

Biological Source Treatment of Acid Mine Drainage

—Rapid Assessment, Cost-Effective Application, Permanent Solution

Background

Acid mine drainage (AMD) water is an extremely acidic result of mining coal and other sulfide-containing ores. During mining operations, the oxidation of pyrite and other metal sulfides generates acidity in water discharged from the site. Treatment of AMD costs millions of dollars a day in the United States alone. Chemical neutralization, passive treatments, and other ex situ methods are commonly used to treat AMD, yet none of these methods address its source.

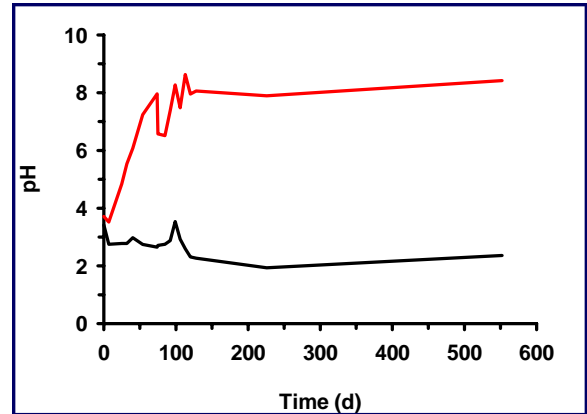
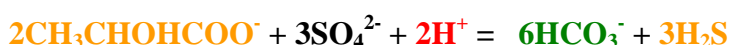


WRI has developed a unique Biological Source Treatment (BST) technique that is distinctive from treatment techniques which focus on AMD effluents. Our BST technique uses readily available, inexpensive sources of inocula (e.g., wastewater effluent and solids, lagoon sediments) and substrates (e.g., returned milk, other dairy byproducts) to raise pH and prevent AMD generation at the source.

How BST Works

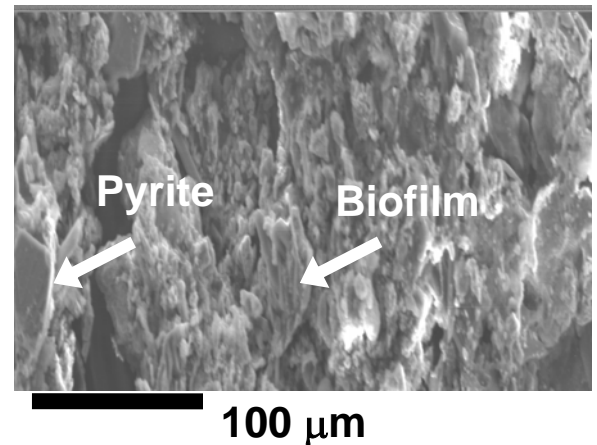
By neutralizing acidity and preventing oxidation, WRI's BST technique addresses the origin of AMD problems.

Acidity Neutralization— The bacteria feed on the **substrates** and neutralize acidity by consuming acid generating **protons** and producing alkaline **bicarbonate** as byproducts of their natural metabolism.



Shown above, pH in pyrite containing AMD microcosms increases from 3.0 to 7.8 when treated using the BST technique.

Oxidation Prevention— The bacteria form a biofilm over the AMD source material, such as pyrite, shielding the material from oxygen and preventing oxidation of the pyrite, which causes AMD, as shown below.



Contact Information:

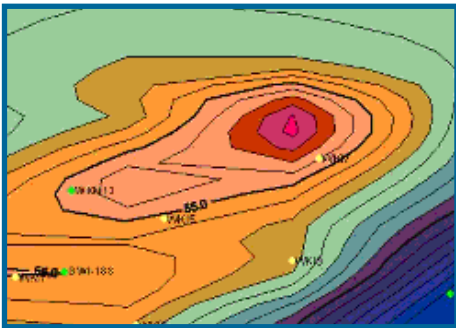
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BST in Action: A Field Case Study

WRI leads AMD source treatment by successfully implementing large scale BST applications at field sites. The following describes one.

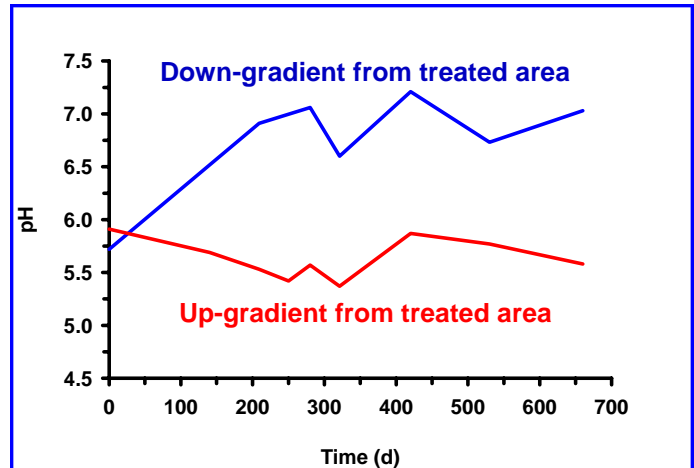
Electromagnetic Survey—An electromagnetic survey was used to measure the subsurface conductivity as deep as 120 m, pinpoint sources of AMD (shown in red), and construct a cohesive map of the overall plume without the need to drill monitoring wells.



