FATE OF COPPER, ZINC, AND NICKEL IN MINE DRAINAGE TREATED WITH ANOXIC LIMESTONE DRAINS [1]

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Abstract: Anoxic limestone drains (ALDs) have been used to effectively treat coal mine drainage containing ferrous iron and manganese. Both of these metals remain in solution as the concentration of alkalinity increases as the mine water flows though the ALD. Ferric iron and aluminum have been shown to precipitate within ALDs. Any precipitation within the ALD has the potential to reduce its effectiveness by passivating the limestone or by reducing the bulk porosity and permeability of the drain. The applicability of ALDs to treat other metals in mine drainage is uncertain. This paper present the results of tests designed to determine the fate of metals commonly found in metal mine drainage within ALDs. In the laboratory, solutions containing 40 to 100 mg/L of dissolved copper, zinc, and nickel were pumped through anoxic, limestone-filled columns. After 16 days, the cumulative amount of each metal that was pumped through the columns totaled 1.1 to 1.4 g (19.1 to 21.0 mmol). The limestone-filled columns retained 75%, 40%, and <1% of copper, zinc, and nickel respectively. Additional tests were conducted using actual coal mine drainage from two different sites that was spiked with copper, nickel , and zinc to yield concentrations of 40 mg/L of each metal. All tests were conducted in triplicate., These tests utilized 1-liter collapsible containers, filled with limestone, and placed in the effluent to maintain the same temperature as the mine water. In a previous study, these tests have accurately predicted the pH and alkalinity concentrations that will develop in actual ALDs, as well as predicting the fate of other dissolved contaminants (e.g., iron, manganese, aluminum, and sulfate). In these tests, 85%, 25%, and 20% of copper, zinc, and nickel, respectively, was retained within the containers after 48 hours of contact between the mine water and the limestone. The significance of these results on the potential effectiveness of ALDs to treat metal mine drainage will be discussed.

Additional Key Words: acid mine drainage, passive treatment.

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