St. Lawrence TECHNOLOGIES

ABSTRACT

Some 140 tonnes of mercury is discharged into the environment every year in Canada. Uncontrolled discharges of this toxic substance, resulting particularly from discarded lamps and certain types of used batteries, are a threat to the environment.

The firm Roche Ltd was mandated to conduct a study to inventory technologies for recovering and recycling the mercury contained in discarded lamps and in some types of used batteries. The technical, economic, legislative and environmental features of these technologies were also subject to a comparative analysis to assess the possibility of introducing them in the Québec context.

HAZARDOUS WASTES

INVENTORY OF RECOVERY AND RECYCLING TECHNOLOGIES FOR THE MERCURY IN DISCARDED LAMPS AND SPENT BATTERIES

MAIN FEATURES

The study, entitled *Étude de faisabilité des procédés de traitement, de récupération et de recyclage du mercure et autres substances composant les lampes et les piles sèches*, has highlighted the following points:

- No global solution exists in Canada for the treatment of mercury residue, although a few isolated initiatives have been taken for its recovery and recycling.
- Over 35 technologies have been inventoried: 24 are found at the industrial scale, 4 at the pilot scale, and 8 are in development.
- Most technologies treat only one type of waste: batteries, button batteries, lamps, fluorescent tubes, etc.

Saint-Laurent Vision 2000

Environment Canada Protection Québec Region

Environnement Canada Protection Région du Québec

Hydro-Québec

Gouvernement du Québec
Ministère de l'Environnement et de la Faune

STUDY OBJECTIVES

Environment Canada, the ministère de l'Environnement et de la Faune du Québec, and Hydro-Québec provided funding for this study by Roche Ltd. Its objectives were:

- To inventory the commercially available and technically proven technologies for the management of discarded lamps and spent batteries in Québec;
- To update a 1991 study on batteries published by Environment Canada (Report EPS 4/CE/1);
- To assess the economic and legal aspects of managing discarded lamps and spent batteries;
- To assess the feasibility of available management options;
- To propose one or more scenarios for introducing applicable technologies in Québec to ensure the environmentally-sound management of discarded lamps and/or used batteries.

BACKGROUND

Different types of waste contain mercury. Certain kinds of used batteries (mercury oxide and silver oxide cell), fluorescent tubes, public streetlights, some medical waste (dental amalgams, thermometers), and many control devices (switches, thermostats) represent a major source of contamination that could be avoided.

As part of Hydro-Québec's energy-efficiency improvement program for public lighting systems, 200 000 mercury streetlights will be replaced. Such a program also exists in the other provinces.

The mercury found in industrial and domestic wastes ends up in sanitary landfills and municipal incinerators, thus threatening to contaminate the air, water, soil and groundwater.

Until now, no global solution has existed in Canada for the recovery of mercury waste. This study is aimed at inventorying available options in order to reduce discharges of mercury into the environment.

CONTENT OF THE STUDY

This feasibility study provides the information necessary for developing and introducing recovery and recycling processes applicable to mercury and other substances found in lamps and batteries.

The composition of various types of lamps and batteries are first described so that the companies involved can easily target the substances requiring management. This section lists the obstacles that must be overcome in implementing a mercury collection and recycling system.

Technologies in development or already available have been inventoried and can be found in the attached appendix. These technologies are grouped according to five main industrial processes: pyrometallurgy, hydrometallurgy, thermal processes (pyrolysis and distillation), mechanical separation, and secure landfilling.

By a comparative analysis, a few possible scenarios have been prepared for the introduction of proven technologies onto the Québec market, in consideration of each's technical, economic, legislative and environmental features.

RECOMMENDATIONS

The following points should be considered before the technologies most suited to Québec can be selected:

- A pricing strategy or policy for the recovery of discarded batteries and lamps is vital to the successful introduction of any recovery program; revenue generated by the sale of recovered materials is not sufficient to ensure the profitability of most recycling processes.
- A collection system for spent batteries and lamps must be set up in order to supply a steady and adequate amount of material for treatment. While the recovery of lamps and batteries form the industrial sector does not appear problematic, the same can not be said of domestic-source mercury. A collection system based on the principle of return to a retailer or distributor appears to be more efficient.

STATE OF DEVELOPMENT OF INVENTORIED TECHNOLOGIES

Type of technology	Number of processes	State of development
Pyrometallurgy	2	Industrial scale
Hydrometallurgy	3	In development
	2	Pilot scale
	2	Industrial scale
Thermal processes		
- Pyrolysis	8	Industrial scale
- Distillation	2	In development
	6	Industrial scale
	1	Unknown
Mechanical separation	2	In development
	2	Pilot scale
	3	Industrial scale
Landfilling	1	In development
	3	Industrial scale

While awaiting for the introduction of treatment technologies in Québec, temporary measures would help decrease mercury discharges to the environment. By way of example, Hydro-Québec has already found a solution by dismantling public streetlights to recover the arc tubes containing droplets of mercury and amalgams of sodium/mercury. These wastes can then be exported and treated at specialized facilities in the United States or in Europe.

However, in order to avoid the accumulation of large amounts of hazardous materials, the storage of spent batteries and discarded lamps is recommended only where recycling, treatment or disposal options exist or can be accessed.

CRITERIA USED TO COMPARE TECHNOLOGIES

Features	Criteria
Technical	- Compatibility of process to materials to be treated - Need to pre-sort materials to be treated - Equipment mobility
Environmental	- Environmental performance - Management constraints of wastes from treatment - Energy requirements (Energy balance) - Ressource recovery rate (Mass balance)
Economic	- Capital costs - Operating costs - Break-even point
Legislative	- Subject to environmental assessment

INTEREST IN THE STUDY

To those working in the field of hazardous waste and who are looking to develop a management strategy for mercury-contaminated waste, at both the private and public sector levels, this study presents:

- A review of the available technologies;
- A description of technologies currently under demonstration;
- Comments on the technical, economic, environmental and legislative features to consider in implementing a mercury-contaminated waste management system;
- Scenarios of introduction onto the Québec market of recovery and recycling processes for spent batteries and discarded lamps.

INFORMATION

This data sheet is based on the results of a study conducted by the firm Roche Ltd, with funding from Environment Canada, the ministère de l'Environnement et de la Faune du Québec, and Hydro-Québec.

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St. Lawrence Technologies data sheets are intended for all companies, industries, organizations and individuals interested in new environmental technologies. They are produced by the Technology Development Section, Environment Canada, as part of the Saint-Laurent Vision 2000. They serve to disseminate the results of technology development and demonstration projects conducted in the following four sectors: industrial waste-water; contaminated soil; hazardous wastes; contaminated sediment.

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Canada