



Cement Kiln Co-Processing (High Temperature Treatment) – Annex to POPs Technology Specification and Data Sheet

Table 1: Technology Overview – Summary Technical Details

Technology Provider	Technology	Scale +	Comp. treated	Related comp treated	Validation project experience **	Applicability Ranking++	Additional Remarks	Others
St. Lawrence Cement Plant (Canada)	Wet Process Cement Kiln High temperature treatment	F	Various chlorinated waste streams			DA	Series of Tests	
Stora Vika Cement Plant (Sweden)	Wet Process Cement Kiln High temperature treatment	F	Various chlorinated waste streams such as PCB's, chlorophenols, and phenoxyacids			DA	Test burn in 1978	
Unidentified	One Wet and one dry Process Cement Kiln High temperature treatment	F	Organic constituents such as Methylene Chloride, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113), methyl ethyl ketone, 1,1,-trichloroethane, toluene			DA	Trial burns in the 1980s	
Unidentified	Dry Process equipped with preheater	F	Carbontetrachloride, Trichlorobenzene				Trial burns in the 1990s	
Twiga Cement Factory, Tanzania	Trial burn	F	4,6-Dinitro-o-Cresol (DNOC)				Trial burn 1993-1996 (W. Schimpf, 1999)	
United Cement Colombia		F					DRE Testing in 1990s	
Colombia	Dry Process kiln	F	POPs contaminated soil with DDT, Aldrin, Dieldrin and pentachlorobenzene			DA	Test burn in 2001	
Vietnam		F	Fenobucarb Fipronil				Test burn at a rate of 2 t/h. In total 40,000 litres in less than 20 hours	
Geocycle Australia		F	Pesticides, Herbicides Insecticides			DA	2004	
Sri Lanka		F	Pure pyralene oil with 56-62% of PCBs: 33-38% tri-chloro-benzene 5-6% tetra-chloro-benzene			DA		
+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			

Table 2: Overview Project Experience per Technology Supplier

Technology Provider	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
St. Lawrence Cement Plant (Canada)	Various chlorinated waste streams	Unknown	99.986 % for the chlorinated compounds			Executed in mid 70s (Karstensen, 2004)
Stora Vika Cement Plant (Sweden)	Various chlorinated waste streams such as Methylene Chloride, PCB's, chlorophenols, and phenoxyacids	Unknown	99.995 % for Methylene Chloride 99.9998 % for Trichloroethylene 99.99998 % for PCB's No TEQ dioxins or furans could be detected			Executed in 1978 (Karstensen, 2004)
Unidentified	Organic constituents such as Methylene Chloride, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113), methyl ethyl ketone, 1,1,-trichloroethane, toluene	Unknown		Wet process kiln	Dry process kiln	Executed in the 1980s (Karstensen, 2004)
			Methylene Chloride Freon 113 Methyl ethyl ketone 1,1,Trichloroethane Toluene	99.983 % >99.999% 99.988% 99.995% 99.961%	99.96 % 99.999% 99.998% >99.999% 99.995%	
Unidentified	Carbontetrachloride, Trichlorobenzene	Unknown	99.999% for Carbontetrachloride 99.995% for Trichlorobenzene			Executed in 1990s (Karstensen, 2004)
United Cement	Sulphur hexafluoride	Unknown	99.9998% for Sulphur hexafluoride			Executed in 1990s (Karstensen, 2004)
Twiga Cement Factory, Tanzania	4,6-Dinitro-o-Cresol (DNOC)	57,000 litres	All samples in dust: <0.25 mg/kg DNOC All samples in clinker: <0.25 mg/kg DNOC 0.25 mg/kg = Detection limit			
Colombia	Pesticide contaminated soil	900 tonnes	>99.9999% PCDD/PCDF: 0.00023-0.0031 ng I-TEQ/Nm ³ at 10% O ₂			Executed in 2001 (Karstensen, 2004)
Vietnam	Expired chlorinated insecticide compounds		Fenobucarb Fipronil	DRE 99.99999719 99.99998531	DE 99.99999692 99.99998321	(Karstensen et al., 2006, see also TSDS part I under A. Performance)
Geocycle Australia	Pesticides, Herbicides Insecticides	1400 tonnes				
Sri Lanka	pyralene	10 000 litres	DRE > 99.9999999%			



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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
Twiga Cement Factory, Tanzania	20% DNOC in Diesel mixture	All samples in dust <0.25 mg/kg DNOC All samples in clinker <0.25 mg/kg DNOC 0.25 mg/kg = Detection limit		1. Air: CO (mg/m ³)=271-280 NOx (mg/m ³)=594-1115			
	PCB's, chlorophenols, and phenoxyacids Average chlorine concentration 17%			No detectable quantities for dioxins and furans containing 4 or 6 chlorines were found			
Vietnam		Raw meal, the product clinker, fine coal, electro static precipitator dust and by-pass dust was analysed for both insecticide compounds and was found to be less than the detection limit for all samples, i.e. <2.0 parts per billion	>99.99999% (see also Table 2)	all analysis results for PCDD/F's, HCB and dioxin like PCB's were below the detection limit			
Geocycle, Australia Sri Lanka	Pure pyralene oil with 56-62% of PCBs: <ul style="list-style-type: none"> • 33-38% tri-chloro-benzene • 5-6% tetra-chloro-benzene Pyralene mixed with HFO, yielding ~5,000 ppm PCB oil		DRE > 99.9999999%	Emissions unaffected by PCB Accredited 3rd party monitors emissions and samples all materials			

Table 4: Client References Overview project experience per technology suppliers in Canada

This Table makes references to the concerning cement companies and not to the individual plants. The know how and experience is with the cement companies.

<i>Organization</i>	<i>Description/Notes</i>
Holcim	Holcim, largest company in the world with plants in 70 countries) which is the most advanced on co-processing of hazardous waste
Others are Lafarge, Heidelberg, Taiheyo, Cemex	See for example World Business Council for Sustainable Development, Cement Sustainability Initiative, which has links to the major companies: http://www.wbcds.ch/templates/TemplateWBCSD1/layout.asp?type=p&MenuId=MTI2&doOpen=1&ClickMenu=LeftMenu
In Europe	The European Cement Association Cembureau: http://www.cembureau.be/
In USA	The American Cement Association: http://www.cement.org/
In Canada	The Cement Association of Canada: http://www.cement.ca/cement.nsf