B.7. Metal Leaching/Acid Rock Drainage Mitigation in Quebec: An Overview

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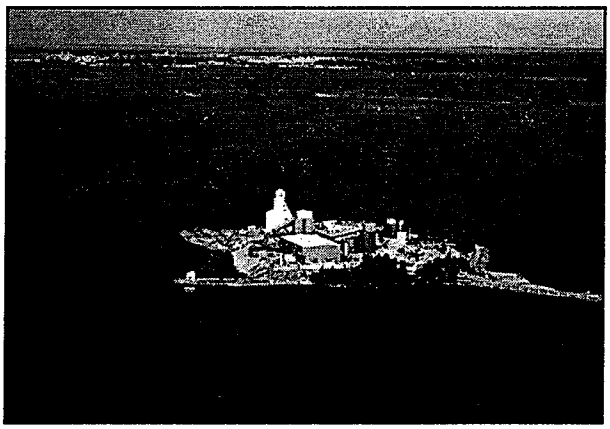
Décembre 1999

Metal Leaching/Acid Rock Drainage Mitigation in Quebec:an Overview



Mining in Québec- some figures (1998)

- Total shipment of $ 3,5 Billions
- More than 17, 000 direct jobs
- Annual investments exceeding $1 Billion
- Production of more than 25 mineral substances :Ag, Cd, Co, Cu, Fe, Ni, Nb, Au, Se, Te, Zn, asbestos, graphite, ilmenite, mica, salt, silica, sulphur, talc, titanium, peat, etc.

Definition of Tailings

Rejected mineral substances, sludge and water, except the final effluent, from extraction operations and ore treatment, and slag from pyrometallurgy operations.

Tailings included

- Tailings ponds for fine processing waste
- Tailings dump for coarse waste
- Sedimentation ponds

Types of Tailings

Acid: pH is lower than 5.5 and/or tailings may potentially generate acidic drainage

Neutral: pH between 5.5 and 8.5

Alkaline: pH over 8.5

Extent of Tailings Sites in Québec

Type	Area of tailings (ha)			Number		
	Tailings	waste	Ponds	Tailings	Waste	Ponds
Acid	3 252	2271	633	66	22	16
Neutral	4 928	1651	429	94	83	14
Alkaline	1 627	320	51	42	38	2
Total	9 807	2 712	1 123	202	143	32
Grand total	13642			377		

Problems associated with the storage of tailings in Quebec

•Wind erosion

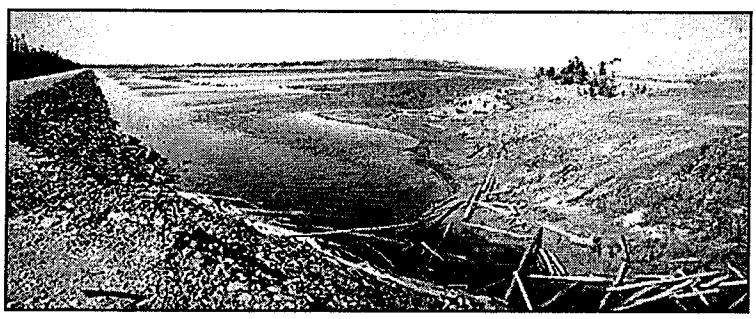
East Sullivan Site
Abitibi, Québec

Problems associated with the storage of tailings in Quebec

Water erosion

East Sullivan Site
Abitibi, Québec

Problems associated with the storage of tailings in Quebec



- Acid drainage
- East Sullivan Site Abitibi, Québec

ML/ ARD Mitigation Works in Quebec

1- Research and Investments

2- Mitigation Technologies

3- Demonstration of Technologies

1- The Québec Government 's Research and Investments in ARD Mitigation

1.1 Mine Environment Neutral Drainage

Québec: 1,967 M$ Canada: 1,665 M$ Industry: 1,37 M$

1.2 Ecological Mines program

Phase I :1993 to 1997 0,439 M$

1.3 Crown Site Restoration Program (80% ARD)

1987 to 1999: 14 M $

1999 to 2001: 6 M$

1- The Québec Government 's Research and Investments in ARD Mitigation

1.4 Private Site Restoration Program

1994 to 1997 : 1,5 M $

Private sector : 3 M $:

