Geochemical Optimization of Thickened Tailings Deposition to Minimize Water Treatment during Operation at the Kidd Metallurgical Site, Timmins, Ontario

Mazda Biglari, Ronald Nicholson, Michael Venhuis
EcoMetrix Incorporated

Michael Patterson

Xstrata Copper Canada

Sudbury 2007 Mining and the Environment

EcoMetrix
INCORPORATED

Outline

- Problem set-up
- Model development
- Results and discussion
- Conclusions
- Acknowledgement

EcoMetrix
INCORPORATED

Kidd Metallurgical Site

- Three mines: Kidd upper mine, Kidd mine D, and Montcalm mine.
- Produces metals mainly zinc and copper.
- Produces 2 - 3 Mt tailings per year.
- Thickened tailings (65% solid) are mixed and deposited with other liquid effluent streams in the tailings management area (TMA) that occupies about 1,200 ha.

EcoMetrix INCORPORATED

Kidd Metallurgical Site

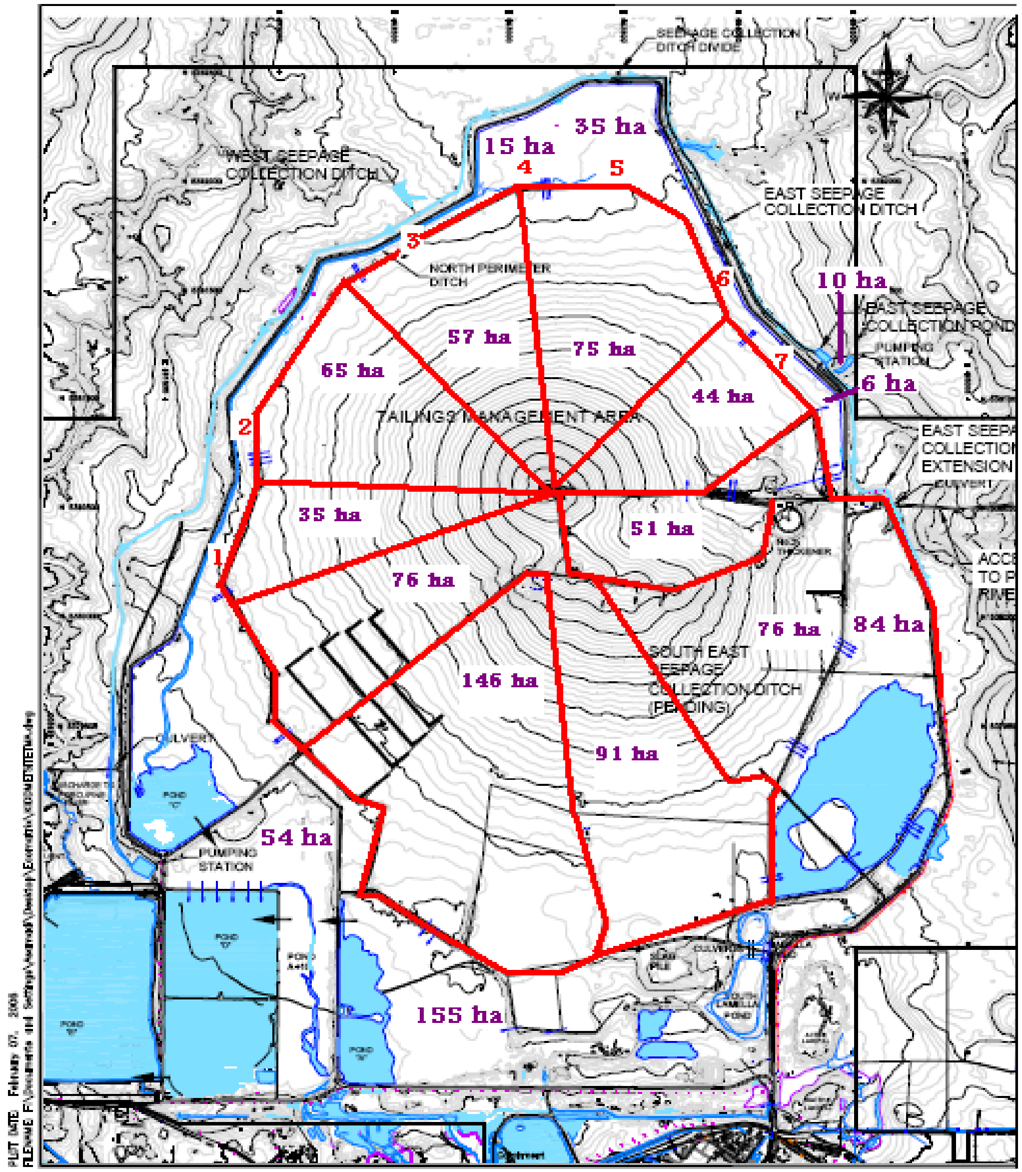
- There is not a tailings pond, instead tailings are deposited in a ~600 ha area conically with the slope of 2-3%.

