



Background

Agnico-Eagle Mines (AEM) produces approximately 245,800 ounces of gold with a by-product production of 156 tons of silver, 7,300 tons of copper, and 82,000 tons of zinc annually.

The LaRonde Mine, AEM's flagship mine, is one of the largest gold mining operations in North America, specializing in bio-mining of gold from low-grade ore deposits. Located in Cadillac, Quebec the mine includes underground mining operations, a mill complex, a wastewater treatment plant, a secondary crusher building, and related facilities. The mine uses a 2,250 meter Penna Shaft, the deepest single shaft in the Western Hemisphere, to hoist LaRonde's ore production of approximately 7,300 tons per day.

Challenge

A two-stage multi-train submerged biological contactor (SBC) process was employed for the degradation of thiocyanate and had operated successfully for many years until the SBC units experienced mechanical failures due to the excessive weight of the rotating biological contactors. The SBC units were attached-growth biofilm contactors that ineffectively sloughed off excess biomass, resulting in accumulated mass that exceeded the design limitations of the SBC mechanical shafts and bearing journals. This resulted in the eventual catastrophic mechanical breakdown of the biological treatment process.

QUALITY THAT NEVER QUILTS™

MBBR Retrofit Provides an Increase in Capacity Without Interrupting Mining Operations

Customer: Agnico Eagle LaRonde Gold Mine
Industry: Mining

KEY FACTS

- **Wastewater Flow:** 45 m³/hr (290,000 GPD)
- **Filtered Thiocyanate (SCN):** Design Influent 800 mg/L
Effluent Rep. < 16 mg/L
- **Total Suspended Solids:** 50-100 mg/L
- **Hydraulic Capacity:** 3,000 m³/day (0.79 MGD)
- **pH:** 7.5 – 8.0
- **Calcium:** 600 mg/L
- **Alkalinity:** 340 mg/L

AEM was faced with the challenge of retrofitting the SBC system with another biological treatment process that would not be susceptible to the same mechanical failure while providing an increase in treatment capacity – allowing higher wastewater recycling rates to enhance the productivity of the gold mining operations. The SBC retrofit and upgrade would also have to be constructed without shutting down the remaining trains of the biological process.

A number of chemical and physical treatment tests were run to remove the toxic parameters from the LaRonde mining operation’s wastewater. After successfully pilot testing the application of a moving bed biofilm reactor (MBBR), AEM decided to partner with Headworks BIO™ Inc. to install an attached growth biological treatment process that would degrade thiocyanate effectively.

ActiveCell® Solution

The ActiveCell process provides an extensive protected surface area for autotrophic bacteria that supports a self-regulating and effective biological treatment process without the build-up of end products and minerals that would inhibit the biological treatment process in suspended growth systems.

A specialized culture of autotrophic bacteria is capable of degrading toxic cyanide, metal-complexed cyanide, thiocyanate, and cyanate into ammonia. A second stage designed for nitrification of ammonia to nitrite and nitrate, further reclaims the mining water for reuse.

Heavy metal toxicity is reduced by adsorptive and absorptive mechanisms at the cell wall of bacteria. End products of the bio-oxidation process are carbonate, sulfate, and nitrate, with the associated removal of metals.

Pilot Test Program

Agnico-Eagle pilot-tested the ActiveCell biological treatment process for a four month intensive program prior to the breakdown of the first stage submerged biological contractor. The pilot demonstrated that the thiocyanate bearing wastewater stream was biodegradable at concentrations of 450 mg/L. The positive test results demonstrated that the MBBR treatment process could effectively retrofit and upgrade the wastewater treatment facility without interrupting the current mining operations (Figure 1).

The ActiveCell process was designed to retrofit and update one of the first stages of the SBC System, known as CBS-31. Due to the hardness of the mining wastewater stream, averaging approximately 600 mg/L of Calcium, 1500 mg/L Sodium and 3500 mg/L Sulphate (for a total of 6,500 mg/L TDS), Headworks BIO combined the MBBR process with a stainless-steel coarse bubble air diffuser system equipped with flexible EDPM duck bill diffusers.

