM	pilot	PCBs, radioactive elements (principally U), and heavy metals	PCBs		DA	Series of 7 melts ranging in size from 1.7 to 5 tons.	



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AMEC	GeoMelt® In-Container Vitrification (ICV)™	pilot	HCBs	HCBs		DA	2-tonne batch pilot plant treated 33 wt% HCB. 98.82% Melt DE. Overall DRE >99.9999%.
AMEC'	GeoMelt®	F	BHC/HCH (lindane) Chlordane DDT Various chlorobenzene herbicides Aldrin, dieldrin, endrin HCB Heptachlor	BHC/HCH (lindane) Chlordane DDT Various chlorobenzene herbicides Aldrin, dieldrin, endrin HCB Heptachlor		DA	In Japan one works with a staged-batch facility with demonstrated process rate of approximately 30-tons/day.
+Key: F - Full-scale applications completed				++Key: Applicability ranking for pesticides			
P - Pilot/Demonstration scale completed; no F-applications				DA – Direct applicable			
B - Bench/Laboratory scale completed; no P or F-applications				FS 1 – Full scale within reasonable period possible 0-2 years			
T - Theoretical applicable, no B, P, F applications				FS 2 – Full scale within considerable period possible 2-5 years			
* Vendor claims performance of demonstration, but no data provided				**Validation on the basis of info provided in Table 2 and 3			



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Table 2: Overview Project Experience per Technology Supplier

Location/project	Contaminants	Amount treated in tons	Results incl. DRE, Pre-treat, Post treat Emissions, energy consumption, costs*	Client References Name, address, contact person phone, Email, fax
Parsons Chemical Works	Agricultural chemicals including pesticides herbicides, solvents, heavy metals	4,350-tons of soil and debris	>99.999 DRE measured for dioxin in preliminary engineering-scale tests for this waste. DRE not calculated for full-scale remediation project.	US Environmental Protection Agency 77 West Jackson Boulevard Chicago, IL 60604-3590 USA
Spokane TSCA Demonstration	PCBs	7,000-tons of PCB-contaminated soil and debris	DRE >99.9999 demonstrated during this project resulting in the GeoMelt technology being granted regulatory approval (national operating permit) for PCB destruction in the US.	Bechtel Environmental, Inc. PO Box 193965 San Francisco, CA 94119-3965 USA
Wasatch Chemical Site near Salt Lake City, Utah USA	Agricultural chemicals including pesticides, herbicides, fertilisers, acids, caustics, solvents, dioxin	5,440-tons of soil and debris	99.99 to 99.999 DRE measured for dioxin in preliminary engineering-scale tests for this waste. DRE not calculated for full-scale remediation project.	Entrada Industries, Inc. 180 East First South Salt Lake City, UT 84111 USA
Maralinga Taranaki Pits	Radioactive elements (principally Pu & U), barite bricks, steel, and concrete	5,400-tons of contaminated soil, steel, barytes bricks, and other debris	>99.99 Pu retention in glass product.	Commonwealth of Australia Edmund Barton Building GBO Box 858, Canberra, ACT Australia 2601
Los Alamos National Laboratory MDA V Site	Radioactive elements (principally Pu & Am), phosphates, and heavy metals	500-tons of contaminated soil and cobble	450 kWh/ton power consumption. \$735/ton project cost (2001 USD)	Integrated Science and Technology Program Environmental Management Programs Los Alamos National Laboratory, PO Box 1663 Los Alamos, NM 87545 USA
WCS Waste Treatment Facility	PCBs, radioactive elements (principally U), and heavy metals	22 tons of contaminated soil	DE measured before final thermal oxidizer ≈99.3%	Waste Control Specialists, LLC Three Lincoln Center 5430 LBJ Freeway, Ste. 1700 Dallas, TX 75240 USA
Orica HCB tests, Australia	HCB 33-wt% hexachlorobenzene (HCB)	~6 tons of HCB blend.	Overall DRE of 99.9999%. When the influence of the off-gas treatment system is removed from this value, a DE of 98.82% is obtained for the melt itself	Orica Australia Pty. 1 Nicholson Street PO Box 1721P Melbourne, VIC, Australia 3001
POPs Treatment Facility, Japan	BHC/HCH (lindane) Chlordane, DDT Various chlorobenzene herbicides Aldrin, dieldrin, endrin HCB, Heptachlor	2062 tonnes	organic destruction efficiencies ranging from 90 to 99.99% have been demonstrated by the melt itself in the GeoMelt process.	ISV Japan Ltd. 24,3-chome, Tokoiwa-cho, Naka-ku Yohohama City, 231-0014 Japan



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Table 3: Overview detailed project information per project – Project name (from Table 2):

Location project	Pre-treat mg/kg	Post-treat mg/kg	DREs	Emissions 1. Air (HCl, Dioxins & furans etc) 2. Water, 3. Waste (slags)	Energy consumption	Costs(Capital, operating costs)	Others, remarks
Parsons Chemical Works	4,4'-DDT = 340,000-ppb) dieldrin = 4,600-ppb)	non-detect levels in the vitrified product.	>99.999 DRE measured for dioxin in preliminary engineering-scale tests for this waste. DRE not calculated for full-scale remediation project.	As, Ba Cr Pb conc. in leachate from these tests was 8 to 1300 times lower for the vitrified product than for the site soil. Leachate generated (applying TCLP procedure to the vitrified product) was well below the established regulatory limits.	≈900 kWh/ton 3740 kW Equipment	Not Available	