- Acidic effluent is collected in 3 ponds and treated using lime.

EcoMetrix
INCORPORATED

Kidd Metallurgical Site

- The tailings are deposited in a cyclic pattern.



EcoMetrix INCORPORATED

Model Components

- **Sources of acid generation:**

  - oxidation of the tailings prior to covering with fresh material
  - acid released from the aged uncovered tailings
  - jarosite dissolution (iron sulphate bi-product of zinc process)
  - oxidation of thiosalts in mill process water

- **Variables affecting lime demand:**

  - acid generating factors (above)
  - tailings Neutralizing Potential (NP)
  - deposition cycling period

- **Objective of this project:** to develop a geochemical model to understand the lime demand components in order to minimize lime use and optimize operation (cycling time – jarosite depositing).

EcoMetrix INCORPORATED

Past Investigations

- **Field study:**
  - ➢ The inactive area (base load) was estimated by pore water measurements to be 2,600 t-CaO/a.
  - ➢ The average acidity due to sulphide oxidation 4 kg-$CaCO_3$/t/a.
- **Laboratory testing:**
  - ➢ Mixture of jarosite in tailings showed that the half-life of jarosite is between 1 and 3 years.
  - ➢ Pilot studies showed that the NP of mine D tailings (uncertain among the three) ranges from 5 to 23 kg-$CaCO_3$/t.