The SS/EPDM aeration grid was mounted on a stainless steel support frame and then lifted into the basin by a crane. AEM hired scuba divers who then attached the grid to the basin floor with a minimal number of anchor bolts. The retention screens were mounted on the influent and effluent ports and the ActiveCell media were loaded into the basin.

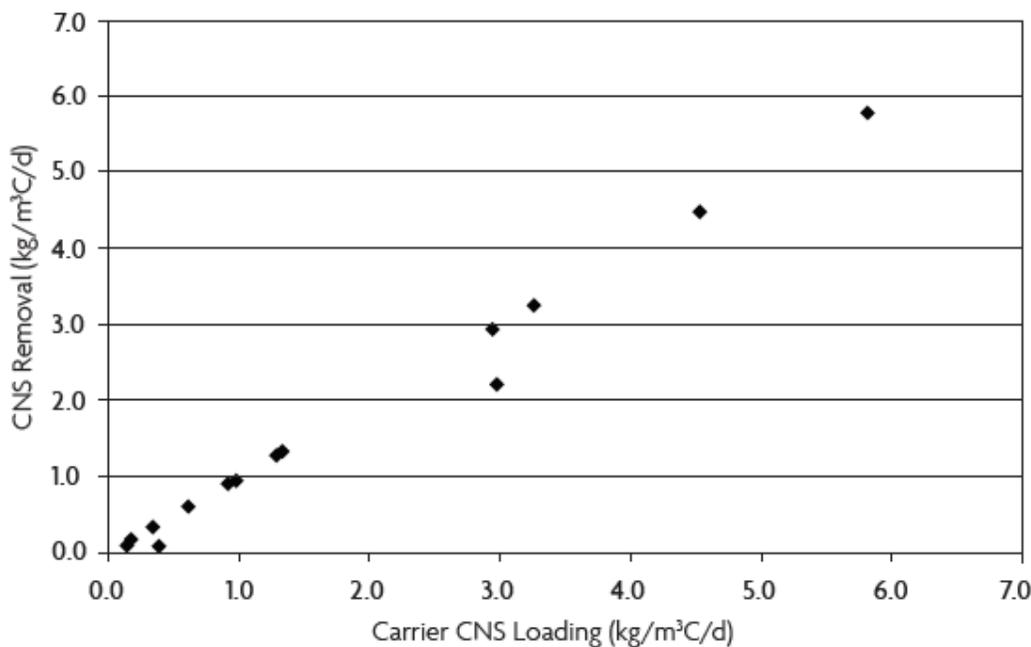


FIGURE 1 - PILOT TEST DATA



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AEM hired scuba divers who attached the grid to the basin floor.

Results

The MBBR was acclimated for a period of two weeks and achieved 98% SCN removal on August 16th, 2007, within 20 days of system commissioning and operation. Due to scheduled system shut downs every weekend, the plant had experienced ineffective removal on Mondays during start-up in the past. One month after commissioning, the ActiveCell media had accumulated sufficient attached-growth biomass to sustain the effects of endogenous respiration over the weekend, enabling effective treatment on Monday when the wastewater resumed flow through the basin.

AEM was also able to increase the throughput of wastewater to the MBBR process from approximately 35 m³/hr to a design of 45 m³/hr. When the system was started and commissioned, the MBBR process was fed a nominal flow rate of ~65 m³/hr, thereby increasing the treatment capacity a factor of ~2x and an HRT of ~3.7 hours, providing additional reclamation of process water for the AEM bio-mining operations.

AEM was able to retrofit the existing aeration basin while the remaining balance of the treatment system remained operational. The second phase of the retrofit that involved another aeration basic was completed in November of 2007. The fluidized bed of aerobic media has proven to provide a continuous, self-sloughing, self-regulating biofilm treatment process without the use of mechanical components, offering high-rate biological treatment without the possibility of mechanical failure.

“ The performance of the ActiveCell system has met all of AEM’s expectations for the biological treatment process. Headworks BIO was very supportive during the pilot phase, the development of an effective retrofit plan, and the commissioning phase. Headworks BIO has proven to be a valuable partner for AEM during all phases of the project. ”

- Sylvain Boily, Ing.

Director de L’Environnement et
Laboratoire d’Analyse



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