Chapter VI

Summary and Conclusions

The treatment of acidic mine drainage using passive treatment technologies has grown in both use and effectiveness over the past two decades. These systems have proven to be viable alternatives to chemical treatment that are both economically and aesthetically pleasing. The advent of Successive Alkalinity-Producing System (SAPS) has shown that severely contaminated mine drainages can be adequately treated using passive means. Their simplicity of design and low construction cost increases their potential for use by both the mining industry and private watershed groups. Inconsistent performance and vague construction guidelines have, however, hampered the widespread acceptance of this technology. The research presented in Thesis has attempted to address these issues by developing relationships between influent AMD chemistry, system design, and treatment performance.

The performance of SAPS can be measured as net alkalinity generation since these systems are not intended to remove metals with in the SAPS cell. In the field study, limestone residence time demonstrated a strong, positive logarithmic correlation with net alkalinity generation. This indicates that the greatest gain in net alkalinity is within the first few hours of contact and that additional residence time yields diminishing gains in treatment. Influent iron and non-manganese acidity both showed strong positive linear correlations with net alkalinity generation, reflecting the increased solubility of limestone under acidic conditions. The variations in these three factors can be modeled to account for over 70% of system variability with respect to system performance.

Laboratory studies of the internal chemistry SAPS showed that limestone armoring might occur in systems with low organic layer residence times in colder weather. This was evidenced by the increase in dissolved oxygen below the organic layer as temperature and residence times declined. For field systems, the seasonal fluctuations in temperature could lead to periodic armoring and de-armoring of the limestone that could affect the treatment efficiency of the system.

The findings from this research can be translated into a series of guidelines for the design and construction of SAPS systems. Since limestone residence time is an important factor in system performance, this layer should be designed for volume. This allows for the manipulation of the depth of the limestone to accommodate for situation where land for construction is limited. The organic layer should also be sized to provide an adequate residence time to allow for the depletion of dissolved oxygen and the promotion of reducing conditions. The actual residence time and thickness of this layer will depend on the bioavailability of the material and its saturated hydraulic conductivity. This method for sizing SAPS systems reflects the site-specific conditions and should improve the reliability and year-round performance of this technology.

Additional research that examines the effect of influent Al, Fe^{3+}, and Fe^{2+} can be expected to improve the system sizing criteria developed in this Thesis.