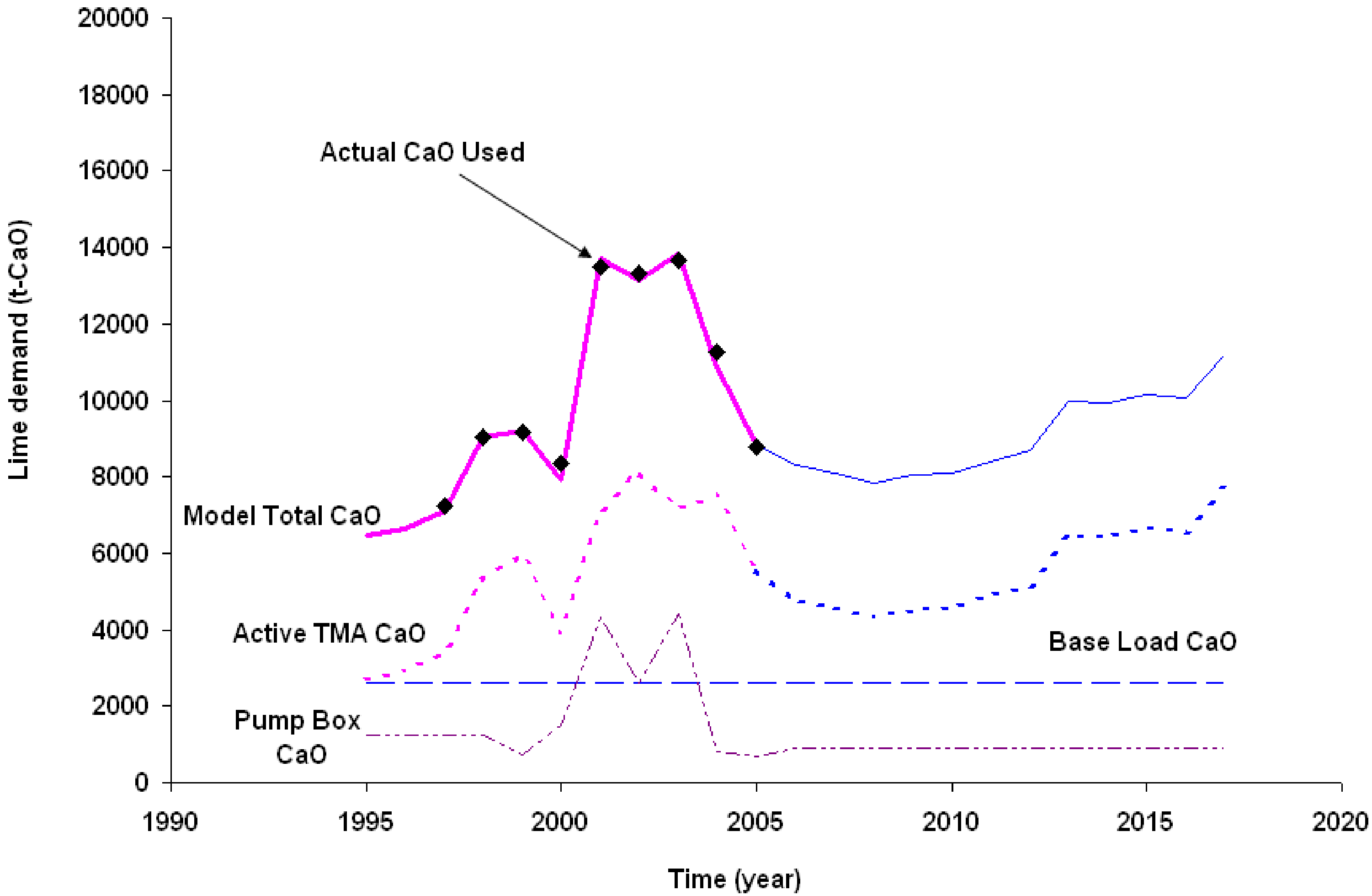
EcoMetrix INCORPORATED

Calibration of the Model

- The lime demand from the active tailings using measured oxygen consumption rates.
- Jarosite dissolution rates from lab studies.
- The lime demand from the inactive perimeter tailings (base load) from field measurements.
- The model was then calibrated for the base-case conditions using the historical data.

EcoMetrix INCORPORATED

Calibration of the Model and Prediction of Future Lime Demand



EcoMetrix INCORPORATED

Sensitivity Analysis

- Sensitivity analysis was performed to address uncertainty
- The factors and their levels are (**bolds are base-case**):

