St. Lawrence TECHNOLOGIES

ABSTRACT

PPG Canada Inc., in implementing the restoration plan for its industrial site at Beauharnois, Québec, has developed and demonstrated a treatment process for mercury-contaminated soil. This process, which uses gravimetric and flotation technologies, was developed in collaboration with Biogénie SRDC Inc., and tested in the summer of 1992.

During this period, the process recovered 1350 kg of the visible mercury initially present in the 5000 m^3 of soil treated, with a residual concentration of less than 900 mg/kg and an associated cost of $211 per cubic metre.

CONTAMINATED SOIL

DEMONSTRATION OF A PILOT UNIT TO TREAT MERCURY-CONTAMINATED SOIL

MAIN FEATURES

- **Technology**
  - Solid-liquid separation process using gravimetry and flotation
  - Modular equipment can easily be moved from site to site
  - Process water recirculation.
- **Environment**
  - Removal of visible mercury in contaminated soil
  - Residual mercury contamination below 900 mg/kg in soil for landfilling
  - Recycling of recovered metallic mercury.
- **Cost**
  - Soil and site restoration treatment costs approximately $200 per cubic metre.

ST. LAWRENCE ACTION PLAN

Environment Canada / Environnement Canada
Conservation and Protection / Conservation et Protection
St. Lawrence Centre / Centre Saint-Laurent

PPG

BIOGÉNIE

PROJECT OBJECTIVES

The project aimed to design, develop and demonstrate the efficiency of a pilot unit to treat mercury contaminated soil. More specifically, the project objectives were:

1. To recover an average 95% of the visible mercury in the soil.
2. To obtain, in 95% of cases, a residual mercury contamination level below 1000 mg/kg in the treated soil.
3. To recycle process water.
4. To design a mobile technology.
5. To assess treatment costs.

PHASES

I Data gathering and pre-piloting.

II Designing a pilot unit for the treatment of mercury-contaminated soil.

III Start-up, optimization and operation of the pilot unit in order to verify the effectiveness of the process.

BACKGROUND

From 1948 to 1990, the Beauharnois plant of PPG Canada Inc. operated an electrolytic process based on the use of mercury cathodes in the production of chlorine. Significant mercury contamination of the soil resulted, primarily in metallic form (Hg). In contact with certain bacteria, mercury can be transformed into methylmercury, a toxic substance which can accumulate in the food chain.

Due to the high costs of site restoration and the non-existence of technologies adapted to this type of contamination, PPG undertook a development and demonstration project, in collaboration with Biogénie SRDC Inc., to develop a treatment process for mercury-contaminated soil. The objective was to remove the visible metallic mercury in the soil prior to its landfilling in a double-membrane cell. The risk of groundwater contamination is thereby minimized in the long term.

TECHNOLOGY

The firm Biogénie SRDC Inc. has developed a process that uses standard mining industry equipment. There are three main steps:

- **Soil preparation:** Soil is prepared in such a way to release the mercury and to remove, by screening, the particles larger than 1 mm in diameter.
- **Soil treatment:** Hydrocyclones are used to separate mercury droplets, which are concentrated by flotation.
- **Soil dewatering:** The clayey part of the soil is flocculated with a polymer before filtration in a filter-press.

RESULTS

Removal of visible mercury

The 2.5 m^3/h-capacity pilot unit recovered all of the visible mercury contained in the 5000 m^3 of soil treated. A total of 1350 kg of visible mercury was recovered, either in liquid form or as a concentrate.

Mass balance of total mercury

A mass balance was obtained by treating 1100 m^3 of soil contaminated with visible mercury over 320 hours of pilot unit operation.

