Treatment of AMD

This fact sheet provides information to operators about treatment of AMD on site once it has formed. It is recognised that treatment of AMD is the 'worst case' scenario for a site; treatment of AMD means that sulfide oxidation has occurred and the water transport pathway is moving AMD around (and potentially off) the site. Active treatment, where labour and materials are used to treat AMD, is possible while the site is operating. Passive treatment operates without any major direct inputs and can be used as part of a closure solution.

Active Treatment Systems

Neutralisation or pH control is one of the most commonly used AMD treatments, however the chemical properties of the AMD being remediated need to be considered (Taylor et al., 2005). Active treatment systems require active reagent addition and regular maintenance. They also incur higher capital cost and operational costs than passive treatment. This generally makes them unsuitable as a post-closure solution to AMD. MRT does not manage any active treatment plants on remediated sites within Tasmania, as the cost burden is too high. Many sites under care and maintenance cannot move towards closure until a solution to AMD treatment is sought. Operation of a treatment plant costs the company a significant amount of money until a solution is found.

Neutralisation plants raise the pH by addition of an alkaline reagent. Typically in Tasmania hydrated lime ($Ca(OH)_2$) is used, however there are many alkaline reagents available at varying costs. Lime products are reasonably priced and available within Tasmania. Neutralisation works by raising the pH, which causes the metals to precipitate into a hydroxide at a particular pH. Figure 17 shows the solubility of hydroxide metals. Most metals are removed from solution by raising the pH to around 9.

Hydroxides removed from solution create a metal hydroxide requiring storage away from acidic conditions for perpetuity to ensure the metals are not remobilised in solution. This can be a challenge, particularly on sites where non-acid-bearing material is minimal and often poses a risk to closure. The cost of handling the sludge can be as high as the treatment cost, this needs to be considered when planning neutralisation as a means of water treatment.

Neutralisation plants are found in many forms, however the most common are low and high-density sludge plants. Both work similarly, however the high-density plants reuse some of the sludge to increase the sludge density, which also recycles the unused alkalinity making them more efficient.

A former Tasmanian gold operation used bacterial leach treatment in their plant, which consumed the sulfide bearing minerals. This formed part of the process to extract the saleable mineralisation, but had the added benefit of producing tailings which were not acidic. Where possible it is ideal to weave treatment of AMD into the process plant.

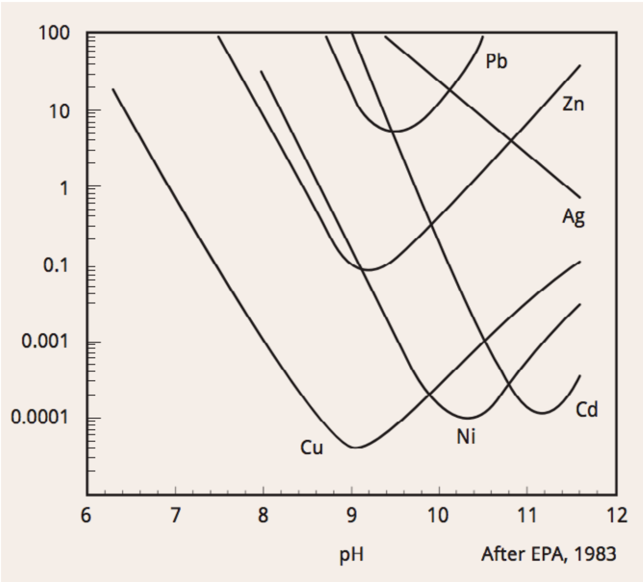

Figure 17 – solubility of hydroxide metals [source: (Kopačková, 2014)].

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Passive Treatment Systems

Passive treatment systems do not require ongoing input with the exception of some routine maintenance. Installation costs are generally minimal, and they have a reasonable lifespan. Passive treatment systems tend to work with low relative acidity loads, in the order of less than 800mg $CaCO_3$/L and loads up to 150kg $CaCO_3$/day (Taylor et al., 2005). Passive treatment systems tend to raise the pH to neutral (around 7), which as per Figure 17 does not remove all the metals from solution. Passive treatment generally uses a lime-based alkali, which is at risk of 'armouring' with precipitates such as gypsum (Taylor et al., 2005). The armouring indicates that the passive treatment system is doing its job, but it reduces the reactivity of the lime product and the effectiveness of the system overall. The GARD Guide (INAP, 2009) provides a table showing the elements which can be treated with a passive treatment system in figure 7-12.

Anoxic limestone drains are buried cells or trenches of limestone which water flows through. Because the trench is underground, atmospheric oxygen is minimised and CO_2 is maximised. The limestone is buried between 1 to 3 metres of clay, with geomembrane sometimes placed between the limestone and clay to further minimise the ingress of oxygen into the drain. Under the anoxic (minimal oxygen) conditions, limestone does not coat with iron hydroxides because it does not precipitate into a hydroxide ($Fe(OH)_2$) (INAP, 2009). The presence of some metals, such as aluminum, in water, can inhibit the longevity because they are prone to build up (precipitation within the cell) blocking water flowing through. Anoxic limestone drains do not work when the pH is extremely low and the ferrous (Fe II) has started to change to ferric (Fe III) iron (which happens as the pH lowers) (INAP, 2009).

There are various types of wetlands but the one currently favoured is the reducing and alkalinity producing system (RAPS) (INAP, 2009). These wetlands are formed by creating a limestone drain with a layer of permeable organic matter on the top. Wetlands work best at pH values greater than 4.5 under steady-state conditions (DFAT, 2016b). Most wetlands discharge into sediment ponds to allow the metal hydroxides to precipitate before discharge. More information about wetlands may be found in the GARD Guide (INAP, 2009) in Section 7.5.2.