  - Tailings deposition time: 1.5 – **3** years

  - Jarosite disposal: separate disposal – **codisposal with tailings**

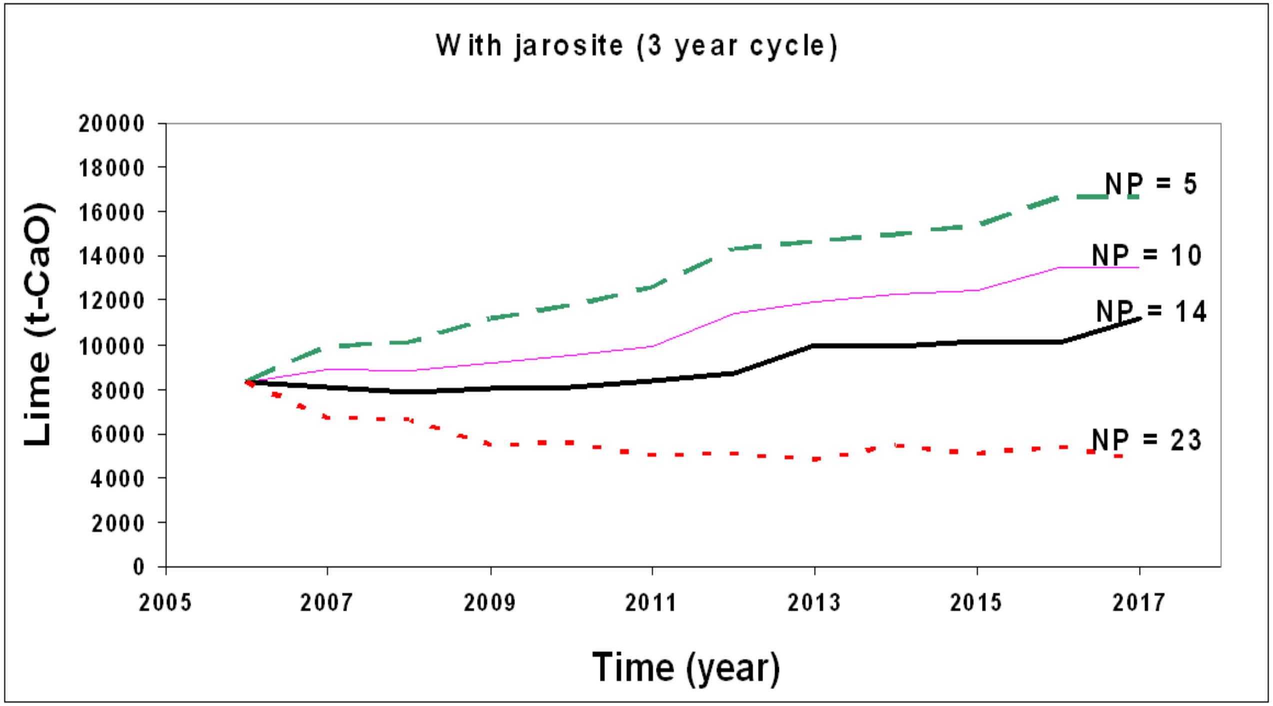
  - Tailings NP content: 5 – 10 – **14** – 23 kg $CaCO_3$/t

  - Jarosite dissolution half-life: 1 – **1.5** – 2 years

  - Sulphide oxidation rate: 2 – **4** – 6 kg $CaCO_3$/t/a

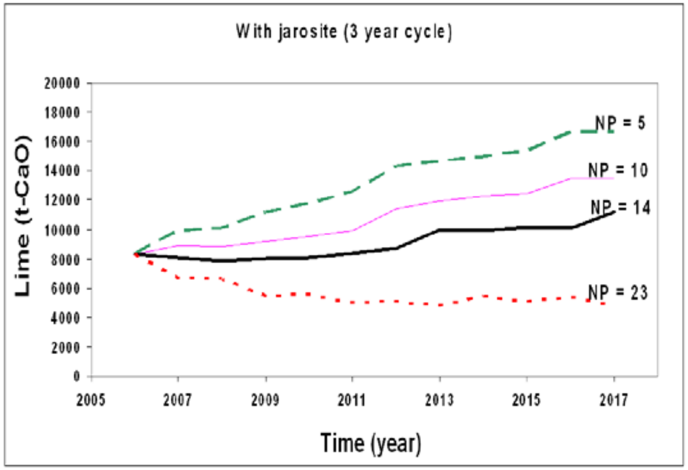
EcoMetrix INCORPORATED

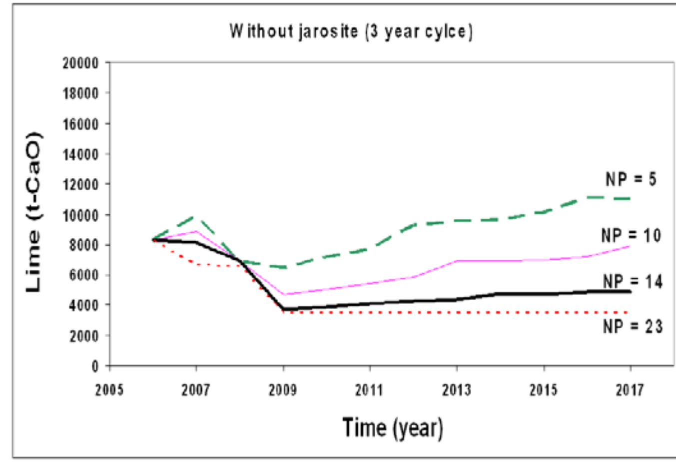
Effects of different NP of Mine D Tailings on the Lime Demand

