St. Lawrence TECHNOLOGIES

ABSTRACT

In Spring 1995, Ferti-Val Inc. joined Cascades East Angus Inc. and Industries Cascades Inc., two component enterprises of Groupe Cascades, to work together on a project to demonstrate a technology for reclaiming acidic mining tailings by using alkaline residues, deinking residues, and compost. The University of Sherbrooke has become associated with this demonstration project, specifically with its scientific aspect.

As part of this project, a 1.6 hectare demonstration cell has been built at the site of the former Eustis mine in the Eastern Townships. A layer of deinking residues from 1.2 to 1.5 m thick has cut off the supply of oxygen to the wastes, and thus stopped the process of lixiviation of the acidic waters.

The project has been monitored, experimentally and environmentally, for 14 months.

Saint-Laurent Vision 2000

INDUSTRIAL WASTEWATER

METHODS FOR STABILIZING AND RECLAIMING ACIDIC MINE TAILINGS BY USING RESIDUES FROM DEINKING FACTORIES

MAIN FEATURES

- **Technology**
  - Technique for restoring acidic mine tailings
  - Capillary barrier limiting the passage of oxygen
  - Development of a geotechnical material for environmental applications
- **Environment**
  - Restoration of acidic mine tailings
  - Large-scale use of deinking residues
- **Economy**
  - An economical technique of restoring mine tailings which generate acidic waters
  - Development of a market for deinking residues from pulp and paper mills

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UNIVERSITÉ DE SHERBROOKE
Federal Office of Regional Development (Quebec)
Bureau fédéral de Développement régional (Québec)

PROJECT OBJECTIVES

1. To demonstrate the feasibility of controlling the phenomenon of acidic mineral leakage with a covering comprised of alkaline residues, deinking residues, and compost.

2. To generate knowledge useful in subsequent work on stabilization and final reclamation of acidic main tailings using deinking residues.

3. To put in place a demonstration project for measuring various parameters necessary in applying new technologies using deinking residues, such as covering up sanitary-waste burial sites.

BACKGROUND

Some mine tailings contain metallic sulfurs which oxidize on contact with the oxygen in the air, producing an acid. Waters draining from such sites are therefore highly acidic and loaded with metals. The presence of acidic mine tailings, therefore, represents an environmental hazard for neighboring habitats.

One of the solutions recognized by the scientific community to this problem is to cover waste sites with a barrier (a capillary barrier, a flooding barrier, a synthetic barrier, etc.) which can cut off the supply of oxygen. In the absence of oxygen, the process of long-term oxidation of the residues is greatly slowed down, if not completely stopped.

The partners in this demonstration have identified the deinking residues from the Kingsley Falls plant of Cascade Industries Inc. as possessing the properties required in capillary barriers. Such a utilization would permit using large volumes of these kinds of residues.

A 1.6 hectare demonstration cell has been set up on the site of the former Eustis mine in the Eastern Townships and, from August 1995 to October 1996, has been monitored in order to demonstrate the feasibility of this technology.

TECHNOLOGY

The project entailed using successive layers of alkaline residues, as neutralizing materials; deinking residues, as saturated materials to limit the diffusion of oxygen and the percolation of water from precipitation into the mineral residues; and compost, produced from both municipal and paper-mill wastes, to support vegetation. The key to the technology is the concept of a capillary barrier, or of a multi-layer covering. The efficacy of such a system is closely linked to the capacity of the material to remain saturated so as to limit the passage of oxygen.

RESULTS

Evaluation of Deinking Wastes for Controlling Acidic Mineral Drainage

The evaluation by Cascade Industries of deinking residues at its Kingsley Falls plant laboratory showed that these residues have the characteristics needed to function as a capillary barrier. The tests actually showed that these residues resist high negative pressure (suction) without permitting drainage. As well, they showed the existence of a permeability band from 4.3×10^{-6} cm/s to 1.6×10^{-7} cm/s (as measured in the laboratory). In the field, lysimetric monitoring showed that effective values varying from 2.52×10^{-7} cm/s to 10^{-9} cm/s could be attained. These deinking residues are, in this respect, comparable if not superior to the fine materials, such as till or silts, generally used in such applications.

As well, oxygen measurements in the field confirm that the deinking residues block diffusion to the acidic mineral residues. Oxygen concentrations less than 3% were observed below 0.1 m in the deinking residues, and dropped to zero below 0.5 m.

The project has definitely confirmed that these residues have the characteristics necessary to act as a capillary barrier.

Performance of the Demonstration Cell

Preliminary results after environmental monitoring showed a marked improvement in pH in surface waters around the circumference of the cell, as well as a significant reduction in metal concentration (Table 1).

However, the iron content increased measurably during the Summer of 1996, to decrease later. This phenomenon shows the efficacy of the barrier in blocking oxygen. Iron content increases until all the oxidized iron present in the cell before the reclamation is purged.

Neutralizing the mineral residues before placing the capillary barrier was, based on the lysimeter readings, judged to be unnecessary. Whether there was or was not neutralization, the pH tended to the same level. This finding will lower the cost of placing a capillary barrier.

Construction

Construction of the demonstration cell allowed the identification of the best ways of placing the deinking wastes which, moreover, showed excellent behavior.

Economic Analysis of the Technology

The final thickness of the layer of deinking wastes on the demonstration cell varied from 1.2 to 1.5 m. This thickness was chosen to ensure adequate protective and capillary-barrier layers. The project showed that the first 30 to 50 cm of deinking residues served as a capillary barrier and considerably reduced the passage of oxygen. However, fundamental data on the geotechnical behavior of deinking wastes remain to be confirmed. These data will be obtained as part of a research project now underway at the University of Sherbrooke.

Various technical scenarios, based on the data obtained, have been evaluated. They show that the technology could be economical when compared to conventional restoration techniques using multilayer barriers.

TABLE 1. METAL CONCENTRATION IN LIXIVIATION WATERS

Metal	Initial concentration (mg/L)		Final concentration (mg/L)	MEF* Standard Directive 019
	Eustis 3	Eustis 4		
Cadmium	0.014	0.078	<0.002	—
Copper	1.7	12	0.003	0.3
Iron	2.2	390	42	3
Lead	0.51	0.39	0.15	0.2
Zinc	2.2	17	0.026	0.5

*MEF : Ministère de l'Environnement et de la Faune du Québec.

POTENTIAL AND LIMITATIONS

Potential

The cell established at Eustis clearly shows the feasibility of controlling acidic mineral drainage by using a capillary barrier of deinking residues.

The impermeability of deinking residues is comparable to that of fine materials, thus offering the potential of other uses of these residues in environmental geotechnology. Finally, this technology permits use of large quantities of this type of residue.

Limitations

The distances between where deinking residues are generated and mine sites increase the costs and decrease the advantages of this technology.

Where these distances are within several hundred kilometers, however, the technology can be considered.

The results obtained are valid for the type of deinking residues produced at the Cascade Industries' Kingsley Falls plant. An exhaustive characterization of the deinking residues is needed before any field application.

INFORMATION

This data sheet is based on the results of a technology development and demonstration project carried out by Ferti-Val Inc., in collaboration with Cascades Industries Inc., Cascades East Angus Inc., and the University of Sherbrooke, and with financial and technical support from Environment Canada, and the Federal Office of Regional Development (Quebec). Several other financial partners supported the project, including : the Ministère des Ressources naturelles du Québec (MRN), the Centre québécois de valorisation des biomasses et des biotechnologies (CQVB), the Ministère de l'Environnement et de la Faune du Québec, the National Research Council Canada (NRCC), and Enviro-Accès.

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St. Lawrence TECHNOLOGIES

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