Differences in pyrrhotite and pyrite reactivity in acidic solutions and the possible influence on acid base accounting prediction techniques

Don Fox
Environmental Technology Department, New Brunswick Community College - Miramichi, P.O. Box 1053, 80 University Avenue, Miramichi, New Brunswick E1N 3W4, Canada

Traditionally, the focus of acid rock drainage (ARD) prediction has been on various types of chemical methods performed in the laboratory on crushed rock samples. These methods invariably involve some form of short-term (up to several hours) static acid-base accounting (ABA) where the acid consuming number is compared to the acid producing number and the overall net acid producing potential of a sample is determined. However, there is no single, universal approach to prediction by chemical methods and the interpretation of results from ABA typically is site specific. In an attempt to make ABA methods more accurate and applicable in the real world, some workers have developed longer-term procedures that require the acid consuming test be run over periods of 24 hours, 48 hours or even up to five days or more. However, the reactivity of specific sulphide minerals under these longer-term conditions is not well known.

Pyrrhotite and pyrite samples were collected from rocks of the Halifax Group in Nova Scotia. Separate, two gram samples of crushed pyrrhotite were reacted with 0.1N and 0.5N hydrochloric acid and sulphuric acid under two sets of conditions, one of weak mixing (grains of sample at bottom of vessel remained stationary), the other of strong mixing (grains of sample at bottom of vessel were in constant motion). In all cases, pH of the solution increased over time. In the case of pyrrhotite mixed with 0.1N hydrochloric acid under strong mixing conditions, the pH increased from approximately 2 to 4.3 within a 36-hour period. Only when the pH reached approximately 4.3 did the pH of solution begin to decrease. Comparatively, pH of solutions reacted with crushed pyrite under the same conditions remained relatively constant. The test conditions of this study are similar to those used in some static ABA prediction techniques. The results show that pyrrhotite (a well known acid producing mineral) is an acid consuming mineral under certain conditions and care should be taken when interpreting the results of ABA when pyrrhotite is a major sulphide mineral present.