CHARACTERIZATION OF THE HYDROGEOLOGICAL AND GEOCHEMICAL PROCESSES IN WASTE ROCKS ARE ESSENTIAL FOR EFFECTIVE RECLAMATION

Ingar F. Walder[1] and John Stormont,[2]

[1]Kjeøy Research & Education Center, Kjeøy, 8412 Vestbygd, Norway, [2]Civil Engineering Dept. University of New Mexico, Albuquerque, New Mexico, USA

Tailings and waste rocks are the end products of a waste stream from sulfide containing ore deposits that can generate acid/neutral rock drainage (A/NRD) in considerable quantities. Fine-grained tailings have a large surface available for mineral reactions. The fine grained materials, however, tend to have low conductivities and correspondingly low oxygen and water flow rates which reduces the availability of reactants and transport of products. Waste rocks are generally coarse grained and have less surface area available for mineral reactions than tailings. On the other hand, waste rocks have high conductivities, which results in greater availability of oxygen throughout the waste rock pile and easy transport of products to the toe/bottom of the piles.

In a semiarid climate, where the waste rocks are typically unsaturated, there are three flow systems that should be evaluated: 1) matrix flow, which occurs within the fine grained matrix located between the larger particles; 2); micro flow, which is flow in and out of particles due to wetting and drying cycles and oxygen diffusion due to sulfide oxidation consumption; and 3) macro flow, which occurs between the larger particles (gravels and boulders) and through channels in the piles. These three flow systems play different roles in the mineral reactions and transport of constituents to the base of the pile. Mineral reactions in the matrix are comparable to those in tailings except the quantities associated with the matrix are relatively small. Depending upon the mineral makeup, neutralizing reactions by silicates may take place within the matrix and within the micro system because of longer water residence time than for the macro system. Within the micro system, due to capillary forces, constituents can be transported to the surface of the larger particles. These constituents can then be transported within the macro flow system, often in response to rainfall, and arrive at the base within hours. However, only a fraction of the rainfall will arrive at the base of the waste rock as much can be retained by the matrix.

The knowledge about the flow system within the waste rock piles can be utilized for remediation/reclamation of the piles. For example, a finer grained cover on top of coarse waste rocks can act as a capillary barrier, with high moisture content in the cover compared with the underlying waste rock. If water moves through the cover, most of this water will be retained by the waste rock matrix. This will result in relatively stable moisture content within the waste rock pile and constituent transport by wetting and drying cycles will be reduced, hence a reduced mass loading to the base of the waste rocks piles. These results will be compared to the Norwegian wet climate and waste rocks from massive sulfide deposits.

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