

Copper removal and recycling from complex waste streams using ElectraMet™

Executive Summary

HDR is an engineering, architecture, environmental, and construction services company working on behalf of an undisclosed Arizona mining client. HDR was hired to look for an effective method of recovering copper from process water from a legacy mine. The company found ElectraMet™ from PowerTech Water to be a highly efficient and cost-effective copper recovery and recycling solution.



Project Background

HDR and PowerTech Water worked together to investigate the potential of using ElectraMet™, a chemical-free water treatment platform, to remove and recover copper from residual process mine water. HDR was investigating effective ways to recover copper. Typically, selective copper removal is difficult because such process water contain a complex mixture of metals, salts, and minerals. Using the ElectraMet process operating at a 95% overall duty cycle, we demonstrated:

- 99.994% copper removal from Cu mine process water
- 99.8% water recovery

Depending on the operating conditions, we found that the ElectraMet process cost for copper recovery would be between \$2 and \$0.25 per pound. [The process cost for copper recovery would start at \$2 per pound for small scale and lab environments and could reach as low as \$0.25 in full-scale production.] Even at the \$2 per pound cost range, the ElectraMet process would deliver an ROI of \$0.67 per pound [a 33% ROI] based on the current value of copper. This study demonstrates that Electramet is an attractive option for metals recovery and recycling.

Test Setup

- “Raw” water sample was collected from the pit lake and sent to PowerTech Water for analysis.
- PowerTech Water used ICP-MS and IC to analyze the contents of the mine tailings.
- Copper was quantified before and after ElectraMet treatment with Hach DR 3900 and Copper kits TNT 860.
- ElectraMet “mini-filter” was operated at less than 2 volts to remove copper from mine tailings, followed by a short back-flush of clean water to recover the copper from the filter. The mini-filter predicts the performance of PowerTech Water’s 3 gpm filter product.



Before: “Raw” wastewater contained 701 ppm copper.

After: ElectraMet treated water with a copper content of 0.041 ppm.

Results

ElectraMet™ Copper Recovery Process Diagram

Step 1: Copper Removal Process



Step 2: Copper Recovery Process



Copper Removal by ElectraMet™ Process

One liter of mine process water (Table 1) was processed through the ElectraMet Copper Recovery Process to selectively remove copper. After two passes through the ElectraMet module, negligible copper could be detected in the treated water (Table 2). The module was operated on a 5–10 hour duty mode (removing copper from wastewater) followed by 15–30 minutes backflush mode (recovering copper). Copper was recovered with 98% selectivity at these operating conditions, despite comprising less than 0.7% of the total dissolved solids in these mine tailings (Chart 1).

Table 2: Copper removal with multiple passes through the ElectraMet™ Process module.

Copper Recovery	Input	Output
First Pass	670 mg/L	118 mg/L
Second Pass	118 mg/L	0.041 mg/L

Table 1: Mine process water contents were measured by ICP-MS and IC.

Water Contents Before Treatment by ICP-MS & IC	
Element	Amount (ppm)
pH	2.8
Copper	701
Aluminum	9,276
Magnesium	5,848
Calcium	546
Sodium	377
Potassium	347
Manganese	320
Iron	241
Zinc	103
Nickel	26
Cobalt	13
Sulfate	71,437
Chlorine	544
Fluoride	900
Total Dissolved Solids	>100,000

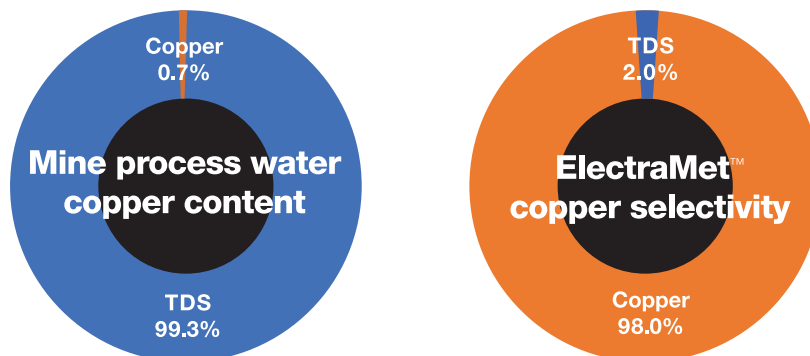


Chart 1: ElectraMet process recovers copper from complex waste streams with >98% selectivity.

The ElectraMet™ process achieves high selectivity for a single metal species by manipulating pH and voltage in copper removal mode. Example solubility of copper based on voltage and pH is shown below (Chart 2). Other dissolved metals, which remain in solution at the operating voltage and pH, are not captured by the ElectraMet filter and pass through the system. In backflush mode, these conditions are simply reversed, allowing highly concentrated copper that was captured by the filter in duty mode to dissolve back into a pure water stream for easy recovery.

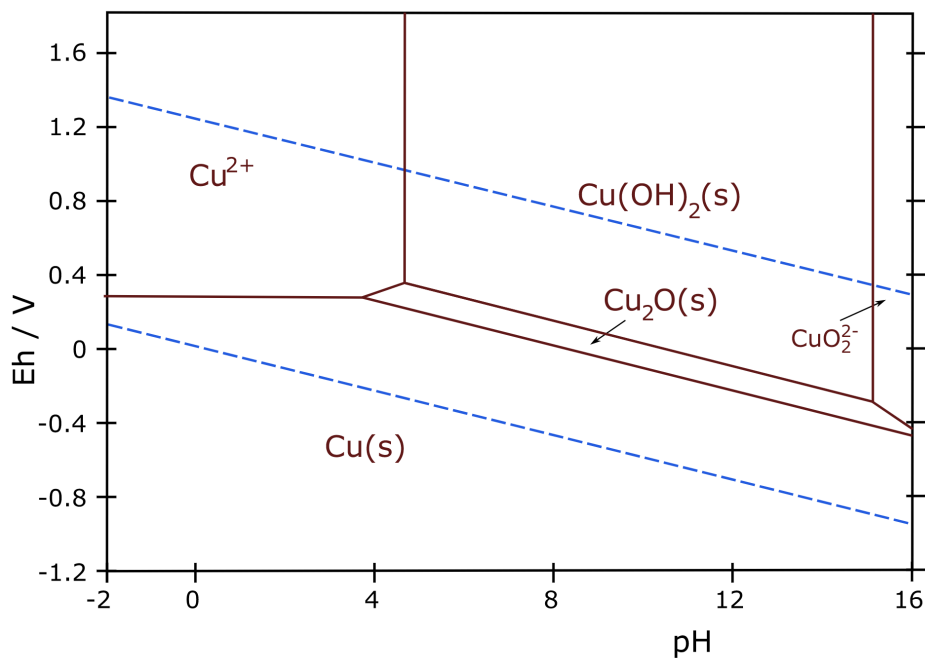


Chart 2: Copper chemistry in water based on voltage and pH.

To find out how ElectraMet can work for you, contact us at:
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