St. Lawrence TECHNOLOGIES

ABSTRACT

Out-of-service, PCB-contaminated electrical capacitors constitute a large part of the total inventory of PCBs, and their destruction using existing technologies is both complex and costly.

In cooperation with Hydro-Québec, the firm Sanexen Environmental Services Inc. conducted trial runs of the Decontaksolv™ process for the decontamination of electrical capacitors on 546 units. This process met the environmental criteria set for residual PCB concentrations in extraction fluid, in the capacitors' active parts (paper, cardboard, metal), and in the metal casings. The criterion was also met for the residual concentration of extraction fluid held in the porous materials (paper and cardboard).

HAZARDOUS WASTES

DECONTAKSOLV™ PROCESS FOR THE DECONTAMINATION OF PCB CAPACITORS

MAIN FEATURES

- **Technology**

  Mobile unit including:

  - Capacitor shredding
  - Vacuum PCB batch extraction
  - Extraction fluid recycling.

- **Environment**

  - Decontamination of active parts
  - Recycling of metal components (aluminum and steel)
  - Reduction in volume of contaminated material.

- **Cost**

  - Reduction in storage costs
  - 65% reduction in total capacitor mass for disposal
  - Potential use of recovered metals.

ST. LAWRENCE ACTION PLAN

Environment Canada Protection Québec Region

Environnement Canada Protection Région du Québec

SANEXEN ENVIRONMENTAL SERVICES INC.

Hydro-Québec

PROJECT OBJECTIVES

The project objectives were:

-to verify the effectiveness of the Decontaksolv™ process in decontaminating capacitors containing PCBs;

-to demonstrate the commercial potential of the process.

At the operating level, the project aimed to optimize:

-capacitor draining;

-shredding of the coils;

-the disposition of shredded material in the vacuum extraction unit;

-parameters such as time of decontamination, flow and temperature of the extraction fluid.

The criteria for decontamination were set at:

-1 mg PCBs/m² for the metal components;

-50 mg PCBs/kg for the coils;

-a residual concentration of 0.2% for the extraction fluid.

These objectives were established in accordance with the acceptability criteria of authorized scrap metal recycling centres for out-of-service electrical equipment. The project also aimed to reduce substantially the mass of contaminated material for disposal.

Project duration: Summers of 1991 and 1992.

BACKGROUND

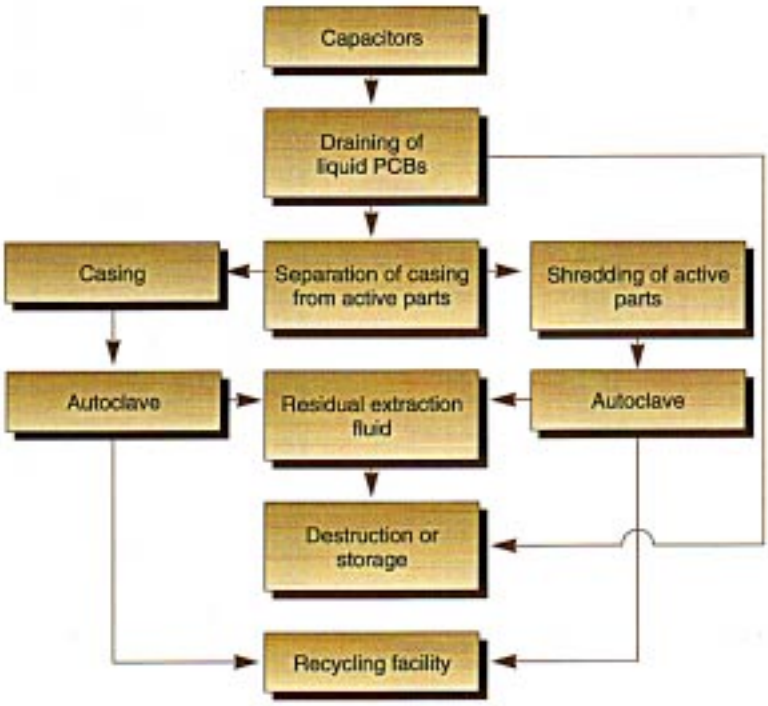
Out-of-service, PCB-contaminated capacitors are a problem due to their liquid and solid compositions, and to the availability of destruction technologies. Although chemical processes can destroy PCBs, these technologies are limited to concentrations of lower than 10 000 mg/kg for pure PCBs. Since a capacitor that uses PCBs as dielectric fluid contains, by weight, 35% PCBs, 45% active parts, and 20% metal, more complex and costly thermal processes must be used to achieve the complete destruction of these higher PCB concentrations. Chemical processes can be used, but the complete decontamination of active parts is difficult since paper and cardboard absorb PCBs. The extraction of liquid PCBs and the decontamination of the various parts prior to the PCBs destruction is therefore an interesting alternative that can reduce elimination and storage costs of PCB-contaminated capacitors.

