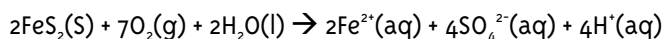


Introduction

Copper Laundering is a process of recovering dissolved copper (Cu) from water. The process by which the copper becomes dissolved in the water is naturally occurring. It is commonly referred to as Acid Rock Drainage (ARD) or Acid Mine Drainage (AMD).

ARD forms whenever sulphide minerals, such as pyrite (iron sulphide - FeS₂) and chalcopyrite (copper sulphide) found at Britannia, interact with air, water and sulphur-consuming bacteria (*Thiobacillus ferrooxidans*). The result is that sulphur is released from the minerals into the water producing sulphuric acid (H₂SO₄), within which metals such as copper (Cu) and zinc (Zn) dissolve.

ARD production is a very complicated process, but the main reaction is:



pyrite + oxygen + water → ferrous iron + sulphate + hydrogen

ARD was occurring at Britannia before mining operations began. The mining operations fractured the rock; this and the tunnels both allowed for more water to be exposed to sulphide minerals increasing the ARD generated.

Any copper flowing from the mine into Howe Sound was of course lost revenues to the Company, so a way to recover the dissolved copper was introduced called Copper Laundering or Copper Precipitation.

Basically, Copper Laundering involves allowing the ARD water to run over scraps of metal containing iron (Fe). Iron dissolves into the water while the copper comes out of solution and deposits, or precipitates, onto the scraps. This natural process is called ion exchange, where the copper and iron swap places. Old tin cans were used often at Britannia.

Copper Laundering was beneficial to the environment as well, as the dissolved iron is not harmful to marine life, whereas dissolved copper is. After Laundering ceased at Britannia in 1979, 250 kg of copper a day was flowing into Howe Sound. That is the equivalent of 100,000 pennies. To put the environmental impact in perspective, 2 pennies worth of copper dissolved in an Olympic-sized swimming pool is enough to make the water toxic to marine life. Britannia had become one of the worst industrial pollution points to the marine environment in North America.

In 2005 the environmental legacy of Britannia was cleaned up. A water treatment plant was built by EPCOR to treat the ARD. All water flowing through the mountain is treated before entering Howe Sound. The water released by the plant is 95% clean – clean enough to support marine life. The result is increased biodiversity in the waters off Britannia Beach.

Copper Laundering

- The first copper launders were built underground
- Above ground launders were constructed at the Beach and Mount Sheer (Townsite)
- To maintain high enough ARD output to the launders, water was pumped into the Mine
- Laundering became a significant part of copper production at Britannia

Before laundering began, it first had to be determined how to best perform the process and what ARD water volumes were necessary to make the process viable. This work was carried out in 1924 - 1925.

The first laundering plant was built in 1925 within the mine. It consisted of wooden box troughs which had shredded tin cans placed on gratings within them. The rate of flow over the metal was regulated by partitions and baffles to optimize precipitation. The copper coated scraps were removed and shipped to the smelter for copper recovery. The total length of these launders was 897 feet.

1926 is the first year for which there are records of the copper recovery from the launders. That year 200,000 pounds of copper were recovered accounting for 0.63% of copper production and a profit of \$12,237.

1928 saw the introduction of a large launder at the Mount Sheer Townsite which replaced many smaller ones. In that year it produced 500,000 pounds of copper accounting for 1.4% of production.



The Mount Sheer Townsite Launders today



The Mount Sheer Townsite Launderers in operation



Copper coated scraps

1956 saw construction of a launder plant at Britannia Beach to process lower grade waters. This plant consisted of five sloped, concrete launders, each 300ft long.

The following table gives typical operating data for the plants (Hatch, 1957).

	Mine	Beach
Flow, gallons per hour	3000 to 25000	20000 to 300000
Mine water concentration in grams of Cu per litre	0.4 to 0.9	0.02 to 0.17
Average Recovery, %	92	70
Precipitate grade, % Cu	60	32
Iron consumption, lb per lb of Cu recovered	2.0	3.3

The reason for the high metal content of the water at Britannia is that water readily makes its way into the mine through the old 'glory holes' and many fractures in the mountain that are a result of mining operations. Eventually the natural flow of the water was not enough. Anaconda, who acquired the mine in 1963, eventually began diverting and pumping water through no longer active areas of the mine to enhance the copper recovery from the launders.

Today, clean water is diverted away from the Jane Basin glory hole to prevent it becoming polluted and the EPCOR water treatment plant removes the heavy metals from the water and adjusts the pH of the water from acidic to neutral.