



Contaminated mining environments: It's better to be green

By Richard (Rick) Mills

As a general rule, the most successful man in life is the man who has the best information

Waste Rock and Tailings

When a mining company wants to dig up specific minerals, it has to remove rock from the earth to do so. Any rock removed that does not contain economic amounts of the wanted mineral is called waste rock. Mining companies put this waste rock in piles called “dumps.”

The economic rock (ore) is then crushed and ground for processing in the mill. Many different chemicals (reagents) such as ammonia, chlorine, hydrochloric acid, sulphuric acid, cyanide and mercury can be used to extract the desired mineral(s) from the crushed material. The wastes from this process are called “tailings.” These tailings are kept in “ponds” - large underwater containment areas. Tailings are contained underwater so no air gets at them. Both tailings and waste rock can contain sulphide minerals.

There are tens of thousands of abandoned mines and sites around the world that display unbelievably high levels of contamination from toxins used in and extracted during the mining process. Historically conventional mineral extraction involved virtually unregulated processing of the ores. There also wasn't any regulated disposal of the unwanted rock and tailings. A lot of the waste, in the quest for better economics and expediency, was dumped in the bush.

Acid Mine Drainage (AMD)

Acid Mine Drainage results from the oxidation of sulfide minerals such as pyrite, marcasite, pyrrhotite, chalcopyrite and arsenopyrite. These sulfide minerals oxidize in the presence of water and oxygen forming sulphuric acid. This means you can have drainage from a mine site that is highly acidic and sulfate rich. This drainage dissolves and releases heavy metals (like lead, zinc, copper, arsenic, selenium, mercury, and cadmium) into aquifers and surface water - waters contaminated by AMD have low pH, low alkalinity and high concentrations of heavy metals and sulphates.

This process can and does occur naturally, but mining activities can obviously expose a significant amount of material in what is a very short amount of time. Mining ups the scale and hence the impact of the acid generation far beyond what is normally found in nature because of the sudden large-scale exposure to air and water of previously buried material containing sulphide minerals.

Acid mine drainage can affect the immediate area around the contaminated site for

decades. It can travel far downstream and drain into underground aquifers impacting areas and drinking water many tens, perhaps hundreds, of kilometers from where it originated. Water pollution from waste rock dumps and tailings ponds may need to be managed for decades, if not centuries, after a mine closes. In countries with long histories of mining the sheer magnitude of the problem can be considerable.

Legacy

Many abandoned and orphaned (those with no traceable owner) mine sites have severe impacts on ecosystem integrity and human health. AMD is seeping out of these sites contaminating fresh water sources and surrounding lands putting local communities at risk. These communities are left to deal with the toxic legacy, or, much more frequently, because of a lack of financial wherewithal and political clout, to try and live with the contamination and its impacts on their and their family's health. Below I've listed just a few of the many contaminated sites in Canada.

Cobalt, Ontario, Canada - In 1903 silver was discovered in Cobalt. An estimated eighteen million tonnes of tailings were left in lakes, on shorelines and in open areas. These tailings contain high levels of arsenic that has been leaching into local lakes, streams and drinking water. With the exception of one of the lakes in the area, most of the lakes contain between 0.040 - 6.510 mg/L arsenic - water wells have reported concentrations as high as 6.97 mg/L. The maximum acceptable concentration for freshwater aquatic life is 0.050 mg/L, for human consumption its 0.010 mg/L.

Faro mine, Yukon, Canada – The mine opened in 1969 and closed again in 1998. The mine is creating acid mine drainage which, if left untreated, could affect fragile northern aquatic ecosystems for hundreds of years. Current environmental liability, including perpetual water treatment, has been estimated at over \$100-million.

Lynn Lake, Manitoba, Canada - The Provincial Department of the Environment has identified 11 contaminated sites within town boundaries. Acid mine drainage is occurring throughout the 1200 hectares of inactive mining properties adjacent to the town. Residents report elevated levels of cancer and early deaths. An aquifer linked to the town water supply, as well as a number of fish-bearing rivers and streams are contaminated.

Tsolum River, British Columbia, Canada - In 1964 in the upper watershed of the river an open pit copper mine was built. The mine closed leaving waste rock piles where pyrite (a sulphide mineral) ores lay exposed to water and oxygen. A copper leachate formed it reached the Tsolum River and from there, the Courtenay Estuary. It has been estimated that the cost to residents and taxpayers is over \$60-million.

The Rouyn-Noranda-Cadillac-Malartic-Val D'Or corridor in Northwest Quebec. Most of the region's ore contains high sulphide mineral concentrations. The Norebec-Manitou mill and associated tailings (20% sulphide content) are located approximately 10 km east of Val D'Or. Presently, there are 12 million tonnes of tailings stored above ground and one million tonnes underground. 138 hectares of tailings follow the Manitou stream, from

the tailings impoundment to the Bourlamaque river, in a path 200 to 300 meters wide, 6.1 km long and several meters deep.

These are just a few of the horror stories generated by the push for more profit. It's been estimated that there are 10,000 abandoned mine sites in Canada. Many of these sites are already ecological disasters and many more are contamination time bombs waiting to go off, not if - when. Its no wonder the public is increasingly demanding that their government at all levels, and the companies responsible, address the contamination.

Treatment for AMD

Toronto-based BacTech Mining Corp. has developed a proprietary biological reactor leaching process (BACOX) that uses naturally occurring bacteria, which is harmless to both humans and the environment. It safely oxidizes sulphides in the waste rock and tailings, thereby eliminating a major source of acid mine drainage.

In the bioleaching process, toxic elements such as arsenic are stabilized. The tailings created by bioleaching are benign, and zero environmental damage occurs as a result of the process. Bioleaching treats the disease - not just the symptom.

The advantages include high metal removal at low pH levels, stable sludge, very low operation costs, minimal energy consumption, while the necessary construction materials readily available and generally inexpensive.

Vancouver-based BioteQ Environmental Technologies Inc. has developed patented processes to treat acid mine drainage, which can selectively recover metals from acidic waste water. Toxic metals such as arsenic, antimony, cadmium, lead, molybdenum and manganese are also removed from the water. Another one of BioteQ's processes removes sulphate from water following metal removal.

Canada's National Round Table on the Environment and the Economy (NRTEE) said on Wednesday that temperatures in the north, including the Arctic, are rising much faster than elsewhere in the world and the permafrost layer had begun to melt. Melting permafrost is undermining building foundations and threatens roads, pipelines and communications infrastructure. The report also concluded that tailings impoundments, usually built into permafrost, could be affected and a release of toxins would be environmentally and socially disastrous.

According to the Mining Association of Canada:

- 19% of the goods Canada exported in 2008 were minerals and metals.
- 70% of Canadian port volumes and 55% of rail freight revenues were generated by the mining industry.
- Over the past five years, the Toronto Stock Exchange has handled 81% of worldwide

mining equity transactions.

- Canada's mining industry was responsible for \$40 billion or 3.3% of Canada's GDP last year.

I'm not against mining. In fact, I'm very much in favor of resource extraction. Mining, fishing and logging all provide quality high paying jobs and these industries are some of only a handful that create new money, bringing prosperity and security to communities. But we inhabit this earth and call it our home. Clean water, breathable air and a land free of contamination has to be the legacy we leave our children.

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