St. Lawrence TECHNOLOGIES

HAZARDOUS WASTES

DECONTAMINATION OF MUNICIPAL WASTE COMBUSTION FLY ASH

ABSTRACT

The management of fly ash from municipal solid waste (MSW) incinerators is an international problem. Because these ashes contain heavy metals such as lead, cadmium and mercury, they are considered hazardous material.

The firm Alex Cendre Inc. and the National Scientific Research Institute INRS-EAU have developed a technology to chemically solubilize the metals contained in fly ash to render them usable. As part of this technology demonstration project, 13 tonnes of fly ash was treated at a pilot plant with a capacity of 300 kg/d. The level of decontamination reached with this treatment process conforms to Quebec government standards for residual hazardous materials.

MAIN FEATURES

- **Technology**
  - Extraction of metals by chemical solubilization
- **Environment**
  - Decontamination of fly ash
  - Possibility of using treated ashes
  - Recovery of extracted metals
  - Declassification of a hazardous material
- **Cost**
  - Reduction in management costs

Saint-Laurent Vision 2000

Environment Canada Protection Québec Region
Environnement Canada Protection Région du Québec
ALEX CENDRE
Université du Québec Institut national de la recherche scientifique (INRS-EAU)
Federal Office of Regional Development (Québec)
Bureau fédéral de Développement régional (Québec)

STUDY OBJECTIVES

The project objectives were as follows :

- To maximize the rate of recovery of fly ash and residual metals
- To minimize landfilling of hazardous material

Testing consisted of :

- Trials carried out on fly ash taken from the Quebec Urban Community incinerator
- Six months of process operation at the pilot plant set up in Sainte-Foy
- Thirty tests, including :
  - tests on combined fly ash
  - tests on lime alone
- Treatment of 13 tonnes of fly ash during the demonstration period

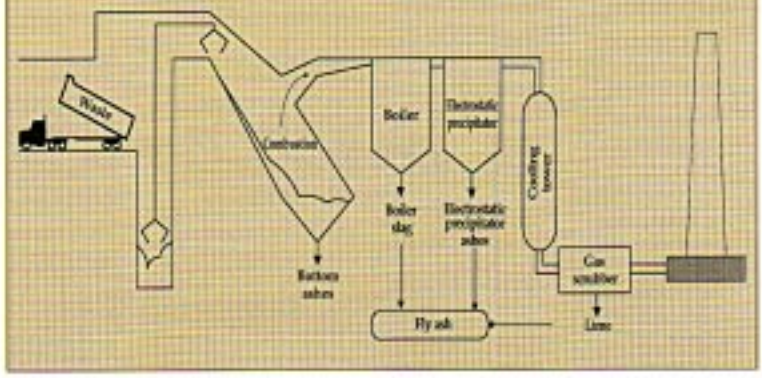
BACKGROUND

The amount of ash generated by MSW incinerators represents between 20% and 35% of the initial weight of the waste incinerated, and is made up primarily of bottom ash and fly ash. Fly ash contains lime, boiler slag and electrostatic precipitator ashes; bottom ashes are stable and pose no risk to the environment.

Fly ash, however, exceeds all leaching standards, particularly with respect to lead, cadmium and mercury. The only treatment approach currently in use for fly ash is chemical stabilization and subsequent landfilling at a high-security site. The cost of such treatment is high, and the treated ash is not suitable for use.

