NSERC Industrial Research Chair in Mine Life Cycle

Newsletter
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GREEN MINING MATTERS...

Getting Down to Business
Industry-Academia Partnership: What Does it Mean?

Our NSERC Industrial Research Chair for Colleges in Mine Life Cycle and her partners, Alexco Resources Corp., Capstone Mining Corp., Yukon Zinc Corp. and Victoria Gold Corp., are currently developing research leadership in order to address northern-specific challenges and opportunities within the mining industry. Together, the academic researchers and the industrial partners will develop technologies for a smarter, greener way of mining. The role of the academic researchers is to develop new ideas and test modern technologies. The results of their research, in conjunction with the support and investigations by the industrial partners, provide invaluable scientific knowledge to Yukon's mining sector. Academic researchers are highly qualified and well equipped to do scientific research, and this is just one of many reasons why partnerships between academia, the mining industry and private consultants are so beneficial.

> *"Alexco Resources Corp., Capstone Mining Corp., Yukon Zinc Corp. and Victoria Gold Corp., are currently developing research leadership in order to address northern-specific challenges and opportunities within the mining industry."*

Developing relationships early on in the Mine Life Cycle allows for a more accurate assessment of the needs of industry and the capacity of the researcher. As a result, an Advisory Committee was created with the four industry partners and the Industrial Chair; initial planning reviews, as well as specific goals and expectations, were set out at the beginning of this research process. This committee drives the research by having quarterly meetings which provides continual and consistent communication between the researchers and the industry partners.

This is the key to ensure that the research is going in the desired direction and eases knowledge transfer to the industry. Furthermore, sound partnerships at the beginning of the process results in a higher probability of potential application of new technology that is most beneficial for Yukon and all partners involved.

The industrial Chair for Colleges in Mine Life Cycle is partly funded by the Natural Sciences and Engineering Research Council of Canada (NSERC), a Government of Canada agency that provides grants for research in the natural sciences and engineering. This government funding provides critical resources that promote economic development and opportunities for the industrial partners.

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YUKON RESEARCH CENTRE
Yukon College

Inside Our Lab
Heavy-Metal Removal by natural materials

Water management and treatment has become a major focus for the mining industry, particularly for hard-rock mines. Strict regulations and legislations at both the federal and provincial/territorial level of government require the treatment of mine-affected waters, including surface run-off, drainage from tailings and waste-rock piles, process waters, etc. This treatment must be conducted during the life span of the operating mine, as well as after mine closure.

Mine waters may contain various metal contaminants along with a high sulfate content from the breakdown of sulfide minerals. Some of the current technology uses sulfate-reducing bacteria (SRB) to remove metals from mine waters; however, there is concern over the effectiveness of SRB to sustain an adequate level of biological activity during the winter months in cold-climate regions such as Yukon. Although biological processes are somewhat affected by cold temperatures, chemical processes are typically less temperature sensitive, and may be effective for metal sorption and removal from mine waters.

The mining industry is presently studying and testing the use of anaerobic bioreactors to treat effluent. A typical bioreactor may be a simple trench with a permeable, solid support of gravel and sand with a substrate of organic matter which is used to support SRB growth. The substrate provides feed to SRB, but may also act as a metal adsorbent. A recent study of the passive treatment of mine drainage waters was recently completed in the lab at the Yukon Research Centre (YRC; Janin and Harrington, 2013). The objective of the study was to test the use of various biochars and wood products in order to enhance metal removal efficiency. Spruce and poplar are common wood sources in Yukon and provide local, cost-effective, biodegradable organic matter which is useful in bioremediation in remote Yukon mine sites. This study examined the adsorption capacity of 3 manufactured biochars samples and 3 wood samples spruce wood chips, poplar wood chips and spruce branch mulch.

The following results were observed in the laboratory:

- Biochars achieved >90% removal of Cd, Cu and Zn from a metal-bearing effluent, and 35-69% removal of As; minimal removal of Se.
- Wood products achieved a range of 51 to 94% removal of Cd, Cu and Zn, and limited removal of As and Se.