TECHNOLOGY

The Decontaksolv™ process applied by the firm Sanexen Environmental Services Inc. employs a reusable fluid to extract PCBs from the solid components. The mobile system is mounted on three 15-m trailers and includes a shredder, air ventilation and filtration systems, an autoclave, a distiller, heat exchangers, a thermal unit and a drying unit for the recovery of residual fluid following the extraction phase.

The capacitors (See diagram) are first drained and the metal casings, with their coils removed, are then decontaminated in the autoclave. The shredded coils are placed in baskets and introduced into the autoclave, where they are washed with the extraction fluid. After the extraction cycle, hot air is circulated in the autoclave in a closed-circuit operation to dry the material and recover any residual fluid. The treated material is then placed in a container, analysed for PCBs, and sent to an authorized recycling facility.

Decontakslov™ Process Flow Chart



RESULTS

A first series of tests conducted on 306 capacitors demonstrated the importance of the positioning and geometry of the injection points in the autoclave, as well as the temperature control of the extraction fluid and the need to shred the coils into fine particles.

The second series of tests was performed on three batches of 80 capacitors each, for a total weight of some 13 tonnes (See Mass Balance). Quality control was maintained by sampling and analysing PCBs. Residual extraction fluid concentrations were also subject to control procedures.

The tests consisted of shredding the capacitors, and decontaminating this material by in-vacuum process, followed by drying sequences and the periodic rotation of the material. Modifications were made to the drying stage of each batch in order to determine the impact of physical placement in the autoclave on the effectiveness of decontamination.

Residue from the treatment procedure contains PCBs drained prior to treatment and those extracted in the distilling phase.

The mean results for the three batches show that all the environmental criteria were met, with the exception of batch No. 3, for which optimization conditions were subsequently corrected. These results demonstrate the efficiency of the Decontaksolv™ process in decontaminating capacitors containing PCBs.

Consequently, 65% of the capacitor's original weight was decontaminated and can be sent to a recycling facility. The remaining 35%, transformed into liquid PCBs, must either be stored or destroyed using another technology.

Mass Balance

Coils, cardboard, casing	PCBs extracted and drained
8206 kg (65%)	4658 kg (35%)

