Prevention of AMD During Operations

This fact sheet provides information to operations in the feasibility and construction phase about preventing AMD during operations. The fact sheet covers waste rock and tailings disposal. It is noted that both waste rock design, and tailings dump design, is site-specific. This fact sheet covers principles of ideal design. The local geology, landscape and climate all have an effect on the appropriate design for the site.

Waste Rock Dumps

Waste rock design should be conducted at the start of the project (along with plant and mine designs) and take into account the end of life landform. This landform should be developed after consultation with stakeholders. Climatic and topographic factors, as well as the composition of the waste, will help determine the design chosen.

Waste rock dumps are generally constructed in Tasmania in one of a few ways; large end dumped tip heads, tip and push dumping, and paddock dumping. The *Preventing Acid and Metalliferous Drainage* (DFAT, 2016c) document provides more detailed information in Section 6.1, as does the GARD Guide (INAP, 2009) in Section 6.6 Waste dumping programs and designs are very site-specific, and should be designed by a knowledgeable professional who is able to consider the geotechnical and environmental issues that may arise over the life of the project.

End dumping presents the biggest AMD risk; fine grained particles remain concentrated by the crest and the coarsest particles collect beyond the slope toe (Pearce et al., 2016b). This allows oxygen ingress into the waste pile. Often the reaction of the sulfides creates a temperature differential with ambient air temperature, drawing more air into the pile, speeding up oxidation and subsequent AMD leaving the waste dump. The segregated nature of end dumped designs also allows ready access for water flow through the dump, aiding in the production and transport of AMD. Clay capping an end dumped waste rock dump when the mine life is complete has a low factor of safety. If the capping fails the waste rock dump can become a significant source of AMD pollution. Push dumping limits the segregation that occurs in end dumped waste dumps (Pearce et al., 2016b), however the voids within the dump still permit oxidation and water ingress.

Paddock dumping is the best way to dispose of PAF waste rock. During paddock dumping (or end dumping over tip faces less than two metres) there is little segregation. Water can still pass through a paddock dumped waste rock facility, however water and oxygen ingress can be slowed down by compacting layers throughout the dump to limit the occurrence of AMD generation.

Progressive risk management of waste should be adopted. Sites often wait until the end of the dump phase to encapsulate, by which time the waste may have already started to oxidise. Building dumps with a higher factor of safety by incorporating a fine-grained compacted layer, such as NAF barriers and NAF toe bunds, reduces oxygen ingress, increase the factor of safety and minimise the closure burden on an operation. Figure 16 shows a low risk low-risk design adapted from the work of Pearce (Pearce et al., 2016b).

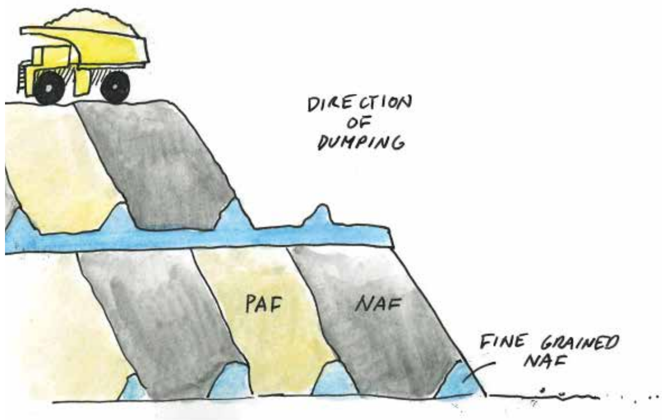

Figure 16 – shows fine grained NAF in blue, NAF in grey and PAF in yellow.

Two case studies, (Pearce et al., 2016c) have used field tests to further classify PAF into different categories, which included PAF, low-risk PAF, high risk PAF and LAG PAF. Initially geochemical test work was conducted to identify PAF lag time, which shows how soon the PAF waste needs to be excluded from oxygen before oxidation commences. Test work was able to show that the site had PAF presenting different risks and needing various management strategies and timeframes for management. The studies showed that development of a site-specific geochemical test work protocol can be used to assist with classification of the waste within a few days of blasting (Pearce et al., 2016c).

Tailings Disposal

Well organised tailings management plans ensure that deposition over exposed tailings occurs within a short period of time so that oxidation does not commence. The geochemistry of the tailings, and oxidation rate, will inform the length of time tailings can remain exposed to oxygen before they become an AMD risk. When tailings dams are designed, the operator should develop a tailings deposition plan and operations plan. The plan should apply to all stages over the life of mine, including closure. Provided the tailings remain saturated, the risk posed by AMD is minimal as oxygen ingress into the saturated tailings will be negligible. Tailings should be deposited with as little water as possible in the slurry to minimise the pore water available to report as seepage (DFAT, 2016c).

Tailings dams remove (contaminate) a large amount of water from the environment to make slurried tailings. Environmental water flowing into the tailings dam is also ultimately contaminated, so where possible, clear water should be diverted around tailings storage facilities. Maintaining segregation between clean and contaminated water until after final discharge from the dam is ideal. Another source of acidic water from tailings dams is seepages from dam walls. Treatment of this water is often difficult, particularly in Tasmania with its steep terrain and lack of infrastructure (i.e. power).

Tailings are placed in an impoundment or behind a dam wall, which is raised over the life of the mine by either a downstream or upstream embankment raise. Downstream raises are expensive and require more fill material to complete, but allow for subaqueous disposal of tailings over the life of the mine. Upstream lifts mean that after the first dam wall, dam lifts are placed on top of a portion of the tailings. Upstream lifts leave a tailings beach against the final lift which is never inundated and remains exposed to oxygen. These tailings will need some remediation to exclude oxygen and prevent oxidation of the material (forming AMD). Planning for, and designing for, closure should be front of mind when building a new tailings storage facility. In Tasmania, dam construction and management is regulated by the *Water Management Act 1999* and associated regulations.

Emerging technologies such as tailings desulfurisation should also be considered when building tailings dams. These technologies remove the sulfides and effectively the risk of AMD issues at the end of mine life. The costs associated with setting up a plant can potentially be offset against many years of water treatment required by exposed tailings on beaches.