SiREM

CASE STUDY

Evaluation of Aerobic and Anaerobic Biodegradation of Weak Acid Dissociable Cyanide

Client
Golder

Site Location
Quebec, Canada, Mine Site

Project Duration
8 Months

Services Provided

- Performed bench scale treatability testing
- Evaluated the addition of cement, mine tailings, and waste rock on WAD cyanide biodegradation

FIGURE 1: Sacrificial Aerobic Control Microcosms were constructed for analysis at specific time points.

Project Highlights

- Observed aerobic microbially mediated cyanide oxidation.
- Adding cement increased pH and slowed the degradation rate.

Problem Definition

Cyanide was used as a lixiviant to extract precious metals at a gold mine in Quebec, Canada (the Site). Free cyanide is extremely toxic to organisms due to its ability to bind metalloproteins. The client wanted to assess possible biodegradation processes controlling the fate of weak acid dissociable (WAD) cyanide in mining tailings ponds at the Site. A laboratory treatability study was designed to monitor changes in aqueous concentrations of cyanide, cyanate, thiocyanate, ammonia, and many other parameters in both aerobic and anaerobic environments at 4 °C. Treatments evaluated to promote biodegradation processes of WAD cyanide included the addition of tailings, waste rock, and cement into laboratory microcosms.

Notable Results

Total cyanide degradation was observed over several months of microcosm incubation via aerobic biological mechanisms, including hydrolysis (which increased the ammonia concentration) and oxidization (which increased the cyanate concentration). Both aerobic and anaerobic treatments showed an increase in the thiocyanate concentration, suggesting a microbially mediated hydrolytic degradation pathway. The anaerobic treatments showed a slower rate of cyanide degradation. The addition of cement increased the pH and slowed the rate of degradation. The results suggested that intrinsic cyanide-degrading bacteria were able to oxidize aqueous cyanide species into less toxic species under aerobic conditions.

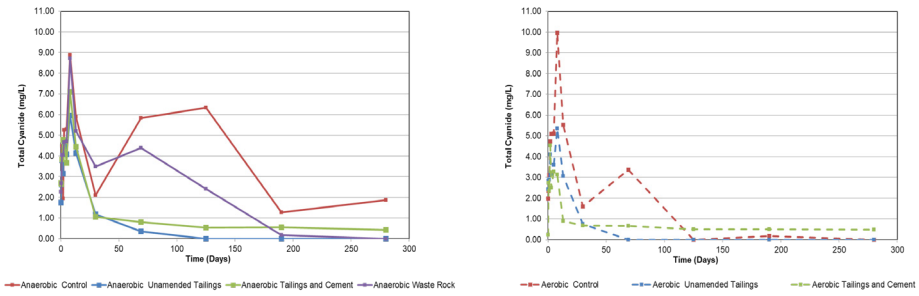

FIGURE 2: Concentration of total cyanide in the anaerobic (left) and aerobic (right) control and treatment reactors.

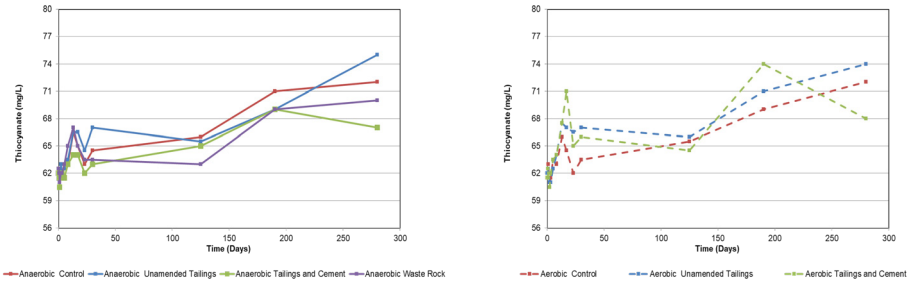

FIGURE 3: Concentration of thiocyanate in the anaerobic (left) and aerobic (right) control and treatment reactors.