

MERG Report 2000-1 - Biological Detoxification of Cyanide in Northern Environments

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Non-technical summary

The use of cyanide in ore processing has long been a common mining practice, particularly for the extraction of gold. Cyanide is used extensively in heap leach mining, which is a modern mining technology that has made the mining of low grade ore deposits economically possible. For the heap leach mining method, crushed ore is piled on top of an impermeable geo-technical liner and cyanide solution is added to the pile for the purpose of dissolving the gold out of the rock into solution. The gold bearing solution is then collected from the bottom of the pile, where it is contained by the impermeable liner, and processed for the extraction of the gold. This process is a closed system, meaning that the cyanide solution is contained and recollected and then either broken down or recharged and reused. Invariably, some of the cyanide remains in the processed ore heap pile, either in solid form as a metal-cyanide complex or in solution.

During decommissioning of the mine, once the extraction process has been completed, the mining company must guarantee that no residual cyanide is left in the heap leach pile in order to ensure that there is no continuing potential harm to the environment as a result of the project. Bacterial break down of cyanide is one method that has proven successful in other parts of the world but remains untested in arctic climates. The purpose of this study was to examine the potential of using cyanide-degrading bacteria native to the Yukon Territory to destroy the remnant cyanide in ore piles, with results being applicable to arctic climates in general. The study also looked at whether biological destruction was more efficient at removing cyanide than flushing the heap leach pile with peroxide solution, which is a method which is more commonly used in mine decommissioning.

The Study:

The study area is located at the Brewery Creek Mine, situated approximately 50 kilometres east of Dawson City, Yukon. The objectives of the study were to: determine whether micro-organisms capable of breaking down cyanide complexes were present in soils from the Yukon Territory, if present, to test if these organisms could be established on the processed ore heap, and demonstrate that the micro-organisms could bio degrade the cyanide substances from both solution and solids in the processed ore heap.

Results:

This study provides the first look at the possibility of using biological detoxification of cyanide at mines in Northern locations. Phase 1 of the study established that cyanide-degrading bacteria are naturally abundant and relatively widespread at the Brewery Creek mine site in Northern Canada. Phase 2 confirmed that these micro-organisms can be established on processed ore from the heap pile, and that they can bio-degrade cyanide associated with the ore, both in solution and in metal-cyanide complexes. Test results also showed that bio-degradation of cyanide was more efficient than the conventional use of hydrogen peroxide to break down cyanide in the processed ore piles. Further studies were recommended.