USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

TITLE: Technology to Help Alaskan Mines Clean-up Cyanide Contaminated Water - Pilot Scale Testing of a Sequencing Batch Biofilm Reactor

FOCUS CATEGORIES: HYDGEO, TS, TRT, WQL KEYWORDS: 48, 150, 265, 271 DURATION: 1 March 1999 to 29 February 2000 FY99

FEDERAL FUNDING: $19,650 FY 99

NONFEDERAL FUNDING: $22,750

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CONGRESSIONAL DISTRICT: Alaska

Background and Objectives

In 1997 we developed a biological process for treating water contaminated with cyanide. The original research was funded by Ryan Lode Mines. The Ryan Lode Project resulted in a laboratory scale bioreactor (2-liter volume) which was fed cyanide laden wastewater and produced treated water with no measurable cyanide. The results from this study were published in the scientific journal "Water Research"(White and Schnabel, 1998).

As part of the FY1998 Alaska Water Resources Research Institute Program, this project was funded for the first of two years to test a pilot-scale plant for treatment of cyanide contaminated water. Although the proposal had the primary goal of scaling-up the 2-liter reactor by 1000 times, the following additional questions were to be addressed:

1. What is the effect of influent waste stream temperature on the rate of cyanide removal?

2. What is the effect of sulfur, iron, arsenic, lead and other metals on the performance of the reactor? Are the metals bioaccumulated and could this be used as a mechanism for removing unwanted metals from the waste stream?

3. How is the rate of cyanide removal affected by fluctuations in the influent cyanide concentration?

4. What is the relationship between the biomass concentration in the reactor and the cyanide removal rate?

During the first year of the project, the primary goal of scale-up was successful. The results from the start-up and operation of a 2000 liter pilot-scale system were presented at the 9th International Conference on Cold Regions Engineering and were published in the

attached proceedings (Pilon and White, 1998). In addition, presentations were made to a joint meeting of the Alaska Water Wastewater Management Association and the American Water Resources Association on December 9, 1998 and to the Water and Environmental Research Center on October 16, 1998. In addition, a manuscript is being submitted to the journal "Water Research" on pilot-scale operation of the cyanide treatment system.

Funding for the second year will be used to continue testing the pilot-scale reactor and use a laboratory-scale reactor to continue addressing the four questions listed above. The first and third questions are presently being addressed in the pilot-scale system.

Justification

Nearly all hard-rock gold mines in Alaska use a cyanide amalgamation process to remove gold from complex minerals. Processes such as those at the Fort Knox Gold Mine near Fairbanks mix cyanide with a crushed rock slurry in large tanks. Others, such as the Ryan Lode Mine, also near Fairbanks, use the heap leach process. In the heap leach process, a concentrated cyanide solution is sprinkled over massive heaps of crushed ore. In both the slurry and heap leach processes, cyanide extracts gold from ore by forming a cyanide-gold amalgam. The amalgam is then washed from the ore for gold recovery. At the end of the process, the ore contains residual cyanide. Rinsing heaped ore with freshwater results in a leachate contaminated with low levels of cyanide (e.g., 2-10 mg/L CN-WAD).

In order to remain economical, gold mines must have an inexpensive technology for removing cyanide from wastewater. At present, most mines use a chemical process to destroy the cyanide at considerable expense. The sequencing batch biofilm reactor produced by this research will be an inexpensive alternative for miners to eliminate cyanide from waste streams. Particularly as the price of gold drops, miners have an increasing need for cost effective processes.