Comparison of inocula applied in the remediation of heavy metals by sulfate reduction

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Abstract. Acid mine drainage (AMD) is an environmental problem that has serious consequences on human health and aquatic life. Sulfate-reducing permeable reactive zones (PRZs), such as anaerobic wetlands, sulfate-reducing bioreactors, and permeable reactive barriers, are an attractive means of passively treating mining influenced waters contaminated with heavy metals. While the low cost and maintenance requirements are significant advantages of PRZs, the lack of clear design criteria is a disadvantage. PRZs have been applied with mixed success. Some systems function as designed for long periods while others fail or do not recover well when exposed to stresses. Since AMD remediation in PRZs is a microbially mediated process, understanding the role of the microbial community in these systems will help improve their performance and design. This study explores the role of microorganisms in PRZs and the potential to use selected inocula to improve performance with respect to start-up time, sulfate-reducing activity level, and activity retention time. Five different inocula were compared: dairy manure, anaerobic digester sludge, acclimated column inoculum, and inocula collected from two sulfate-reducing bioreactors operated in the field (Luttrell and Peerless Jenny King). Our results demonstrate that there are clear differences between the inocula and that the Luttrell bioreactor inoculum performed the best in terms of start-up time and overall activity. DNA-based methods that profile the microbial community are being used to determine microbial community structure and to quantify key functional groups. The ultimate goal will be to transfer these results to the field by developing the capability to intelligently design inocula for site-specific concerns.

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