The Problem: Before 1972 underground coal mines and western metal mines were not required to carefully manage the waste pyritic rock and mine spoil overburden. Exposure to air and water eventually caused oxidation of the pyritic material which began leaching sulfuric acid and toxic metals. The phenomena is called acid mine drainage (AMD) and it can be found flowing from abandoned underground mine tunnels. Small contaminated streams feed larger streams. Entire watersheds were poisoned. Water was discolored due to precipitation of orange iron hydroxide and white aluminum hydroxide. When technology and funding became available to remediate the streams, it was difficult to reach the AMD sources located in remote areas and electricity was not available at the sites.

The Solution: Quicklime is increasingly used to treat AMD rather than other chemicals such as soda ash, caustic soda, and ammonia. These reagents have lost favor due to both economic and material handling problems. Mike Jenkins of Aquafix states that "Pebble lime is the material of choice. When compared with ammonia or sodium hydroxide, chemical costs are significantly less, and the hazard of handling caustic material is completely eliminated." (www.aquafix.com).

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– Mike Jenkins
Aquafix
Kingwood, WV

At one site in Northern West Virginia, quicklime was used at a cost of $0.53 per 1000 gal. of treated water versus $1.40 for ammonia. A major benefit at this site was that quicklime treatment generated about 45% less iron and aluminum oxide precipitated sludge compared to ammonia. Another site in Southern West Virginia that treats a 250 gpm flow has a quicklime cost of $0.11 per 1000 gal., as compared to $0.43 for caustic soda. They also state AMD sludge generated with quicklime is denser and precipitates quicker than caustic generated AMD sludge. (Source: “Acid Mine Drainage Treatment Costs with Calcium Oxide and the Aquafix Machine,” Green Lands, Summer, 2001.)

"Liming is an effective method to mitigate streams suffering from both acid rain and abandoned mine drainage," according to Alan Heft of the Maryland Dept. of Natural Resources. From a site on the North Branch of the Potomac River an average of 4,000 gpm of water is treated to a pH of 7 at a cost of $0.02 per 1,000 gallons.
Quicklime is not only the least costly chemical for active treatment of AMD -it is also the only dry chemical that has been successfully used with a “doser” which does not require electrical power or daily monitoring. This machine is powered by diverting part of the AMD stream to flow over a water wheel which mechanically turns an auger to feed quicklime from the hopper underneath an upright silo like that shown in figures 2 and 3. The doser will provide the addition of lime at a rate proportional to the AMD flow rate.

**The Results:** The Ohio Department of Natural Resources installed a lime doser on Monday Creek at Jobs Hollow on land managed by the Wayne National Forest that is heavily impacted by AMD. The Monday Creek Restoration Partnership, which is a citizen's watershed group, manages the doser operation. Quicklime has been applied to an upstream tributary at a rate of approximately one half ton per day since March 2005. Regular water sampling and 2005 and 2006 biological samplings indicate an improvement in the water quality of the main stream of Monday Creek for many miles downstream. *(Source: R. Black and M. Farley, “Results of Stream Dosing at Jobs Hollow Reclamation Project”, ODNR Div. of Mineral Resources Management, Columbus, OH, 2006.)*

An USEPA 2003 study in cooperation with the Bureau of Land Management called this technology promising and inexpensive. At a State of Oregon site, metal concentrations were reduced from 94% to 99% for the principal acid mine drainage metals of aluminum, cadmium, copper, iron, lead, manganese, and zinc. It was stated that “water quality standards can be achieved even for trace metals if the target pH of 9.0 is maintained.” *(Source: "Pilot Demonstration Project: Aquafix Water Treatment", USEPA - Abandoned Mine Lands, April, 2003)*

Metal contaminant removal in another USEPA study was compared between the lime doser "active" treatment process and the passive water treatment (PWT) using buried limestone rock and compost. The lime doser process was found to achieve near complete removal for all the metals of concern as compared to the passive treatment system. The report states the average cost for a permanent Aquafix system designed to treat 25 gpm is expected to be approximately $72,400/yr., based on a 15 yrs. life, i.e., equates to $0.005 per gallon. *(Source: "Demonstration of Aquafix and SAPS Passive Mine Water Treatment Technologies at the Summitville Mine Site", Innovation Tech. Evaluation Report: EPA/540/R-04/501, June 2004)*

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