1.5 Ministère de l 'Environnement

ARD sites Weedon: 5,6 M $ Aldermac : 0,6 M$

1- The Québec Government 's Research and Investments in ARD Mitigation

1.6 Orphan Sites Program (in preparation)

- A total of 74 orphans sites in Québec
- Total estimated cost: $75 M
- $40 M needed for 15 priority sites, mainly acidic

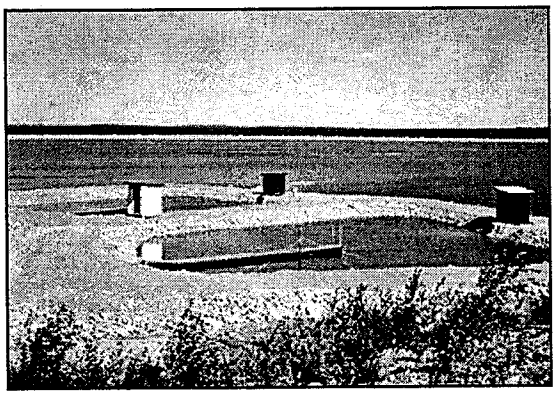
2- Mitigation Technologies

2.1 Immersion of fresh pyritic tailings

(LOUVICOURT, MEND PROJECT)

2- Mitigation Technologies
2.1- Immersion of fresh pyritic tailings

Louvicourt Mine
Site
Abitibi,Québec

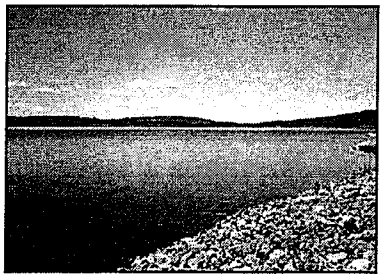


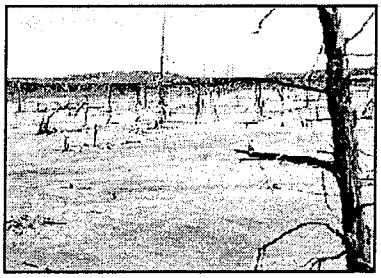
2- Mitigation Technologies

2.1 - Immersion of fresh pyritic tailings (L.M.)

2.2 - Immersion of acidic tailings (CAMBIOR)

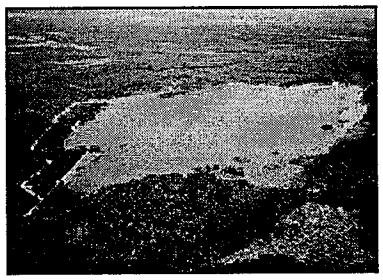
2- Mitigation Technologies
2.2 - immersion of acidic tailings

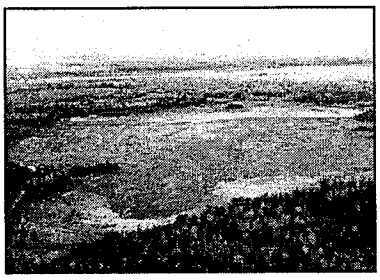




Solbec Site, Cambior inc. , Estrie

2- Mitigation Technologies
2.2 - immersion of acidic tailings





Solbec Site , Cambior inc., Estrie

2- Mitigation Technologies

2.1 - Immersion of fresh pyritic tailings (L.M.)

2.2 - Immersion of acidic tailings (CAMBIOR)

2.3 - Engineered dry cover for reactive tailings

2.3.1 - Clay cover (MRN)

2- Mitigation Technologies
2.3.1 - Clay cover

Lorraine Site
MRN
Abitibi,Québec

2- Mitigation Technologies
2.3.1 - Clay cover

Lorraine Site
MRN
Abitibi, Québec

2- Mitigation Technologies
2.3.1 - Clay cover

Lorraine Site
MRN
Abitibi, Québec

2- Mitigation Technologies

2.3 - Engineered dry cover for reactive tailings

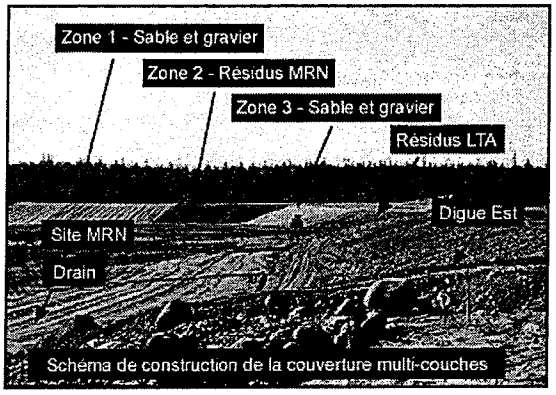
2.3.1 - Clay cover (MRN)

