

## Using Bioremediation to Remediate Acid Mine Drainage

**Michael R. Sieczkowski**, CHMM ([msieczkowski@jrwbioem.com](mailto:msieczkowski@jrwbioem.com)) and  
Donovan Smith, P.E. (JRW Bioremediation L.L.C., Lenexa, KS)  
Mary Ann Robinson Lora, Katherine Umlah, and Rachel A. Brennan, Ph.D. (Pennsylvania State University, University Park, PA)

The mining of coal for energy and metal ores for precious metals and minerals has been a major factor in the development of western culture and is often viewed as a critical factor in maintaining a modern economy. As with the development of many other natural resources, waste from historical as well as operating mines has resulted in significant environmental impact. The USEPA has reported that there may be over 200,000 inactive and abandoned mines nationwide and the U.S. Forest Service has estimated that 5,000 to 10,000 miles of streams and rivers may be impacted by acid mine drainage (AMD).

Mine drainage typically results in high levels of dissolved metals in an acidic solution. Exposure of mine waste to water and oxygen begins a cascade of reactions wherein sulfide metal ores oxidize to form sulfuric acid which lowers the pH of runoff and causes the release of soluble metal compounds from the surrounding rock. Highly acidic and metals-laden runoff can negatively impact the biological quality of drainage systems and water bodies downstream of a mine or tailings pile. Conventional active treatment of AMD has relied on effluent treatment by chemical buffering. These systems typically consume large quantities of chemicals and produce sludge that requires disposal. The passive treatment of AMD consists of the establishment of biological systems (usually in an ex situ form such as a wetland) that promote chemical and microbial processes that increase pH and reduce metals. These systems are essentially flow-through cells and can require large areas of land and continuous monitoring to meet discharge criteria.

In contrast, in situ enhanced reductive biological treatment is a promising technology that incorporates chemical and biological control through the addition of a carbon substrate. The process buffers the acid, encourages the growth of sulfate-reducing bacteria, reducing the sulfate, increasing the pH, and precipitates the metals. In this study, laboratory microcosms containing AMD water and associated benthic sediments were treated with various carbon substrates to promote both chemical and biological reduction of acidity, sulfate, and metals. Killed-controls and controls without substrate were also evaluated. The microcosms were analyzed for pH, alkalinity, acidity, sulfate, metals, and ammonia over time. This presentation will demonstrate the relative effects and interactions of biological and chemical processes of the various substrates.