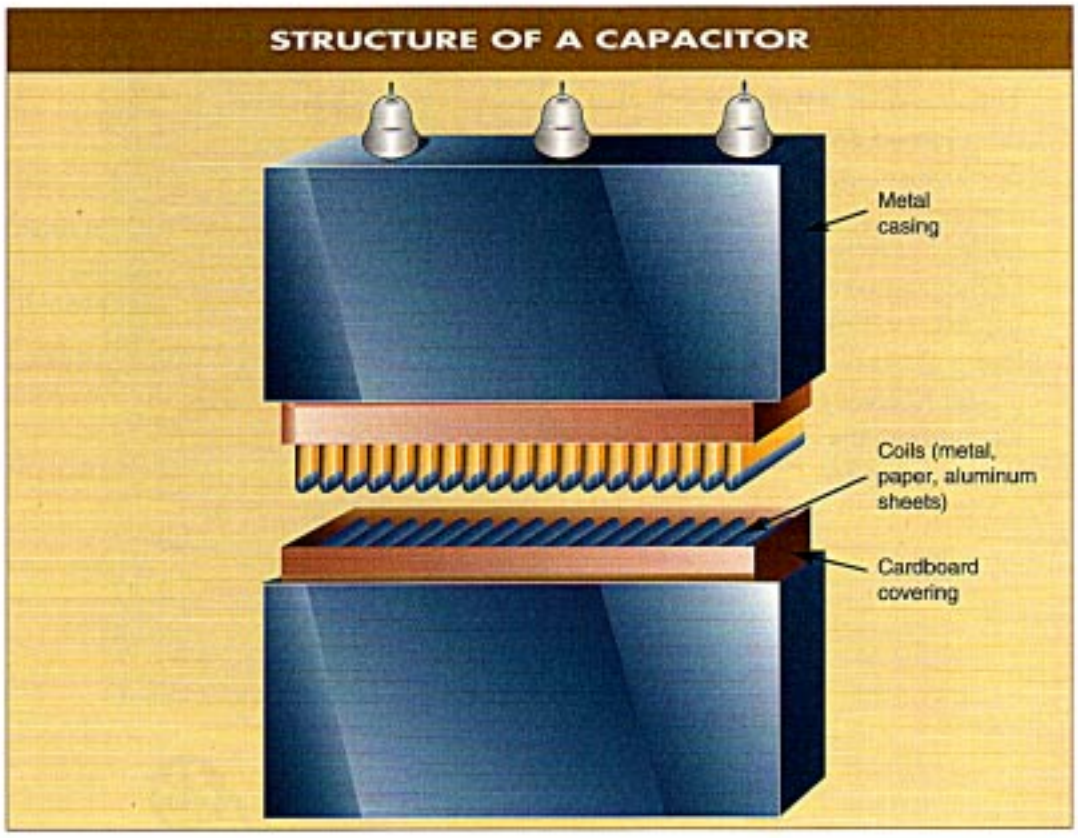
TOTAL: 240 capacitors x 53.6 kg/unit = 12 864 kg≈13 000 kg

TEST RESULTS

Batch	Mean residual concentration of PCBs* Coil (mg/kg)	Cardboard (mg/kg)	of extracted fluid** held in active parts (%)**
No. 1	9.9	20.5	0.102
No. 2	6.9	24.3	0.014
No. 3	17.2	10.8	0.525

* The criterion set for PCBs is 50 mg/kg.
** The criterion set for the extraction fluid is 0.2%.

STRUCTURE OF A CAPACITOR



POTENTIAL AND LIMITATIONS

The on-site reduction in the volume and mass of PCB-contaminated electrical capacitors for disposal is a promising development, both economically and environmentally. Metal parts thus decontaminated can be recycled or reused commercially. The Decontaksolv™ process facilitates the recycling and the commercial reuse of the metal components, which correspond to 65% of the total weight of an electrical capacitor, thus reducing storage costs.

This mobile system offers an alternative to fixed facilities and their accompanying drawbacks. With the Decontaksolv™ process, PCBs are extracted in the liquid state, thereby simplifying both handling and final elimination.

A minimum amount of contaminated equipment is needed, however, in order to render the process economically feasible. In some cases, several users will have to be brought together.

Finally, this process can be applied to other types of contaminated materials, such as transformer cores and other porous materials.

INFORMATION

This data sheet is based on the results of a technology development and demonstration project carried out by Sanexen Environmental Services Inc. in cooperation with Hydro-Québec. The project received financial support from the St. Lawrence Centre.

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