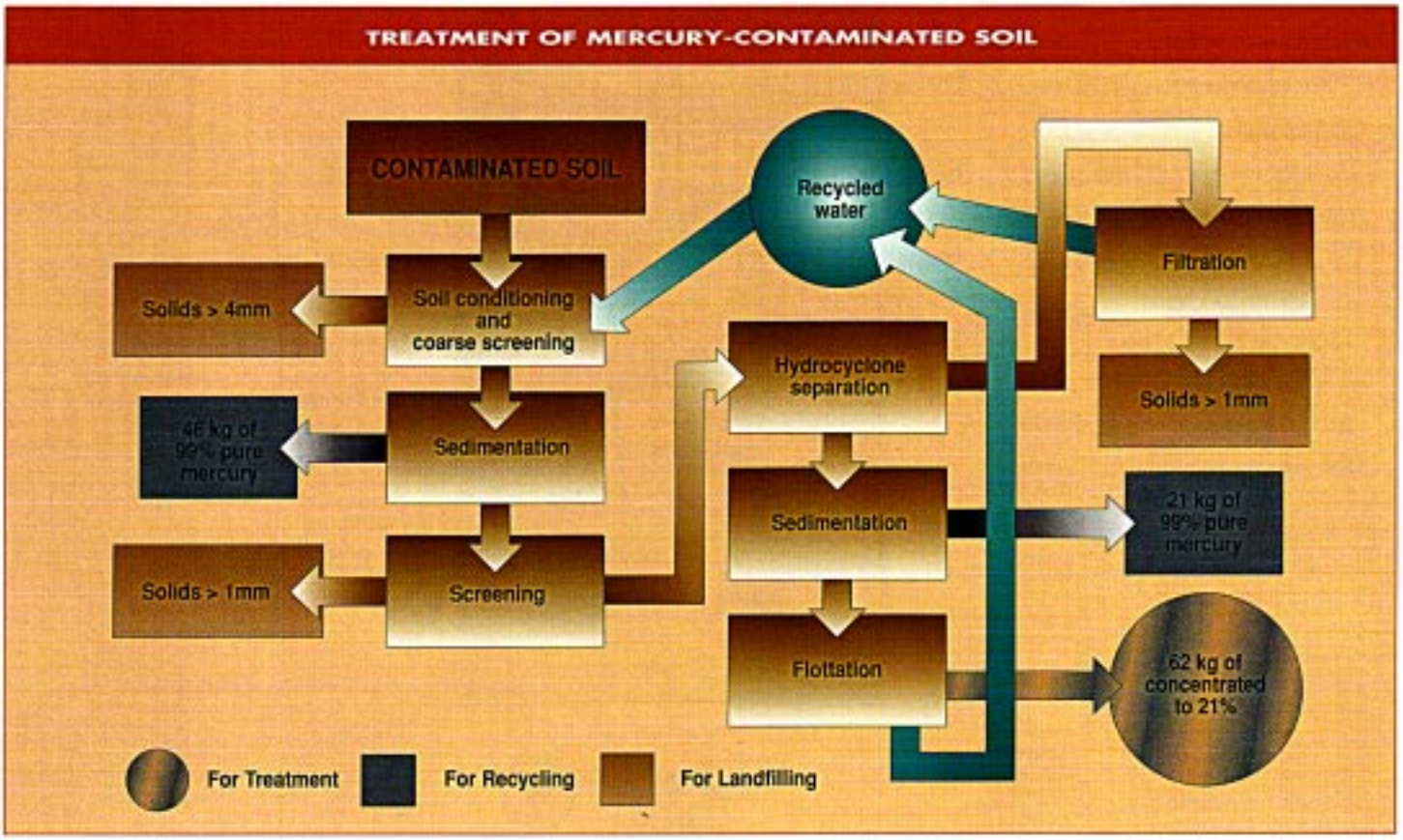
During this period, the pilot unit recovered 24.8%, or 129 kg, of the mercury in the soil. Just over half of this amount (67 kg) was recovered as highly concentrated, pure metallic liquid mercury (>99%) and shipped to a specialized recycling centre. The remaining 62 kg were recovered as a 21% mercury concentrate by flotation, and an ultimate treatment remains to be determined.

Residual mercury in the soil was present as sulphurs (HgS) and as droplets of metallic liquid (Hg) with an average concentration of 624 mg/kg; in 95% of cases, this concentration is lower than 900 mg/kg.

At the end of treatment, solids free of visible mercury are disposed of in a secure landfill at PPG's Beauharnois plant site.

Treatment costs

In PPG's particular case, soil treatment costs were estimated at $211 per cubic metre for a 2.5 m^3/h-capacity unit with a minimal soil volume of 25 000 m^3. This amount includes engineering and development costs ($43/$m^3$), equipment and installation ($48/$m^3$), and all costs associated with process operation and disposal in a double-membrane cell ($120/$m^3$).



POTENTIAL AND LIMITATIONS

Potential

The contaminated soil treatment process allows mercury that would otherwise be disposed of in a landfill cell to be removed and recycled. The process is promising for use to remove heavy metals prior to other types of treatment, like biodegradation or chemical extraction.

The modular assembly is advantageous since the treatment units can be transported to a new site within a three-week period.

Limitations

Process efficiency is limited by the type of contaminated soil (especially clayey soils), and by the diameter of metallic mercury droplets; there may be repercussions on cost where treatment complexity must be increased. The cost of smelting the recovered mercury for recycling also has to be estimated and added to the process cost.

INFORMATION

This data sheet is based on the results of a technology development and demonstration project carried out by PPG Canada Inc., in collaboration with Biogénie SRDC Inc.

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Canada