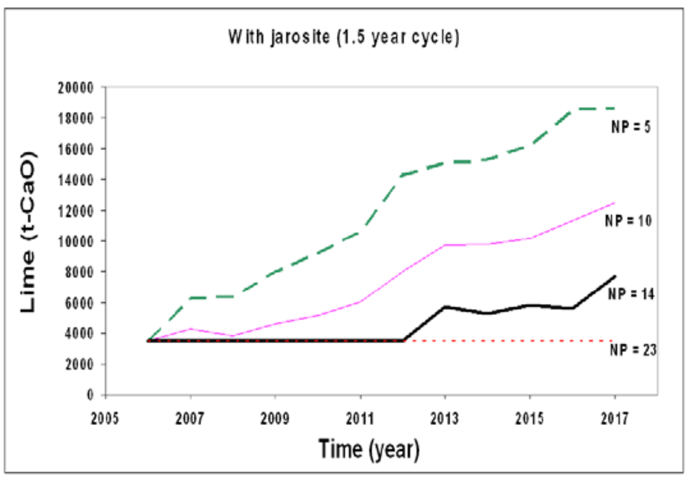


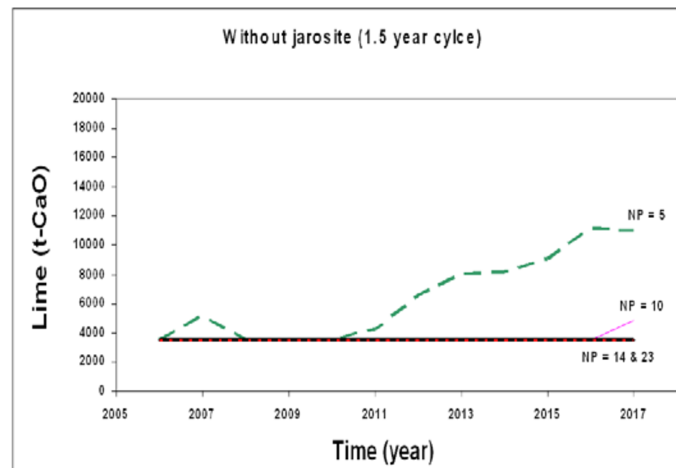
Effects of different NP of Mine D Tailings at different:

