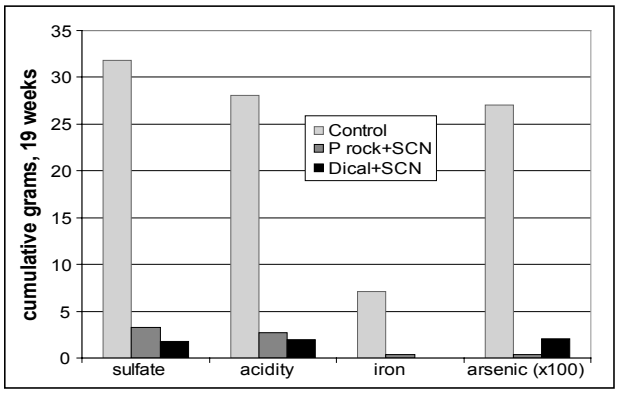

Reduction in ARD parameters after 19 weeks by combined phosphate and thiocyanate treatment of sulfidic waste rock in laboratory humidity cell tests. P rock + SCN = phosphate rock plus thiocyanate treatment; Dical + SCN = agricultural (more soluble) phosphate plus thiocyanate treatment.

and phosphate treatment dramatically reduced ARD production (see chart above) by controlling both chemical and biological oxidation of sulfides. Thiocyanate improves the stability and longevity of iron phosphate coatings and precipitates because it stops microbially catalyzed reactions that generate extremely acidic conditions.

Field performance, however, is the key criterion of success. Researchers began tests in summer 2004 at the Red Dog zinc-lead mine in northwestern Alaska to evaluate whether thiocyanate and phosphate can control oxidation of sulfides in waste rock. The waste rock contains zinc sulfide and pyrite as the primary sulfide minerals. Waste rock in 600-ton lined test pits was dosed with combinations of thiocyanate and phosphate. It was then leached with rainfall and snowmelt only. Results from the first season showed that following initial washout of soluble salts, leaching of ARD parameters using the combined treatment was reduced 50 to 70 percent compared to untreated rock. The test will continue next year.

The cost of the combined treatment is about $1 per ton of waste rock but can be further reduced if phosphate rock is found to be effective and practical at large scales. This cost is much lower than other proposed source control technologies. Key questions being addressed in field trials are longevity of the treatment, the most effective forms and dosages of thiocyanate and phosphate, and the best methods of application.

Although thiocyanate and phosphate are relatively benign, releasing them into receiving waters in elevated concentrations is undesirable. The preferred approach to ARD control is to minimize the use of these chemicals, thereby avoiding their presence in seepage or drainage. Drainage or seepage containing these chemicals can be recycled or treated using active or passive processes in a relatively inexpensive and straightforward manner.

Source control of ARD using chemical treatments is a promising approach, but must be incorporated in a comprehensive plan that includes applying the treatment during placement of waste rock and minimizing infiltration of precipitation. Consequently, the semi-arid Southwest may be a good location for this technology.

HydroFacts

Average annual flow of the Colorado River: 15 million acre-feet
Storage capacity of Colorado River reservoir system: 60 million acre-feet
Water in storage as of December 2004: about 35 million acre-feet

Low reservoir level impact on hydropower production, Hoover Dam, 2003-1993: -15%
Low reservoir level impact on hydropower production, Glen Canyon Dam, 2003-1993: -30%

Cost to build Hoover Dam Visitors' Center, 1992-1995: over $100 million
Cost to build Hoover Dam, 1930-1935: $49 million
Cost to build Hoover Dam in 1933, adjusted for inflation to 1993-4 dollars: $550 million

Total Dissolved Solids, Colorado River headwaters: 70 mg/liter
Total Dissolved Solids, Colorado River at U.S.-Mexico border: 800 mg/liter