Quantifying Hydraulic Conductivity in Mine Drainage Passive Treatment System Vertical Flow Bioreactors[1]

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Abstract: Passive treatment systems (PTS) are cost effective treatment technologies that are designed to use relatively little fossil fuels and natural physicochemical and biological processes for the treatment of AMD. One of the key components of PTS are vertical flow bioreactors (VFBRs). VFBRs typically include waste organic materials as microbial substrates overlying rock drainage layers. They utilize the dissolution of limestone to generate alkalinity for neutralization of excess protons and promote sulfate-reducing bacteria in the organic layer for additional alkalinity generation and trace metal removal as sulfides. However, long-term operation and maintenance issues in PTS include decreased hydraulic conductivity in VFBRs. Decreased hydraulic conductivity leads to either water by-passing the cell or decreased treatment efficiencies. This research focused on quantifying the hydraulic conductivity and characterizing the organic layer in VFBRs of multiple passive treatment systems with the intention of developing plans for extending the lives of the treatment systems. VFBRs at the Mayer Ranch, Hartshorne, and Red Oak PTS of Oklahoma were selected for this study. This research used four different methods to estimate hydraulic conductivity in VFBRs that have been in operation for 8-15 years. Hydraulic conductivity was compared against several different treatment media characteristics. The hydraulic conductivity measurements ranged from $9.93x10^{-3}$ to $1.74x10^{-5}$ cm/s. A comparison of the hydraulic conductivity and the treatment media characteristics indicated a trend that as porosity increased the hydraulic conductivity decreased. The comparison of the different methods found that site variables dictated that certain methods may be more viable than others. The results helped to characterize the treatment media and quantified the hydraulic conductivity of VFBRs.

Additional Key Words: VFBR, hydraulic conductivity, Mayer Ranch, Passive Treatment

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