Passive Treatment of Acid Mine Drainage at Parys Mountain (Wales): Column Experiment Results

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Abstract

Parys Mountain deposit in Anglesey (northwestern Wales) is a volcanic-hosted massive sulphide deposit consisting of lenses of massive Zn-Pb-Cu sulfides at and near the contact between Ordovician shales and overlying Lower Silurian rhyolites. Historical mining activities at Parys Mountain has resulted in extensive workings and the deposition of an important amount of metalliferous mine wastes with a high Acid Mine Drainage (AMD) generation capacity. The highly acidic, metal polluted run-off from Parys Mountain enters the freshwater rivers of the Afon Goch Amlwch and Dulas prior to reaching the Irish Sea, representing a significant outflow of Fe, Cu, Cd and Zn.

As a first step for the design of a full-scale passive treatment plant based on the Dispersed Alkaline System (DAS) technology for the AMDs originating at Parys Mountain, we have run column tests. The experimental arrangement consists of two suites of reactive-sections (DAS-columns) each having 1130 cm^3 capacity. Three columns were used in each arrangement, each one filled with 20 cm DAS reactive material comprising (80% (v/v) wood chips and 20% (v/v) alkaline reagent), including a drainpipe and a 3 cm basal layer of glass pearls, creating a water drainage layer that increases the porosity and permeability of the column. A 25 L tank was used as an AMD-water source and as an iron oxidation/precipitation step prior to the reactive columns. In addition, a decantation vessel of 445 cm^3 was connected to each column in order to reach chemical equilibrium between the treated water and atmospheric conditions, enhancing mineral precipitation. AMD-water was pumped from the 25 L tank into two different DAS-systems: System-A and System-B.

After 5 weeks of test runs, System-A (limestone+MgO DAS) promote total metal removal of Fe, Al, Zn, Cu and Mn. Trace elements (As, Cd, Co, Cr and Ni) were also removed by adsorption/coprecipitation processes. Sulfate removal was, however, not significant. System-B (limestone+$BaCO_3$ DAS) promote total metal removal of Fe, Al, Zn and Cu, and high retention / removal of Mn, As, Cd, Co, Cr and Ni by adsorption/coprecipitation processes. Sulfate removal was highly efficient in this set-up. From the incoming 2340 mg/L of sulfate, the output solution concentration was 543 mg/L. No loss of permeability has been observed during the experiments, which indicate that the pore space occupied by the precipitating metals is compensated by the dissolution of reactive grains.

Keywords: Passive Treatment of Acid Mine Drainage; Dispersed Alkaline System; Parys Mountain; Wales

Full Paper

A full paper on the results of this study will be published in an upcoming issue of the "Mine Water and the Environment" journal. If you have further interest or questions in the meantime, please contact the authors.