

Memo

To:	Tony Brown	Date:	May 14, 2012
Company:	SENEC Consultants Ltd.	From:	Chris Kennedy
Copy to:	Daryl Hockley, SRK Arlene Laudrum, SRK	Project #:	1CS019.021
Subject:	Bioleaching remediation of the Giant Mine tailings		

1 Purpose

This memo provides an assessment of BacTech Environmental Corp.'s (BacTech) Bacterial Oxidation (BACOX) technology for remediating the Giant mine (Giant) tailings, located on the north side of Yellowknife, NWT. It should be noted that the tailings under consideration here do not include arsenic trioxide dust, but only the tailings deposited in surface ponds (i.e. the northwest, south, central and north tailings ponds).

2 Assessment

2.1 BACOX Process

BacTech has developed and patented a biological reactor leaching process ("BACOX") that utilizes bacteria (moderate thermophiles) in the bio-oxidation of refractory gold bearing ores. The main requirements include a source of iron sulphide, acidic conditions (ph ~ 2), heat, and aeration. A source of primary iron sulphide is the most important as the remaining requirements can be engineered. After bacterial oxidation is complete, an oxidized sludge is treated to remove gold and an acidic liquor is neutralized to precipitate ferric arsenate (scorodite), which is ultimately returned to the original tailings storage facility (TSF). Tailings are also generated from gold extraction, and would also require disposal.

2.2 Geochemistry Review

Based on review of previous reports, the main geochemical characteristics of the tailings include:

- **Non-Acid Rock Drainage (ARD) Generating:** there are abundant carbonates in the tailings that readily consume any ARD generated by pyrite and arsenopyrite oxidation
- **Contain Oxidation Products:** significant amounts of sulphur are present as sulphate and iron oxide coatings are present on sulphide grains. Calcine roaster products are present, which are nearly all oxidized
- **Attenuating Arsenic:** Monitoring results indicate that solid phase ferric arsenate is present and arsenic attenuation is occurring *in-situ*

2.3 Bioleaching Amenability

A primary source of iron sulphide is available in the Giant tailings and the tailings would likely be amenable to the BACOX process. Crushing to expose sulphide surfaces and flotation to remove carbonates would be required. Both processes would likely be technically feasible, but due to significant prior oxidation of the tailings, recoveries would likely be poor.

2.4 Environmental Effects

Although the tailings would likely be amenable to bioleaching, there is not a clear environmental benefit to do so. The tailings are not acid generating, therefore one of the primary environmental benefits of the process, removing ARD potential, would not apply. The arsenic in the tailings is largely immobile and most arsenic released by oxidation is sorbed or co-precipitated with iron oxides. Therefore the second benefit of the process, conversion of arsenic to a more stable form, is already occurring. Any of the stability concerns (e.g. reductive dissolution) with available arsenic in the Giant tailings would also apply to ferric arsenate formed during the BACOX process.

Furthermore, there are practical difficulties that would have environmental consequences. It would likely take anywhere between 15 to 20 years from present to re-handle and treat all of the material, to ultimately return it back to the TSF with minor improvement in the long term stability of arsenic. During the anticipated 15-20 years to re-handle the tailings, significant risks would be present, notably containment of arsenic laden dust from the surrounding environment.

2.5 Economic Assessment

Reprocessing the tailings was attempted in 1988 using hydraulic mining. The plant operated for three years before being shut down. One of the biggest challenges included delivering a consistent slurry to the re-treatment plant on account of the cold winter conditions. While these challenges could be overcome, it would not be without a significant cost.

Based on other gold bioleaching operations, the current price of gold, the grade and amount of gold in the tailings, and SRK's experience elsewhere, bioleaching the tailings would not generate sufficient return to pay for the process. Capital expenditures would be significant, and operating expenses would be above average due to the oxidized components in the tailings and frozen conditions during the winter in Yellowknife.

3 Recommendation

SRK does not recommend that BacTech's technology be used to remediate the Giant tailings. While the tailings are likely amenable to BacTech's process, there is not a significant environmental or economic advantage to do so.