EFFECTIVE MODIFICATIONS TO THE DESIGN AND APPLICATION OF CONSTRUCTED WETLANDS AND LIMESTONE BEDS[1]

Brent Means* and Malcolm Crittenden[2]

Abstract: Constructed wetlands and limestone beds have been used to treat mine drainage for many years. Both treatment systems have undergone an evolution of design changes to address issues that degrade treatment performance. Recent modifications have been made to the design and application of these technologies to optimize treatment performance and maintenance requirements. This paper reviews the modifications used to optimize treatment and provides the performance of numerous modified wetlands and limestone beds. Ponds are the technology of choice to oxidize and settle iron from net alkaline mine drainage; however, ponds struggle with achieving effluent standards for electrostatically stable solutions containing iron colloids. Ponds use gravitational settling as the primary removal mechanism, which is ineffective if the mass of the colloid is small enough where electrostatic repulsive forces dominate over gravitational forces. Wetlands were placed after ponds at several treatment sites to cleanse the water of colloidal iron to concentrations as low as 0.07 mg/L. The authors hypothesize wetlands remove iron colloids through an electrostatic attraction between colloidal iron and vegetation. An empirical-based sizing methodology was developed that accounted for the annual vegetative growth cycle to ensure removal during winter months. This application of wetland technology can help achieve strict total iron effluent criteria and replace the use of organic polymers in both active and passive treatment scenarios. Limestone beds are used to passively treat acidic mine drainage. Accumulation of metal hydroxide sludge within the bed is a major operation and maintenance issue that degrades treatment and leads to hydraulic failure. Engineering solutions, such as flushing systems, have been historically used to remove sludge. As an alternative to engineering solutions, the authors modified the basic design of a limestone bed to promote periodic sludge maintenance using excavators. The bed is designed to pond water above on top of the limestone in areas that are hydraulically plugged with sludge. This visual cue is used to perform targeted rehabilitation long before effluent quality degrades. Plugged areas are mechanically agitated or replaced to restore flow. More than ten of these systems have been constructed over the past decade.

Additional Key Words: Mine water treatment, Passive Treatment

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2. Brent Means, Hydrologist, U.S. Office of Surface Mining Reclamation and Enforcement, 215 Limekiln Rd, New Cumberland, PA 17070; Malcolm Crittenden, Watershed Manager, Pennsylvania Department of Environmental Protection, 286 Industrial Park Road, Ebensburg, PA 15931.