# The Use of Calcite Precipitation to Treat Zinc-, Lead-, and Cadmium-bearing Mine Drainage at the Rex Mine Site Coeur d' Alene, Idaho[1]

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**Abstract:** The Rex Mine and Mill Site is located on the northwest side of the East Fork Ninemile Creek watershed in Shoshone County, Idaho and approximately 7 miles north of Wallace, Idaho. Discharge from the Rex Mine and Mill Site underground mine adit has a pH of approximately 5.6, and zinc, lead, and cadmium concentrations of about 5100 µg/L, 380 µg/L, and 2.9 µg/L, respectively. The sulfate concentration was only 36 mg/L, making a traditional substrate-based biochemical reactor type system potentially impractical without sulfate supplementation. A bench-scale treatability study was conducted to investigate the use of a novel abiotic calcite precipitation-based passive treatment approach. The mine water received at the laboratory (pH ~7) was reacted with carbon dioxide ($CO_2$) to restore the field pH conditions discharging the underground mine. The water was then passed through a column of limestone in an upflow configuration. The discharge from the column was air-stripped in an open vessel using an aquarium air pump, resulting in a pH increase and precipitation of calcite. Removal of zinc and cadmium was achieved through coprecipitation with calcite within the air-stripping vessel, while the lead was removed via precipitation of lead phosphate at the higher pH. Removals of zinc, lead, and cadmium of about 99% were achieved. The majority of the zinc and cadmium were removed within the stripping vessel, indicating that adsorption within the columns were not the main removal mechanisms. However, the lead was removed mainly within the columns. Geochemical modeling suggested that the lead was removed as a phosphate phase as opposed to an adsorption onto the calcite. The implications of this research provide a potential treatment alternative for slightly lower-pH and $CO_2$ saturated mine waters containing elevated metals (excluding iron and aluminum), as opposed to costly active treatment systems or biotic sulfate reduction treatment methods.

Additional Key Words: limestone, coprecipitation.

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