ACID MINE DRAINAGE PREVENTION USING BIOLOGICAL SOURCE TREATMENT: COAL AND HARD ROCK EXPERIMENTS[1]

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Abstract: Western Research Institute has developed a biological source treatment (BST) technique to address acid mine drainage (AMD) at its source. The site-specific BST system is a composition of substrate and inoculum amendments designed to grow a hydrophobic, reductive biological barrier over the AMD source material to prevent oxidation of metal sulfides. The results of 4+ years of an ongoing field study of the BST technique at a backfilled coal mine indicate that AMD generation is being prevented or controlled. For instance, in one down-gradient monitoring well the pH increased by as much as 3 units from 5.7 to 8.8, iron concentrations decreased by >99% (93 to 0.2 mg/L), conductivity decreased from 1,279 to 500 µS/cm, and sulfate decreased from 724 to as low as 174 mg/L. Electromagnetic induction surveys supported this improved water chemistry by revealing a treatment zone created around and between injection wells where the conductivity of contaminated groundwater was lower within the treatment zone than in adjacent untreated areas. Additionally, a laboratory feasibility test was performed using water and mine waste material from a historic gold mine to determine if BST could be used as a potential remediation scheme or augmentation at hard rock mine sites. Several variations of microcosms with continually saturated source material and source material undergoing wet/dry cycles with different inoculum and wet and dry substrate amendments were simulated. The pH of the treated microcosms was significantly ($P \leq 0.001$) higher than control microcosms (pH 8.0 vs 2.6, respectively) after 60 days. Finally, 16s rRNA analysis indicates a robust biological community present in treated microcosms and a lack of acidobacteria in treated microcosms compared to controls. Overall, our results indicate that the BST system effectively prevents AMD generation from coal and hard rock mine waste material using wet or dry substrates under both saturated and wet/dry conditions.

Additional Key Words: Acid rock drainage; bioremediation, source control

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