Curing Abandoned Mines with Clean Biotechnology – Rock-eating bacteria ready to feast on and clean up contaminated mine tailings

Oscar Alvarado, BASc, MA, Project Research Analyst, BacTech Environmental Corp., Toronto, Ontario

Introduction

It's no secret just how resilient bacteria can be. From underwater volcanic vents to frozen tundra, bacteria can live in extreme environments that were once thought to be completely uninhabitable. Today, several unique species are behind an innovative method to permanently clean up tailings and other toxic wastes left behind by mining operations.

History of Bioleaching

Despite the increasing number of advantages of using bacteria to remediate mine wastes, it is only recently that this application has come about. Species such as *Acidithiobacillus ferrooxidans* were first discovered in 1950, but it wasn't until the mid 1980s that scientists began investigating their potential role in eliminating sulfur from coal. It is around that time that the technology migrated to Australia, where private funding allowed it to develop toward a more industrial scale. BacTech Mining Corp.'s first commercial bioleaching plant was built in 1994 at the Youanmi Mine in Western Australia and to date, REBgold (formerly known as BacTech Mining Corp.) has designed, built and operated four plants in various parts of the world. However, in these instances, bioleaching was being applied as a process alternative to smelting for the purpose of recovering metals from difficult to treat ores.

A desire to pursue the application of bioleaching toward tailings remediation led to the formation of BacTech Environmental Corp. in 2010, a result of BacTech Mining Corp. splitting into two companies, one focused on mining (REBgold) and the other on environmental remediation (BacTech Environmental). The latter, which is currently listed on the Canadian National Stock Exchange (CNSX: BAC), has been granted a perpetual, royalty free, exclusive license by REBgold to use the technology for the remediation and reclamation of tailings and waste rock left behind by previous mining operations. Now, bioleaching is being introduced for the first time to areas in the Americas with long histories of mining and large numbers of abandoned mine sites.

Abandoned Mines & Acid Mine Drainage

Currently, the U.S. Bureau of Land Management (BLM) indicates that there are over 31,000 known abandoned mine sites on U.S. public lands alone, many of them containing large stockpiles of toxic tailings (the stuff that is tossed aside once the sought-after metal has been separated). Approximately 75% require further investigation and/or remediation[1], yet acquiring the necessary funds can be a difficult challenge, especially for nearby communities and local environmental groups.

While there is a long list of health and environmental hazards associated with these stockpiles, the most consistent threats that nearby ecosystems and communities face are Acid Mine Drainage (AMD) and heavy metals contamination. AMD occurs when sulfides in tailings react with atmospheric conditions to create an acidic solution that, over time, migrates into the surrounding area. In the process, this acidic solution leaches heavy metals into nearby sources of groundwater that eventually make contact with watersheds, soils and vegetation. The health risks to humans and animals are well documented, but this was not the case when historic gold rushes and other mining booms were taking place.

Conventional practice in the industry has been to continuously treat the water discharge from disposed tailings. However, this approach, which can go on indefinitely, does not prevent the possibility of future problems since the sulfides remain in the tailings. "They bury them and hopefully piping will drain off the water which is treated. Or they'll build a dam around them. It's putting a BandAid on the problem," says Ross Orr, President and

Mine tailings in Northern Ontario (BacTech Environmental).

CEO of BacTech Environmental. The innovative solution that BacTech provides, in his words, is to instead "cure the patient" by removing the source of AMD, the sulfides, and leave behind material that is environmentally benign.

Snow Lake test work (BacTech Environmental).

Snow Lake stockpile (BacTech Environmental).

Our Bugs Eat Rocks!

BacTech's workforce, bacteria that work 24/7 under optimal conditions, are indigenous, naturally-occurring and harmless to both humans and the environment. There are over 60 strains involved in the oxidation of sulfides that takes place inside steel bioreactor tanks. The oxidation process, which takes over 20 years to occur naturally, is achieved within 6 days inside bioreactors. In the process, not only are the sulfides oxidized, but the bacteria also simultaneously stabilize toxic substances, such as arsenic, into environmentally benign compounds that have been approved for safe disposal by the U.S. EPA. In contrast to conventional smelters that can only treat specific types of material at a time, one single bioleaching plant is able to treat a wide variety of tailings waste from multiple sources, even if their toxicity is high and their composition is diverse (i.e. from uranium, gold, copper, zinc and even coal mines).

The cherry on top of the bioleaching sundae is its ability to simultaneously liberate any base and precious metals that are still left over in the tailings from historical mining practices. These metals are then recovered and sold to effectively help finance the entire remediation operation *at no cost to the taxpayer*. While the focus is currently on abandoned mine sites given their ubiquity, this technology holds great potential for one day *proactively* treating mine tailings as they are being produced to prevent the possibility of AMD right from the start!

Snow Lake, Manitoba

Toward the end of 2011, BacTech Environmental signed the final contract with the Manitoba Department of Innovation Energy and Mines for the remediation of an arsenopyrite stockpile in Snow Lake, Manitoba. This stockpile, with high amounts of arsenic, sulfur and gold, has been sitting onsite at the Snow Lake Mine (formerly known as the Nor-Acme Mine) since the mid-1950s. It was eventually handed over to the Province of Manitoba after the original company went bankrupt.

In responding to a Request for Proposal from the Manitoba provincial government, BacTech Environmental proposed a "no cost to the taxpayer" approach to the operation. This means that BacTech will build and operate the bioleaching plant, at its sole expense, in exchange for the gold and silver recovered from the stockpile. The Province is also set to receive a 2% net smelter royalty on production once the capital costs for the plant have been recovered.

Construction is expected to be underway within the next few months, with production beginning before the end of 2012. Snow Lake will thus be the proud host of the first ever bioleaching plant in Canada and already, similar remediation opportunities are arising from governments interested in this unique approach.

In the long run, this bioleaching plant will be able to process a wide range of tailings and other stockpiles from around the nearby area, thus providing a cost-effective remediation alternative that will soon be applied to other mining-affected regions in Canada, the United States and Latin America. ■

For more information on this topic please contact Oscar Alvarado at oalvarado@bactechgreen.com or (416) 813-0303 ext. 227.

1 http://www.blm.gov/wo/st/en/prog/more/Abandoned_Mine_Lands.html