Design Factors and Performance Efficiencies of Successive Alkalinity Producing Systems

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Abstract: Successive Alkalinity Producing Systems (SAPS) are passive treatment wetlands that have been used successfully in renovating acidic mine drainage (AMD) for several years. Unfortunately, design parameters and treatment efficiency of these systems vary widely due to a lack of clear, consistent design and construction guidelines. This study is investigating ten operating SAPS systems in Virginia and West Virginia for the purpose of identifying the relationship of design and construction factors to system performance. Influent and effluent water samples were collected for a period of two years or longer by the operators of each system. Each sample was analyzed for pH, alkalinity, acidity, sulfate, total iron, total manganese, and aluminum. The individual systems were also characterized according to system age, size, and construction materials. Residence times for the ten systems ranged from 4.5 hours to 13.31 days. On average, they were able to raise the pH 0.65 units and generate a net alkalinity of 84.84 mg/l as $CaCO_3$. Iron and manganese removal did occur in the SAPS cells, but the majority of the removal took place in post-SAPS settling ponds. Net alkalinity generation was positively correlated with residence time and iron removal rates suggesting a synergistic effect. Seasonal variation in alkalinity production was also noted, possibly indicating changes in alkalinity generation rates by dissimilatory sulfate reduction. These data provide the foundation for the development of a user-oriented SAPS design model based solely on influent AMD chemistry and final treatment goals as input parameters.

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