Linking waste rock dump construction and design with seepage geochemistry: an integrated approach using quantitative tools

S.Pearce¹, B.Dobchuk², R.Shurniak², J.Song³, D.Christensen²
¹OKC, St Asaph, Wales, UK,
²OKC, Saskatoon, Canada,
³OKC, Calgary, Canada,
email: sperace@okc-sk.com, bdobchuk@okc-sk.com, r.shurniak@okc-sk.com, J.song@okc-sk.com, D.christensen@okc-sk.com

Technical aspects of waste rock characterisation and assessment have been the focus of considerable research over the past decade, with many guidance documents being published on the subject internationally. These documents provide detailed information on how to characterise waste rock geochemically as part of AMD prediction methodology. However there is not a great amount of guidance on how the placement of waste rock will control AMD production rates and thus seepage quality. The net result of this mismatch is that although AMD assessments are undoubtedly being carried out to a higher level of detail than in the past, there is not a definitive correlation with site management practices and therefore an effective means to demonstrate closure risk reduction (with respect to AMD) over this time.

A detailed risk based investigation of the influence of common factors to waste placement on AMD risk has been completed as part of the development a quantitative assessment tool. OKC has developed an assessment process based around a risk matrix type tool linked with probabilistic analysis that captures these multifaceted inputs, and employs an analytical model to provide quantitative analysis and outputs. This method of assessment allows AMD risk to be assessed on the basis of waste placement technique, and waste facility engineering design, and not just on material properties such as geochemical characteristics in isolation.

The findings of the assessment have been compared to extensive field data gathered from instrumentation installed in a number of waste rock dumps containing reactive mine waste of various ages and construction methods [1]. This has been completed as part of calibration of modelling. The modelling and field data indicates:

• Gas flux rates (oxygen ingress rates) are highly dependant on waste placement method with a clear divergence in AMD risk potential between diffusive controlled and advective controlled systems
• Lower lift heights produce waste rock dumps that have lower oxygen ingress rates and thus lower potential for AMD production in seepage (Figure 1). The correlation between lift height and potential AMD production rate it not linear however as many interdependent factors influence AMD production rate
• The rate of sulfide oxidation is elevated during the construction period indicating that the construction phase may play a very significant role in determining AMD risk potential of waste facility.
• Seepage fluxes are highly dependant on waste rock placement method as a result of structural controls on seepage mechanisms. The results indicate that larger lift heights have significantly higher potential to generate seepage in even dry semi arid climates.
Figure 1: Model outputs showing gas flux and toe seepage acidity for waste rock dump constructed of lifts of various heights

The implications of the work carried out are threefold: (1) management of reactive waste during construction has been shown to be a key risk driver of future AMD release which is contrary to widely held views that AMD risks can be largely managed at closure (2) the method of waste placement has a significant control on AMD risk. (3) These factors require consideration when final closure solutions such as covers are being selected and relied on as the main closure mitigation solution for AMD management.

Key words: Toe seepage, gas flux, sulfide oxidation rate

References: