St. Lawrence TECHNOLOGIES

ABSTRACT

Most methods using inorganic substances to treat contaminated sediment are costly when applied to small-scale restoration projects. With a dredging volume of less than 5000 m³, the Port of Sorel, located at the mouth of the Richelieu River on the St. Lawrence, is a case in point. This project consisted of demonstrating the technical and economic feasibility of a new physico-chemical treatment process for sediment contaminated with heavy metals. The objective was to render the sediments clean enough for disposal at an authorized on-land site.

CONTAMINATED SEDIMENT

DEMONSTRATION PROJECT OF A PHYSICO-CHEMICAL TREATMENT PROCESS FOR CONTAMINATED SEDIMENT AT THE PORT OF SOREL

HIGHLIGHTS

- **Technology**
  - Dredging with a clamshell dredge;
  - Sediment storage basin on a wharf at the Port of Sorel;
  - Desilting and settling;
  - Conditioning and dewatering with a rotary press;
  - Treatment of the filtrate using a mobile water-treatment unit.
- **Environment**
  - Restoration of the aquatic environment;
  - Respects standards for on-land disposal;
  - No negative impacts on the environment.
- **Cost**
  - Simple technology;
  - Rapid mobilization;
  - Reduced labour;
  - Reduced costs of disposal of dredged material.

Saint-Laurent Vision 2000

Environment Canada — Protection — Québec Region

Environnement Canada — Protection — Région du Québec

Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

Canadian Coast Guard

Garde côtière canadienne

PROJECT OBJECTIVES

The main objectives of the project were as follows:

- To develop a new physico-chemical treatment process that is easy to implement and operate and as low cost as possible;
- To demonstrate the technique under working conditions;
- To assess the feasibility of applying this method at different contaminated sites on the St. Lawrence River or the Great Lakes;
- To verify the maximum capacity of this treatment process on different types of dredged material and a range of contaminant concentrations;
- To optimize treatment methods by using a reduced quantity of sediments;
- To estimate the real overall unit costs of this treatment process, including the disposal costs of treated dredged material and elimination of the contaminants extracted;
- To assess the environmental and commercial potential of this treatment method for the restoration of contaminated aquatic sites, and the benefits for the Canadian environmental-protection industry.

BACKGROUND

Shallow areas in the St. Lawrence River pose a major problem for shipping. Maintenance dredging in port facilities and in the ship channel has proven to be necessary to ensuring a safe water level for ship traffic.

Today, an assessment of the impacts on the aquatic environment must precede any such dredging. More and more, various federal and provincial regulations require that dredging projects be combined with technologies for the pretreatment and/or treatment of contaminated sediment when the presence of contaminants inhibits the discharge of dredged material into open waters.

We are thus compelled to develop and demonstrate novel solutions to reducing or eliminating the discharge of contaminated sediment into the St. Lawrence River.

TECHNOLOGY

The main technological appeal of this demonstration project is the dewatering process. In this case, a rotary press — previously demonstrated in dewatering industrial and municipal sludges — was used in an attempt to decontaminate the sediment.

With the rotary press technology, preconditioned sediments are fed into a rectangular channel on the periphery of a rotating disk whose lateral walls are composed of filtering elements (screens) that extract water and retain solids. The disk exerts a compressive force and forward motion on the material to be dried. Together with a low feed rate and the mechanical pressure exerted at the outlet, the result is a cake with very low water content.

The rotary press operates continuously. A drive box maintains the disk rotation speed at between 0.2 and 2 rpm. The rotating disk is completely enclosed, thereby eliminating any health risks at the site. A pressurized flocculator is integrated into the system to condition fluid sediments. The addition of polymers proved necessary and would appear to be required in most cases of sediment treatment.

The press is fed by an automatic centrifugal pump, which exerts constant pressure at the inlet.

A system of conveyor belts evacuates the cakes and the filtrate is treated if necessary by a mobile water-treatment unit before being discharged to the St. Lawrence River.

RESULTS

The rotary press reduced the volume of sediments by 5 to 10 times, depending on dryness at the inlet. The dryness level went from 15% to 72% of total particulate matter (TPM) during dewatering tests on sediments fortified with chromium, zinc and copper. These metals were artificially added to the sediments for experimental purposes.

The rotary press dewatering process produced a filtrate that conformed to municipal standards for its discharge to receiving water. However, filtrate from tests on fortified sediments required the use of a mobile treatment unit. After treatment, residual heavy-metal contamination in the cake was in the A-B range of the provincial government's policy on the rehabilitation of contaminated soil, and the B-C range with fortified sediment.

The production rate of the dredge averaged 44 m³/h. The raw dryness rate of the dredged material from the clamshell dredge was an average 50% of TPM.

In treatment tests with the rotary press, the dredged material had to be diluted to between 15% and 25% of TPM directly in the detritus tank for flocculation.

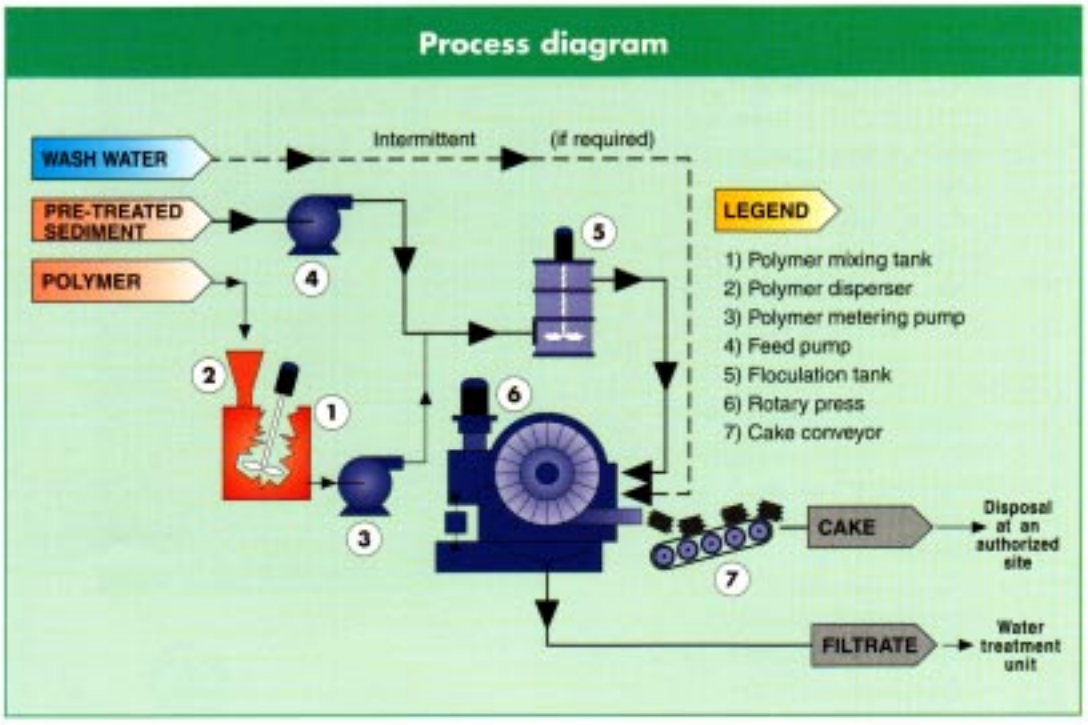
Levels of shovellability for purposes of disposal range between a minimum of 50% and 55% of TPM. At 60% to 70% of TPM, the environmental impacts of on-land disposal are considerably reduced.

The project demonstrated that it is possible to store 4000 m³ of dredged material on a port wharf if it is the product of a mechanical dredge (50% dryness); but would be more difficult with the dredged material of a hydraulic dredge (15% of TPM), in the absence of a dewatering process.

Dewatered sediments may be used to develop commercial and industrial land. In the former case, for example, an old sandpit was rehabilitated in part.

Unit costs of dredging, temporary storage and on-land disposal average $40/m³ using a mechanical dredge. These costs rise to $65/m³ with a hydraulic dredge and a sediment-treatment technology that uses a series of hydrocyclones, flocculant injections and drying with band filters. The rotary press would cost 30% more due to its average production rate.

Process diagram



POTENTIAL AND LIMITATIONS

The treatment process employed by Decontam Inc. facilitates the handling and disposal of sediments while lowering heavy-metal concentrations and reducing volumes for on-land disposal.

The project demonstrated that the addition of grain dust, generally found at many ports, facilitates the sediment dewatering process and offers interesting possibilities in terms of agricultural reuse of dredged material.

The dewatering process yielded a very dry cake at the outlet of the rotary press, but production and capture rates were only average due to the large amount of very fine particles present in the material to be treated.

During the sediment dewatering process, the metals removal rate was no higher than 30% on average. This is adequate for sediment contaminated just above the C range, but insufficient if contaminant concentrations are very high.

In order to render contaminated sediment acceptable for unrestricted on-land disposal or reuse, other physico-chemical treatment methods should be combined with the dewatering unit.

The project also demonstrated that this treatment method needs further development and for now can only be applied to sediments excavated with a hydraulic dredge.

INFORMATION

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For more information, contact :

Jean-René Michaud, P. Eng., M.Sc.A.
Environment Canada
Technology Development Section
685, Cathcart Street, 8th Floor
Montréal, Québec
H3B 1M6
Tel.: (514) 283-9207

André Poulin, P. Eng., Ph.D.
Project Leader
Décontam Inc.
2401, Lapierre Street
LaSalle, Québec
H8N 1B7
Tel.: (514) 364-6860

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Data sheets may be obtained from:

Environment Canada
Technology Development Section
685, Cathcart, 8th floor
Montréal, Québec
H3B 1M6
Tel.: (514) 283-9274

Production:
Dianne Ouellet
Hélène Perrault

Writers:
Jean-René Michaud, P. Eng.
André Poulin, P. Eng., Ph.D.

Layout and printing:
Richard Veilleux Imprimeur

Editor:
Patricia Potvin

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