

Using Laboratory Mesocosms to Evaluate the Potential Effectiveness of Constructed Wetlands for Acid Mine Drainage Treatment

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Although constructed wetland treatment of acid mine drainage has grown in popularity, treatment efficiency is both highly variable and difficult to predict. A set of laboratory mesocosms was used to evaluate spatial and temporal patterns of metal retention in wetlands exposed to acid mine drainage. Six model wetlands (2.4 m x 15 cm) were filled to a depth of 15 cm with Sphagnum moss and were planted with cattails (Typha latifolia), living Sphagnum, or left with no living vegetation. Over 16 weeks, each of the wetlands was exposed to synthetic acid coal mine drainage (pH 3.5, concentrations of Fe, Al, Mn, Ca, Mg of 75, 10, 5.2, 12 and 4.5 mg/L. respectively) at a rate of 90 mL/min, 6 hr/da, 5 da/wk. Analysis of metal fractions (exchangeable, organically bound, oxide, residual) in the peat indicated that the wetlands were net sources of Al, Mn, Ca, and Mg, but 79% of the added Fe was retained, with no significant effect of vegetation type. At 16 weeks, the Fe oxide fraction comprised 73-86% of total Fe in the peat, indicating that oxide formation was the major process contributing to Fe retention. Fe retention appeared to reach saturation at the inflow ends of these wetlands at a total Fe concentration of 23% of the dry mass of the peat. Laboratory mesocosms may be useful for predicting the lifetime of effective treatment for a wetland of a given size receiving a known flow and chemistry of mine drainage. The ability to make such a prediction would improve the presently minimal ability to formulate a priori cost-benefit analyses regarding contemplated wetland treatment of acid mine drainage.