- **Jarosite Co-Disposal**
- **Deposition Time**



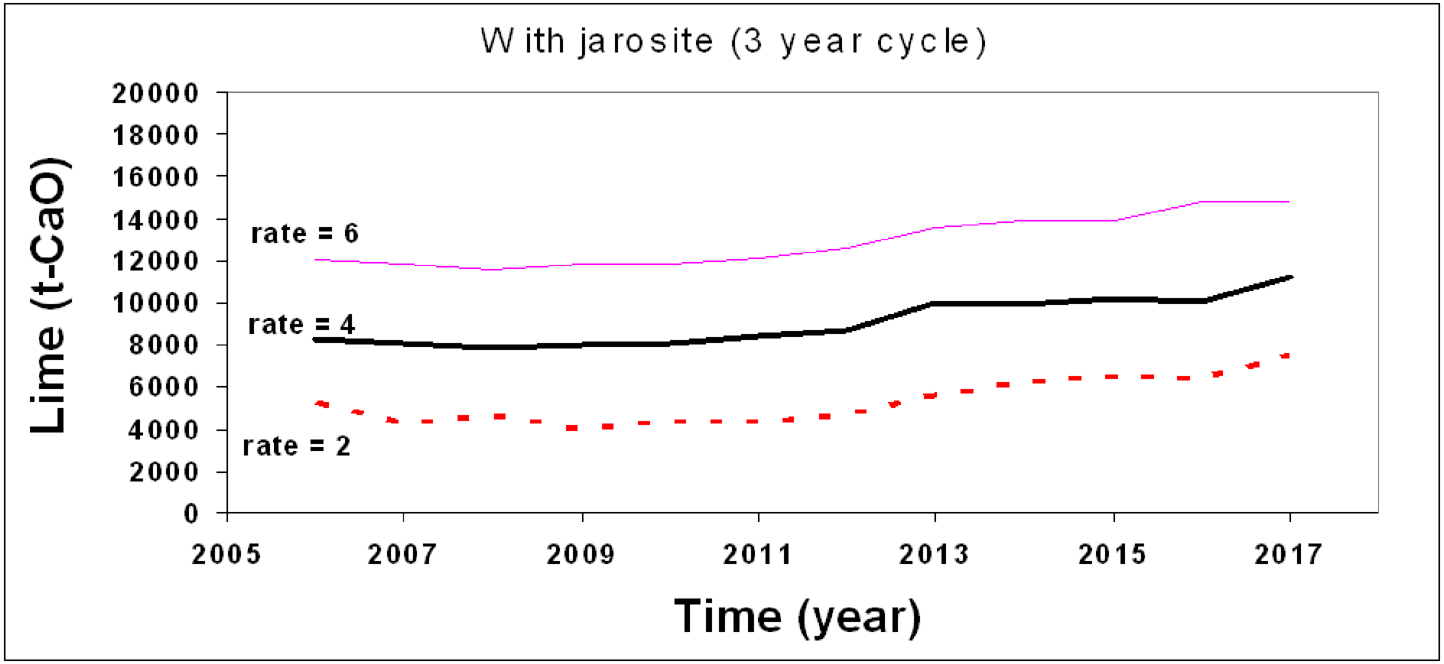




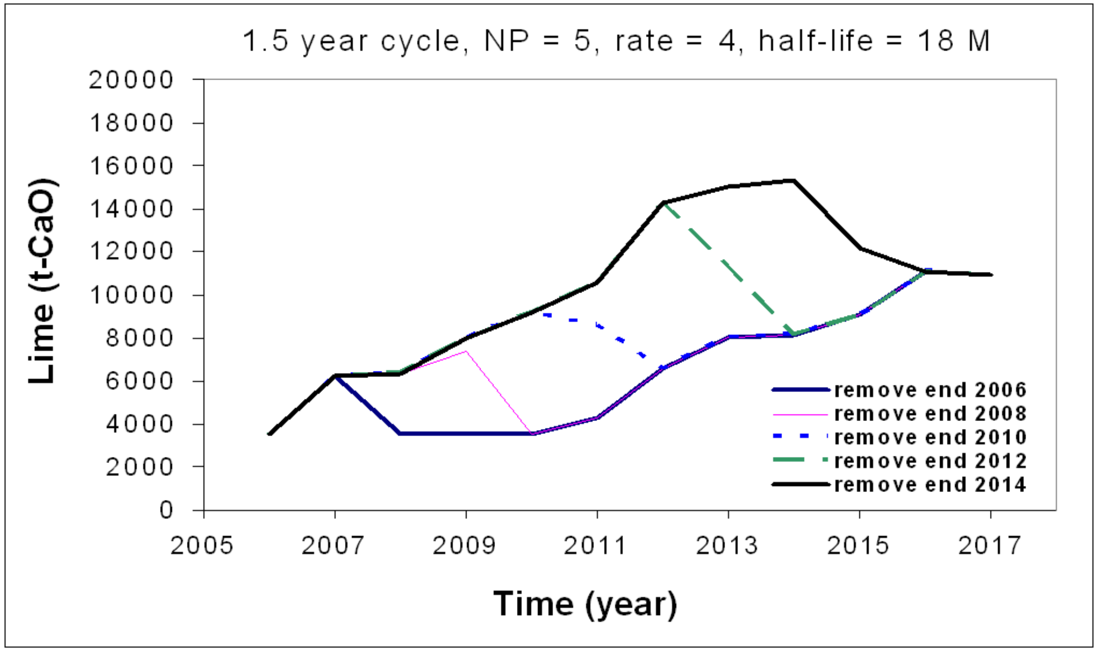


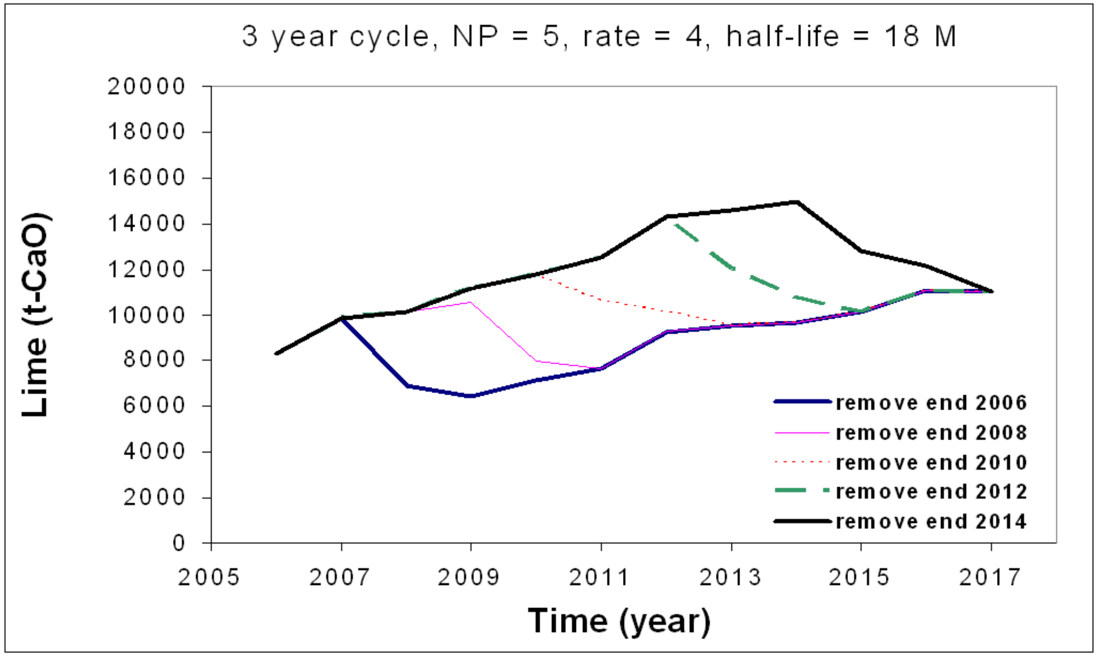
EcoMetrix INCORPORATED

Effects of different Sulphide Oxidation Rates on Lime Demand



Effects of Jarosite Removal from Tailings at different Years





EcoMetrix INCORPORATED

Partitioning of Lime Demand to different Components

Base case – 2010:

- Active area: 17%
- Jarosite dissolution: 38%
- Thiosalt oxidation: 14%
- Inactive area: 23%
- Pump box: 8%
- **Total Lime demand: 8100 t CaO**

No-Jarosite – 1.5 year cycle – 2010:

- Inactive area: 72%
- Pump box: 28%
- **Total Lime demand: 3600 t CaO**

EcoMetrix INCORPORATED

Conclusions

- Optimal cycle time for 0.3 m fresh tailings per cycle (1.5 years).
- The NP of the Mine D tailings and the average annual oxidation rate of sulphides are the two most important variables that will control lime demand.
- The presence of jarosite in the tailings can increase lime demand by 5,000 to 6,000 t-CaO/a and scheduled to be removed by late 2007.
- Proper cycling and deposition management can eliminate lime demand during operations.
- The largest uncertainty is the NP of the tailings and appropriate characterization is required to predict actual lime demand

EcoMetrix INCORPORATED

Acknowledgements

The authors would like to thank Xstrata-Copper Canada for the opportunity to participate in this project.

EcoMetrix
INCORPORATED