BST Application—To apply BST onsite, a calculated mixture of bacterial inoculum and substrate was delivered to the AMD source material through injection, addition to up-gradient flow, or through insertion of a down-gradient bio-barrier that intercepts AMD, depending on site characteristics.



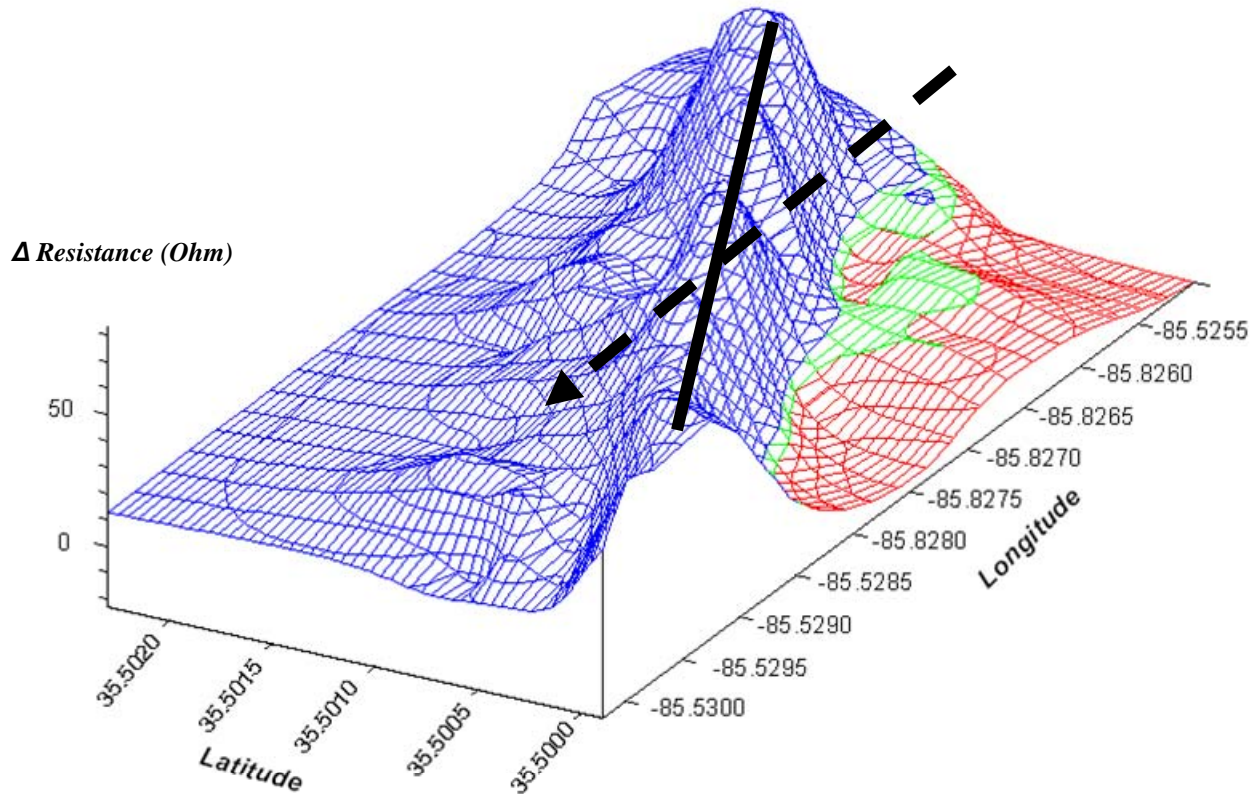
Field Performance of BST—Monitoring to date indicates positive results from BST application in AMD-impacted areas. The pH of groundwater down-gradient from injection wells has been steadily increasing while remaining in the neutral range.



A Cutting-Edge Solution to AMD

WRI's BST technology can be applied to various areas impacted with AMD from back-filled coal mine sites to hard-rock mining operations. It offers industry and the government a cost-effective remedy for addressing AMD problems.





Proven in the Field

An electromagnetic induction survey at 40 meters depth was created to show the impact of WRI's BST technology in remediating and prevent acid drainage at a backfilled coal mine area. This chart shows the relative change in resistance over a year. Resistance decreased in red areas (indicative of acid generation or infiltration), remained constant in green areas, and increased in blue areas. The solid black line indicates locations of injection wells, the dashed black arrow indicates gradient and water flow direction. In this case, low pH water with a low resistance (high conductivity) was being intercepted and treated once it entered the vicinity of our injection wells.

Publications

- Jin, S., P.H. Fallgren, J.M. Morris, R.B. Gossard. 2007. Biological source treatment of acid mine drainage using microbial and substrate amendments: Microcosm Studies (under review).
- Jin, S., P.H. Fallgren, J.M. Morris, J.S. Cooper. 2007. Source Treatment of Acid Mine Drainage at a Backfilled Coal Mine Using Remote Sensing and Biochemistry (in press).

Don't manage AMD problems perpetually when they can be solved permanently!