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A geochemical examination of humidity cell tests

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Abstract

Humidity cell tests (HCTs) are long-term (20 to >300 weeks) leach tests that are considered by some to be the among the most reliable geochemical characterization methods for estimating the leachate quality of mined materials. A number of modifications have been added to the original HCT method, but the interpretation of test results varies widely. We suggest that the HCTs represent an underutilized source of geochemical data, with a year-long test generating approximately 2,500 individual chemical data points. The HCT concentration peaks and valleys can be thought of as a "chromatogram" of reactions that may occur in the field, whereby peaks in concentrations are associated with different geochemical processes, including sulfate salt dissolution, sulfide oxidation, and dissolution of rock-forming minerals, some of which can neutralize acid. Some of these reactions occur simultaneously, some do not, and geochemical modeling can be used to help distinguish the dominant processes. Our detailed examination, including speciation and inverse modeling, of HCTs from three projects with different geology and mineralization shows that rapid sulfide oxidation dominates over a limited period of time that starts between 40 and 200 weeks of testing. The applicability of laboratory tests results to predicting field leachate concentrations, loads, or rates of reaction has not been adequately demonstrated, although early flush releases and rapid sulfide oxidation rates in HCTs should have some relevance to field conditions. Knowledge of possible maximum solute