Geochemical characterisation and water quality prediction of mine waste storage facilities: a combined field, laboratory and modelling approach

YUAN TIAN[1*], JAMES TUFF[1], ROALD STRAND[1], BRENT USHER[1]

[1]Klohn Crippen Berger, Level 5 – 43 Peel Street, South Brisbane QLD, Australia (ytian@klohn.com)

Effective, long term management of mine waste materials is a significant challenge for the mining industry. Part of the management strategy is data gathering and simulation process to assess water quality changes and potential impact to downstream receptors. We propose an integrated approach by combining field sampling/monitoring, laboratory testing and hydrogeochemical modelling to simulate the geochemical evolution of mine waste and seepage water quality from mine waste storage facilities. This approach allows the impact to the environment, and downstream receptors to be estimated.

Generally, industry leading practices include sampling of representative mine waste materials and mining-influenced water and a comprehensive laboratory testing program (static and kinetic testing) to understand the mineralogy and hydrogeochemistry of a particular site. Geochemical characterisations provide key information about thermodynamic control and kinetic loading rates for use in geochemical modelling. We propose an integrated approach to handling this contextual data by incorporating this information into a platform such as GoldSim, which is capable of simulating site wide water balance and mass balance to model dynamic fluxes of both dissolved mass and the transport parameters, as well as geochemical processes based on appropriate constraints. Stochastic techniques allow further analysis of sensitivities. Predictions of water quality and load can be adequately communicated by graphical outputs, with confidence intervals to show magnitudes of impact for various mine waste facilities. The conceptual model is also constrained by site specific contexts (e.g. local climatic sequence, spatial/volumetric data of mine facilities, and mine production plan) and model results can be calibrated to field data.

This approach has been applied for several mine site waste storage facilities across a range of different climates, for a range of applications including environmental impact assessments, facility planning, mine remediation and mine closure planning.