FLUSHING OF METALS FROM REDUCING AND ALKALINE PRODUCING SYSTEMS[1]

George R. Watzlaf, Candace L. Kairies and Karl T. Schroeder[2]

Abstract. Reducing and alkalinity producing systems (RAPS) are used to passively treat low-pH mine water containing ferric iron and aluminum. RAPS typically contain a layer of water (0.3 - 1 m), organic matter (0.15 – 1 m), and limestone (~1 m). A network of perforated pipes, placed in the bottom of the limestone, forces water to flow downward through the system. Both iron and aluminum are removed within these systems. RAPS may be less prone to plugging with aluminum than anoxic limestone drains because of their larger cross-sectional areas (perpendicular to flow paths) and higher available head pressures. Reduction in permeability of these systems can occur due to the precipitation of metal hydroxides and sulfides. To extend the life of these systems, most are periodically flushed, though guidelines have not been developed for the design of flushing systems nor the frequency, duration, and intensity of the flushes. In general, the flush valves are opened until the water "runs clear." The cloudy water can persist for a few minutes to a few hours. Results from the flushing of four RAPS indicate that less than 5% of iron and aluminum retained in each system is removed during the flushing events. While none of these flushes removed a significant percentage of the metals from any of the systems, only a small percentage of the void volume (0.25 - 5%) in each RAPS was calculated to be filled with precipitates at the time of the flushes. A possibility is that too little material has accumulated to be flushed effectively. The precipitates may occur as a band rather than being distributed uniformly throughout the available void volume. The width and position of the band would be determined by the pH gradient and rates of precipitation and agglomeration. Therefore, the permeability of the RAPS could significantly be reduced long before 100% of the void volume was occupied.

Additional Key Words: acid mine drainage, wetlands, anoxic limestone drains, successive alkalinity producing systems (SAPS), vertical flow systems, metal removal, limestone dissolution, sulfate reduction.

---

[1]Paper was presented at the 2003 National Meeting of the American Society of Mining and Reclamation and the 9th Billings Land Reclamation Symposium, Billings, MT, June 3-6, 2003. Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

[2]George R. Watzlaf, Environmental Engineer, Candace L. Kairies, Research Associate, and Karl. T. Schroeder, Research Chemist, U. S. Department of Energy, National Energy Technology Laboratory, Pittsburgh, PA 15236.