Performance of a Wetland/Anoxic Limestone Drain Treatment System at the Douglas Abandoned Mine Land Project. P.L. Sterner, J.B. Cliff, J.G. Skousen and A.J. Sexstone

Abstract. Acid Mine Drainage (AMD) exiting West Virginia's Abandoned Mine Land (AML) sites often is remediated using passive treatment systems. A new passive treatment technology which employs a combination wetland/anoxic limestone drain (WALD) is currently being evaluated at one AML site near Thomas, WV. The WALD utilizes a three cell design to complete treatment. Cell 1 (dimensions 365.8m x 2.5m x 1.8m- L x W x D) employs a 0.6m base of limestone overlain by 1.2m of organic material. Cell 2 (dimensions 457.2m x 9.1m x 2.4m) employs a 1.5m limestone base overlain by 0.9m of organic material. Cell 3 (dimensions 25m x 9.1m x 1.2m) is a sedimentation basin which allows deposition of precipitating metals. Thirteen polyvinyl chloride (PVC) cylinders with multiple ports were installed throughout the system so that water sampling at various locations and depths can be conducted. The working hypotheses to be tested is whether microbial iron reduction in organic sediments is sufficient to prevent limestone coating by iron oxyhydroxides, thus allowing continuous limestone dissolution and subsequent pH increase of the treated AMD. Influent water enters the system via surface flow at a rate of approximately 240 gpm from pipes draining an underground coal mine. Average influent AMD parameters over the study period were: pH= 3.0, total acidity= 426 mg/L, total alkalinity= 0 mg/L, total iron= 20 mg/L, total manganese= 6 mg/L and aluminum= 31 mg/L. Results based on effluent water quality indicate that AMD is being treated by the WALD. Average water quality parameters exiting the WALD over the course of the study period were: pH= 6.6, total acidity= 25 mg/L, total alkalinity= 152 mg/L, total iron= 0.1 mg/L, total manganese= 1.5 mg/L, and aluminum= 0.8 mg/L. Despite dramatic improvement in effluent water quality parameters, the organic matter in cells 1 and 2 does not currently function as desired. The organic matter has limited hydraulic conductivity so less AMD infiltration takes place than is desirable, resulting in surface rather than subsurface flow. Therefore minimal treatment occurs because of limited contact between AMD and the WALD. Dissolved oxygen values within the organic matter are not conducive to Fe^{3+} reduction, therefore Fe^{3+} is likely precipitating. Limestone is dissolving sufficiently to raise pH of the AMD allowing hydrolysis and precipitation of Fe^{3+} and Al^{3+} as shown by absence of total iron and aluminum and increased Ca^{2+} in the effluent water. Considering these results, the WALD treatment system may prove to be an effective retainer of metals that contaminate mine waters. However, retention of metals coats limestone, inhibiting dissolution, which leads to decreased functionality of the WALD. The pH of the effluent water has declined since AMD was introduced, accompanied by an increase in total acidity.

Additional Key Words: acid mine drainage and wetland/anoxic limestone drain.