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Spokane TSCA Demonstration	polychlorinated biphenyls (PCBs) in contaminated soil between 170-ppm to over 17,860-ppm, (average concentration = 14,377-ppm)	PCB concentration found in the vitrified product was below detection limits.		Combined results indicated overall PCB DRE for process in range > 99.99962% to >99.99998%. Discounting off-gas treatment system's contribution to overall DRE, results indicate PCB DRE for melt itself in range of 97.11 - 99.77%	Samples off-gas stack exit during processing for PCBs and TCDD equivalents: all non-detect. Additional off-gases analyses of (PAHs – e.g., naphthalene, fluorene, phenanthrene, fluoranthene, +pyrene) + other VOCs: in low ppb range. Concentrations three orders of magnitude below respective accepted NIOSH exposure limits. Off-gas effluent analyses for particulates, chloride, CO, and NO _x emissions. PM ₁₀ particulate emissions: in range 0.23 - 7 -mg/dscm; HCl emissions in range: 0.6 - 14-ppm. Emission levels at least one order of magnitude lower than US federal guideline values. NO _x emissions: in range: 30-40-ppm; Conc CO: below detection limits.	≈900 kWh/ton 3740 kW Equipment	Not Available	
		Post Geomelt in ppb	Surrounding Soil (ppb)					
Wasatch Chemical Site near Salt Lake City, Utah USA	TCDD dioxin=11 2,4-D=34,793 2,4,5-T=1,137 4,4'-DDD=52 4,4'-DDE=3,600 4,4'-DDT=1,090 Total	< 0.12 ⁽¹⁾ < 20 < 14 ND ⁽²⁾ ND ND <80	< 0.0045 ND ND <2.4 ND <83.1	99.99 to 99.999 DRE measured for dioxin in preliminary engineering-scale tests for this waste. DRE not calculated for full-scale remediation project.	Off-gas effluents analysis at stack exit: conc. pesticides + herbicides listed in the table were all below detection (ppt) limits. Dioxin analysis of off-gas effluents: conc. also	≈900 kWh/ton 3740 kW Equipment	Not Available	



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	chlordanes=535,000								
	Heptachlor=137.5	ND	ND						
	Hexachlorobenzene =17,000	ND	ND						
	Pentachlorophenol=272,918	<10.3	<1.2						
	Trichloroethene=36,875	ND	ND						
Maralinga Taranaki Pits				DRE is not applicable for radioactive waste treatment	No emission data available	≈900 kWh/ton		Not Available	
Los Alamos National Laboratory MDA V Site				DRE is not applicable for radioactive waste treatment	No emission data available	450 kWh/ton 1000 kW equipment		Not Available	
WCS Waste Treatment Facility				DE measured before final thermal oxidizer ≈99.3%	No emission data available	1700 kWh/ton 500 kW Equipment		Not Available	
Orica HCB Tests				2-tonne batch pilot plant treated 33 wt% HCB. 98.82% Melt DE. Overall DRE >99.9999%.	Off-gas effluent sampling + analysis at stack: conc. 89-ppb for HCB, 1.2-ppm for bis(2-ethylhexyl) phthalate, and non-detect (< 72-ppb) levels for dichlorobenzene isomers, 1,2,4-TCB,			Not Available	



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				hexachloroethane, naphthalene, and hexachlorobutadiene. Total VOC and HCl conc. in off-gas effluent: < 1.5-ppm and 0.7-ppm, respectively. Particulates:3.3mg/dscm in off-gas effluent. Conc. CO in off-gas effluent in range of 2-4-ppm. NO _x conc. 27 - 74-ppm.			
POPs Treatment Facility, Japan				No emission data available	relatively small equipment (500 kW)	Not Available	



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Table 4: Client References for GeoMelt®

Organization	Contact	Description/Notes
CH2M HILL Hanford Group	PO BOX 1500, Richland WA, 99352, USA Richard E. Raymond 509-372-8767 Peter K. Brockman 509-376-9942	Bulk Vitrification Project. CH2M HILL manages this project for the US Department of Energy. AMEC is the technology supplier for this project which involves Large-Scale testing and Plant Design of In-Container Vitrification (ICV) TM of Hanford Low Activity tank waste. 2003-present
US Department of Energy	US Department of Energy PO Box A Aiken, SC, 29802 USA Angela Sistrunk-Morton, Contracting Officer (803) 952-9236	In-Situ TRU Waste Delineation and Waste Removal Project involving large-scale vitrification testing for Hanford Vertical Pipe TRU Waste Disposal Shafts. 2004-2005
Waste Control Specialists, LLC	Waste Control Specialists, LLC Three Lincoln Center 5430 LBJ Freeway, Ste. 1700 Dallas, TX 75240 USA Jeff Shouse, Director of Operations (505) 394-3517	Various projects involving In-Container Vitrification (ICV) TM of mixed radioactive waste 2003-2004.

Table 5: Utilities Required for High-strength Pesticide Waste Treatment
Japan capacity 4.5t /day

Utility	Units	Quantity required per tonne of waste input	Quantity required per month (Semi-mobile plant)	Quantity required per month (Full-scale plant)
Electricity	MWh	1.5-1.7 MWh/Tonne		
Caustic	T			
CO2	Kg	0		
Steam	Kg	0		
Natural Gas or propane	Nm ³			
Cooling Water	m3			
Processing Rate		kg/min		
		Tonnes/month		
		Tonnes/yr		