Novel Approach to Controlling Acid Mine Drainage

The mining and mineral processing of ores, including coal, generate huge quantities of tailings and waste rock containing metal sulfides, particularly pyrite (FeS$_2$) and pyrrhotite (Fe$_{1-X}$S). These sulfides undergo atmospheric and aqueous oxidation, producing large quantities of acid-mine drainage, which is responsible for widespread water and land pollution.

This project developed a novel approach for minimizing acid mine drainage problems through at-source pyrite stabilization by coating the pyrite surfaces with an inert hydrophobic film that is impermeable to both oxygen and water—the necessities of acid production. The coatings utilized the driving forces of pyrite oxidation and inhibited the production of acid drainage. The inert hydrophobic coating on the pyrite surface was achieved by application of dilute solutions of an anionic/cationic surfactant.

This surfactant coating on the pyrite significantly reduced acid production for a considerable period. The coating was chemically adsorbed on the surface and was found to be too difficult to remove using harsh abrasive conditions. The study also found that a combination of two surfactants was little better than a single surfactant coating. The research findings will have significant effect in controlling acid mine drainage problems in the coal and sulfide mineral industries.