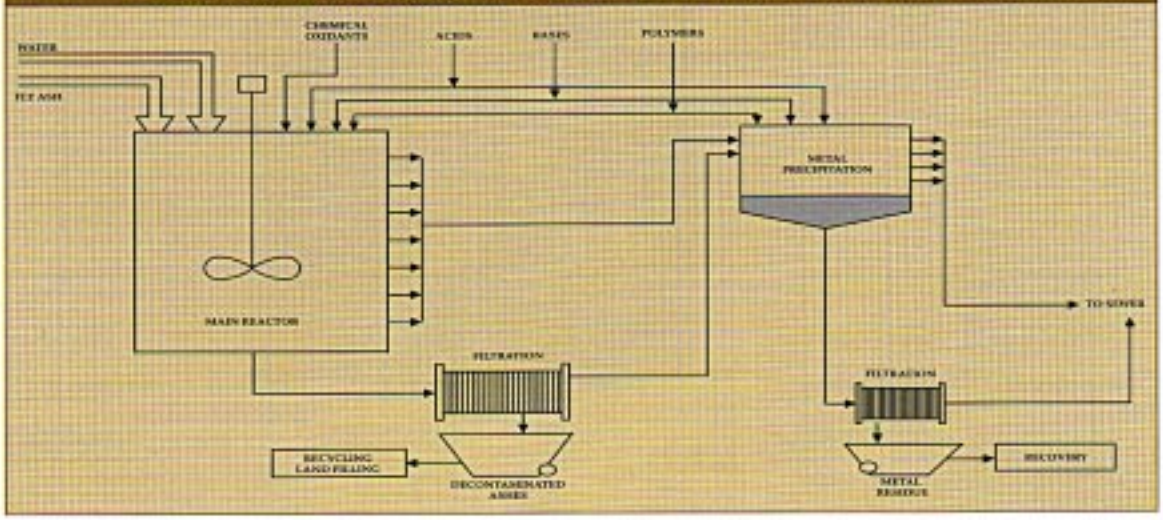
TECHNOLOGY

SCHEMATIC DIAGRAM OF AN INCINERATOR



The proposed process consists of chemically solubilizing the metals contained in the fly ash and then recovering them by precipitation. First, the fly ash is placed in a reactor and cleaned by means of successive basic and acidic solutions. The ashes are then sent to a filtration unit to recover the decontaminated ash, which may now be used or landfilled as solid waste. Wash waters are channelled to a metal-precipitation unit that functions on the principle of the solubility product constant (Ksp). The metal precipitate is then filtered and may be recovered for metallurgical purposes.

SCHEMATIC DIAGRAM OF THE DECONTAMINATION OF FLY ASH



RESULTS

The treatment process was demonstrated in two series of tests, the first on combined fly ash, the second using lime only.

The environmental standards for allowable metal concentrations in residual hazardous materials are 5 mg/L of lead (Pb), 0.5 mg/L of cadmium (Cd), and 0.1 mg/L of mercury (Hg). Following treatment, tests with the TCLP found that concentrations of these three metals test were between 2.34–3.23 mg/L of lead, 0.27–0.41 of cadmium, and were below the detection limit for mercury.

The results of TCLP tests on lime alone were also positive, demonstrating the ability of the treatment process to attain government standards for the main problem metals. Concentrations varied from 0.37 to 3.15 mg/L of lead, and from 0.02 to 0.12 mg/L, with mercury concentrations below 0.06 mg/L.

Metal removal is calculated by comparing metal concentrations before and after treatment. Removal rates indicate the extent to which the process removes metals rather than merely stabilizing them in the matrix. In combined ash, average removal rates were 28.8% of lead and 94.6% of cadmium; in lime, they averaged 59.1% of lead, 84.2% of cadmium, and 48.6% of mercury.

RESULTS OF TCLP TESTS

Element	Fly ash		Lime			Standard
(mg/L)	Test #1	Test #2	Test #1	Test #2	Test #3	TCLP
Pb	2.34	3.23	3.15	0.37	2.50	5.00
Cd	0.27	0.41	0.02	0.12	0.09	0.50
Hg	< DL	< DL	< DL	0.06	0.01	0.10

< DL: below the detection limit.

METAL REMOVAL RATE

	Fly ash			Lime		
	Concentration			Concentration		
Element	Before (mg/kg)	After (mg/kg)	Removal (%)	Before (mg/kg)	After (mg/kg)	Removal (%)
Pb	1825	1299	28.8	462	189	59.1
Cd	168	9.1	94.6	35.0	5.5	84.2
Hg	27.2	ND	ND	68.8	35.4	48.6

ND: not determined.

POTENTIAL AND LIMITATIONS

The chemical solubilization treatment process for incinerator fly ash has shown that it is possible to respect metal leaching standards while being both environmentally sound and economical. It is odour-free and has few equipment requirements. Moreover, ashes so treated may be used and the residual metals recycled. This process is suitable for use where incinerator treatment capacity is sufficient to justify its installation. Projected treatment costs are less than $160/metric tonne.

INFORMATION

This technology data sheet was produced based on the results of a demonstration project conducted jointly by Alex Cendre Inc. and INRS-EAU, with the technical and financial assistance of Environment Canada and the Federal Office of Regional Development (Quebec).

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