Water Resources Center

Annual Technical Report

FY 1998

Introduction

Research Program

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Technology to Help Alaskan Mines Clean-up Cyanide Contaminated Water - Pilot Scale Testing of a Sequencing Batch Biofilm Reactor
Project Number	B-02
Start Date	03/01/1998
End Date	02/29/2000
Research Category	Water Quality
Focus Category #1	Hydrogeochemistry
Focus Category #2	Toxic Substances
Focus Category #3	Treatment
Lead Institution	University of Alaska-Fairbanks

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Daniel M. White	Assistant Professor	University of Alaska-Fairbanks	01

Problem and Research Objectives

The purpose of this project is to develop an inexpensive, biological process with which Alaskan mines can detoxify cyanide contaminated water.

Methodology

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 FY1998/99 Alaska Water Resources Research Institute Programs, this project was funded for two years to test a pilot-scale plant for treatment of cyanide contaminated water. 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 conference proceedings (Pilon and White, 1998). 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 was accepted to the journal "Water Research" on pilot-scale operation of the cyanide treatment system (White, Pilon and Woolard, 1999). In January 2000, current results on the project will be presented at the International Symposium on Cold Regions Development in Hobart, Tasmania (White, Zhang and Woolard, 2000).

Principal Findings and Significance

Although the proposal had the primary goal of scaling-up the 2-liter reactor by 1000 times, the following additional tasks were proposed: Task 1: Determine the effect of influent waste stream temperature on the rate of cyanide removal. The influent temperature of the wastewater tested will be varied to determine how the organisms respond at the pilot scale. This temperature variation will help us predict the effects of both diurnal and seasonal temperature fluctuations on process performance in the field. Task 1 is nearly complete (90%). As expected, the rates of cyanide destruction vary greatly with temperature. The cyanide removal rate has been calculated for temperatures of 5, 8, 15 and 20 oC. Rises in temperature consistently result in an increased cyanide removal rate. Task 2: Determine the effect of metals (e.g., sulfur, iron, arsenic and/or lead) on the performance of the reactor. A few studies have shown that the organisms in biofilm systems accumulate metals to the point of toxicity. Since this system will be used to treat mining effluent, the organisms will be exposed to various metals. The potential for metal accumulation and toxicity will be tested by adding selected metals to the feed solution. Work on Task 2 will begin in December 1999 Task 3: Determine the effect of influent cyanide concentration on the cyanide removal rate. Some concentrations of cyanide are toxic to microorganisms. This study will demonstrate what cyanide concentration can be applied before reactor failure occurs. Task three is complete. Influent cyanide concentrations were fluctuated between 10 and 100 mg/L. As with most toxic substrates, the rate of cyanide removal increased with concentration to the point of toxicity after which increases in cyanide concentration resulted in a decrease in removal rate. If time permits, the concentrations will be increased to determine the point of cell death. Task 4: Determine the relationship between the biomass concentration in the reactor and the cyanide removal rate. In general, the more organisms that are present in a reactor, the faster the cyanide will be removed. With cyanide degradation, however, this does not hold. We will investigate the organisms - cyanide removal relationship. This task is nearly complete (90%). Approximately 15 batch tests were conducted to compare cyanide removal rate to biomass concentration. Future work: Work will

continue on Tasks 1, 2 and 4. Completion of laboratory work is anticipated for March 2000. Data interpretation and manuscript preparation will be completed by May 2000. Conclusion: Of the four tasks established for the second year of funding, three are nearly complete or completed. A complete assembly of data for these tasks is available on request. The data is currently being processed and prepared for publication in peer-reviewed journals.

Descriptors

Gold Mine Reclamation Biological Detoxification Cyanide Seqencing Batch Bioflim Reactor

Articles in Refereed Scientific Journals

White, Daniel M. and William Schnabel, 1998, Treatment of Cyanide Waste in a Sequencing Batch Biofilm Reactor, Water Research, Vol. 32, No. 1, pp.254-257.

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Pilon, Tim and Daniel M. White, 1998, Cyanide Treatment in a Pilot Scale SBBR "in" Proceedings: 9th International Cold Regions Engineering Specialty Conference, ASCE, pp. 235-242.

Other Publications

Information Transfer Program

For many reasons (e.g., cost, time, demand), our web pages (http://www.uaf.edu/water) have become the primary source of information transfer for our center. The pages provide information on current research, publication listings, pertinent links, timely announcements, etc. However we are still heavily involved in more traditional methods of providing information on water and water related issues. During the year, we participated in training classes of water resources technology for Alaskan natives, presentations at local K-12 schools, professional meetings (AWRA, AGU, ASCE, etc), and sponsored seminars. We also provided considerable support to the Alaskan state section of AWRA.

USGS Internship Program

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	1	N/A	N/A	N/A	1
Masters	3	N/A	N/A	N/A	3
Ph.D.	N/A	N/A	N/A	N/A	N/A
Post-Doc.	N/A	N/A	N/A	N/A	N/A
Total	4	N/A	N/A	N/A	4

Awards & Achievements

Publications from Prior Projects

Articles in Refereed Scientific Journals

Mendez, Johnny; Larry D. Hinzman; Douglas L. Kane; 1998, Evapotranspiration from a Wetland Complex on the Arctic Coastal Plain of Alaska, Nordic Hydrology, 29(4/5), 303-330.

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Kane, Douglas L.; Derek J. Soden; Larry D. Hinzman; Robert E. Gieck; 1998, Rainfall Runoff of a Nested Watershed in the Alaskan Arctic "in" Seventh International Conference on Permafrost, Centre d etudes nordiques, Universite Laval, Laval, Quebec, 539-544. Hinzman, Larry D.; David W. Robinson; Douglas L. Kane; A Biogeochemical Survey of an Arctic Coastal Wetland "in" Seventh International Conference on Permafrost, Centre d etudes nordiques, Universite Laval, Laval, Quebec, 459-464.

Other Publications