Research Lab News
Atomic Absorption Spectrometer

The Yukon College is very excited to announce the recent purchase of an Atomic Absorption Spectrometer (AAS). The instrument was purchased by the Yukon Research Centre (YRC) and the Mineral Resource Technologist program, with partial funding from the Canadian Northern Economic Development Agency, for a total of $90,000 including installation. It is the only one of its kind in the Territory that will be exclusively used for researchers, students and visiting scientists. Housed at the YRC laboratory, it is also a valuable resource for geology and chemistry instruction at Yukon College.

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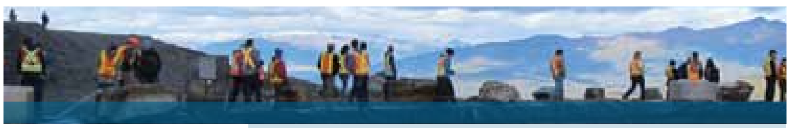
The AAS is used to analyze metal concentrations in water, soil, rock, plant, and tissue samples, thus having many significant applications. This AAS includes both graphite furnace and flame spectrometry capability and will be used for both research and training purposes in Yukon.

When considering the purchase of an AAS, researchers were looking for versatility and reliability. An instrument having the capability of detecting both very low and very high concentrations of metals is vital to scientific research, particularly with regards to environmental remediation. A machine that requires very little maintenance is also very important since Yukon is quite remote and far from major centres.

The AAS has been up and running in the lab for the last 2 months. The spectrometer is already being used to support environmental research projects in Yukon. It can also benefit other scientific research projects, support research in mining exploration, or community health. The Atomic Absorption Spectrometer is a state-of-the-art technology that will serve the hopes and needs of scientists, environmentalists, miners and Yukon citizens.



Research Focus

Building a Strong Team

Guillaume Nielsen, M.Sc., was recently appointed at L'Institut National de la Recherche Scientifique (INRS) University in Quebec City, with co-supervision from the Industrial Research Chair and her collaborators. Guillaume, a French citizen, joins the team at YRC to conduct most of his doctoral study in the Yukon, in collaboration with Alexco Environmental Group and its subsidiary Access Consulting Group. Guillaume is an outdoor enthusiast with a special interest in remediation and the environment. His Ph.D. thesis involves the identification of adequate substrates available in Yukon to improve metals removal from mine waters using anaerobic bioreactors.

Guillaume pursues his doctoral research by determining appropriate organic materials that can be used efficiently as a substrate in a packed bed to assist in bacterial development, as well as promote metals adsorption to help with chemical metal sequestration in cold-temperature climates.

The research is divided into the following specific objectives:

- Assess a selection of organic materials that are readily available in northern regions for (1) their ability to sustain bacterial growth and (2) their ability to sequester metals by adsorption mechanisms.
- Determine the capacities of the selected materials (and mixtures thereof) to sustain bacterial development. This analysis will be carried out by integrating the materials in small-batch anaerobic bioreactors, under nitrogen atmosphere, at room temperature, as well as at 4°C.
- Monitor pilot-scale bioreactors operating in cold temperatures and filled with various organic materials for their metal removal efficiency. The cold-tolerant (or psychrophile) microbial community will be examined in order to identify the parameters that promote their metabolic activities with an emphasis on sulfate, arsenic and selenium-reducing bacteria.
- Characterize metal speciation in bioreactors and their long-term stability.

Ph.D. wages are co-funded by Mitacs, a research funding agency, and Cold Climate Innovation (CCI). Mitacs aims at the development of the next generation of innovators in Canada with vital scientific and business skills to support Canadian economy while CCI, a program of the YRC, is focused on the development and commercialization of cold climate technologies.

A few numbers...

- **99.9** is the percent removal of copper obtained in a bioreactor in the lab in December 2013.
- **8 bioreactors** are currently being tested in Yukon Research Centre laboratory.
- **5.6** is the number by which industry money has been multiplied through research funding.
- **330,000 i**s the surface, in square miles, of the Yukon River Basin (USGS 2001).

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