Fact Sheet 4

AMD Prediction Methods

This fact sheet provides information to site in the feasibility and construction phases.

The need to understand the rate of AMD reaction becomes necessary to be able to design waste rock dumps and tailings storage facilities which limit the generation of acidic water. During the feasibility and construction stages further drilling is often conducted to better define the ore. Consideration should be given during 'infill drilling' to also better defining the higher risk waste lithologies.

Proponents should consider:

- Better defining high risk waste using infill drilling;
- Sulfur species analysis and the variability in their effect on AMD;
- Kinetic Test Work; and
- Mineralogical Assessment using XRD.

If a project is looking likely to proceed beyond the exploration phase, regulators encourage consultation early in the feasibility stage. Regulators find the earlier proponents consult, the better the outcome when a development application is submitted.

Waste exploration

Simple lithologies should not require any specific waste domain drilling to fully quantify the AMD present on the site. Complex lithologies are common in Tasmania, particularly in the prospective zones on the Western side of Tasmania. In complex geological environments additional drilling should be undertaken around mining areas, including the waste. To define and quantify the likely AMD risk with an adequate level of confidence, the waste needs to be modelled along with the ore. Modelling should be undertaken for all regions where materials are going to be broken.

Sulfur Species Analysis

The most conservative approach to estimating AMD potential is to use total sulfur (INAP, 2009). The total sulfur content is generally used to assess AMD potential because it's the easiest and cheapest test to perform. This method also provides the most conservative assessment of AMD potential. Not all sulfur species generate acid and some are only mildly acidic (AMIRA International, 2002), therefore being able to identify and quantify various sulfur species can allow management to make more detailed decisions about lag times and waste dumping routines. Sulfur species analysis is not essential, however it can refine the management solutions and potentially reduce the amount of highly reactive PAF which needs to be managed quickly. Price (2009) gives a very detailed synopsis of 'Sulfur Species and Acid Generation Potential' in chapter 12.

Kinetic NAG Test

The kinetic NAG test is the same as the single addition NAG test (as outlined in AMIRA) but the temperature, pH and electrical conductivity of the liquor is recorded (AMIRA International, 2002). This test gives an indication of sulfide oxidation and acid generation behaviour before moving towards the kinetic leach tests, or can be used as a management tool to select samples to be included in the kinetic leach tests. The behaviour of the analytes will give an indication of the relative reactivity, lag times and oxidation rates (AMIRA International, 2002).

Kinetic Leach Columns

Kinetic leach column tests show the rate of oxidation and the estimated lag time (Davis et al., 2014), used to estimate the extent and magnitude of AMD generation over the life of the project. When combined with the life of mine plan, the timing of AMD generation can be derived and subsequently planned for. The test methods used in the industry are well studied and documented, with the useful references being the GARD Guide (INAP, 2009), the Leading Practice Handbooks (DFAT, 2016b) and *Prediction manual for drainage chemistry from sulfidic geologic materials* (Price W.A., 2009).

There are three main types of kinetic tests; column leach, humidity cell and oxygen consumption tests (Davis et al., 2014). The aim of kinetic test work is for assessments to be made into the way AMD needs to be managed, over the life of the mine or quarry. Kinetic test work procedures make it possible to quantify the likely performance of AMD management plans, such as oxygen exclusion covers (Davis et al., 2014). Static test work and waste characterisation will form the basis of decisions about which samples are included in the kinetic test work program, as will geological mapping and field measurements such as XRF (Price W.A., 2009).

"Kinetic information is a critical part of drainage chemistry prediction"
(Price, 2009).

Selection of samples for kinetic test work is imperative to understanding the resultant information. Operators wishing to understand issues like lag time, need to ensure that fresh rock is used in kinetic tests. Operators wishing to understand secondary reactions which might be masked by the initial oxidation reactions might choose to use an oxidised sample (Price W.A., 2009).

Mineralogical Assessment

There are cases where samples cannot be classified as either NAF or PAF using the AMIRA (AMIRA International, 2002) method, because samples fall into the "uncertain" category. Consideration should be given to defining the mineralogical assessment tools to inform management decisions around the uncertain classifications. The commonly used methods are optical microscopy and X-ray diffractometry (XRD) (Parbhakar-Fox and Lottermoser, 2015). The use of mineralogical assessment tools on all samples can inform more detailed decisions about waste classification, however the test work can be expensive to conduct on a mass scale.

Detailed mineralogy can identify the different sulfur species, which is key to management of AMD (Pearce et al., 2016a). Various sulfur-bearing minerals break down and form AMD at different rates, which can effect management decisions on how long they are exposed to oxygen. Selection of the correct tools for the job is dependent on the required outcome. A skilled practitioner will be able to assist with the selection of appropriate lab techniques to define the required outcome (Parbhakar-Fox and Lottermoser, 2015).

Water Balance

Once the mining method has been decided and the landform modelling has been conducted, a site water balance will be required as part of the development application assessment process. The water balance will need to be modelled using surface and groundwater flow and water quality data. This modelling can be used alongside the geological model to estimate the water balance over various stages of the mine life.