2.3.2 - Tailings cover (BARRICK)

2- Mitigation Technologies

2.3.2 - Tailings cover

LTA Site
Barrick inc.
Abitibi, Québec



2- Mitigation Technologies

2.3 - Engineered dry cover for reactive tailings

2.3.1 - Clay cover (MRN)

2.3.2 - Tailings cover (BARRICK)

2.3.3 - Bentonitic geomembrane (MRN)

2- Mitigation Technologies

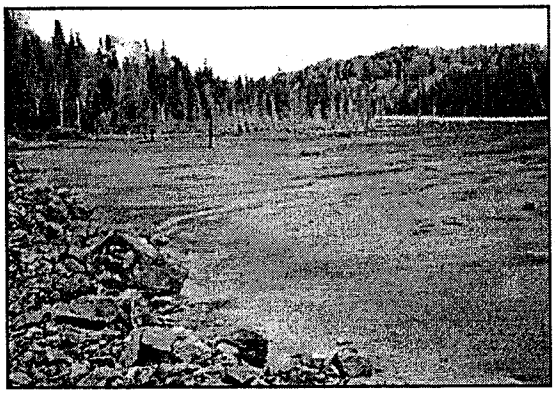
2.3.3 - Bentonitic geomembrane

Somex Site
MRN
Mauricie, Québec

2- Mitigation Technologies

2.3.3 - Bentonitic geomembrane

Somex Site
MRN
Mauricie,Québec



2- Mitigation Technologies

2.3.3 - Bentonitic geomembrane

Somex Site
MRN
Mauricie,Québec

2- Mitigation Technologies

2.3.3 - Bentonitic geomembrane

Somex Site
MRN
Mauricie,Québec

2- Mitigation Technologies

2.3 - Engineered dry cover for reactive tailings

2.3.1 - Clay cover (MRN)

2.3.2 - Tailings cover(BARRICK)

2.3.3 - Bentonitic geomembrane(MRN)

2.3.4 - Organic waste material (MRN)

2- Mitigation Technologies

2.3.4 - Organic waste material

East Sullivan
Site, MRN
Abitibi,Québec

2- Mitigation Technologies

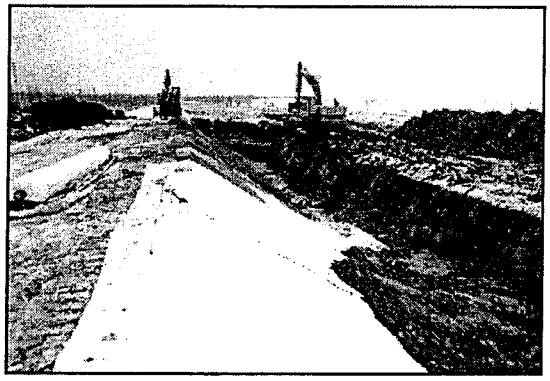
2.3.4 - Organic waste material

East Sullivan
Site, MRN
Abitibi,Québec
Barks

2- Mitigation Technologies

2.3.4 - Organic waste material

East Sullivan
Site, MRN
Abitibi,Québec
Impervious
dyke building



2- Mitigation Technologies

2.3.4 - Organic waste material

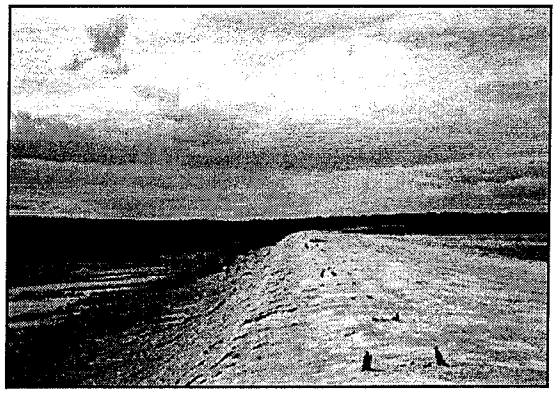
East Sullivan
Site, MRN
Abitibi,Québec
Recirculation

2- Mitigation Technologies

Self-neutralization of an acidic site using the potential of underlying neutral tailings (MRN)

2- Mitigation Technologies
Self-neutralisation

Canadian
Malartic
Site,MRN
Abitibi,Québec



2- Mitigation Technologies
Self-neutralisation

Canadian
Malartic
Site, MRN
Abitibi,Québec

2- Mitigation Technologies
Self-neutralisation

Canadian
Malartic
Site, MRN
Abitibi,Québec

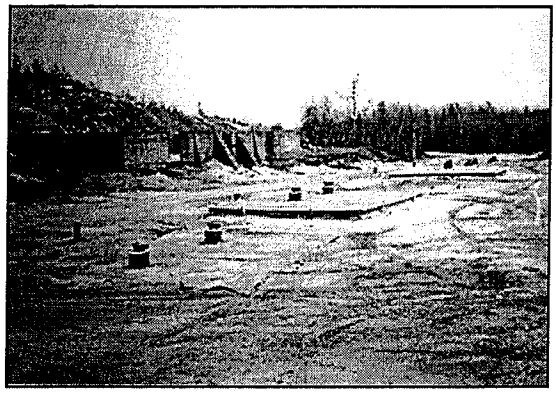
3 - Demonstration of technologies

3.1 - Using cement dusts

3 - Demonstration of technologies

3.1 - Using cement dusts

Eustis Site
Sherbrooke U.
Estrie,Québec



3 - Demonstration of technologies

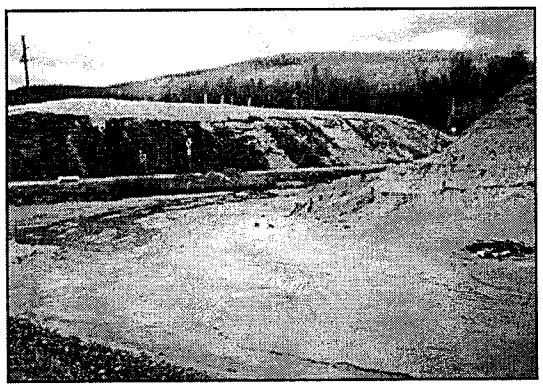
3.1 - Using cement dusts

3.2 - Using de-inking waste

3 - Demonstration of technologies

3.2 - Using de-inking waste

Eustis Site
Ferti-val
Estrie,Québec



3 - Demonstration of technologies

3.1 - Using cement dusts

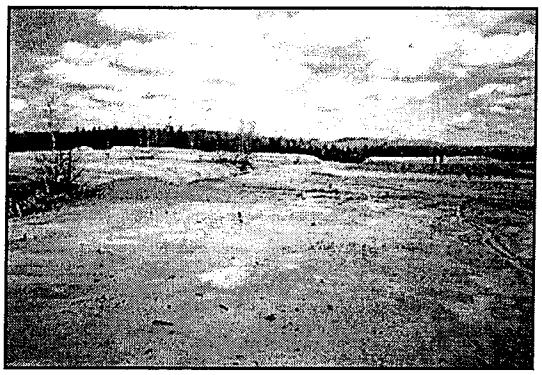
3.2 - Using de-inking waste

3.3 - Using papermill waste

3 - Demonstration of technologies

3.3 - Using papermill waste

Ascot Site
Estrie,Québec



RESULTS

•At the turn of the millenium

• More than 45% of all inactives mining sites have been restored;

• More than 85% of sites given back to the Crown have been restored;

• All existing mines have presented their restoration programs to the MRN;

Performance indicators

Progress of mine restoration works in Québec

	1995	1996	1997	1998
Area (ha)				
Disturbed	12548	13199	13365	13580
In used	6279	6745	6924	7017
Inactive (SI)	6269	6454	6443	6528
Restored(SR)	2169	2454	2622	2861
SR/SI %	34.6%	38.0%	40.7%	43.8%

Conclusion

Laval Nature
Center
Laval,Québec