How do we prevent mining activities from contaminating streams?

Key points of this fact sheet

- Acid mine drainage (AMD) can be prevented from affecting the environment.
- Waste rock management can limit water or oxygen contact with sulphides.
- AMD can be treated.
- Treatment involves neutralising acidity and removing toxic metals.
- Active treatment involves continuous addition of chemicals, which is costly, but very effective.
- Passive treatment relies on natural biogeochemical processes, which is less costly, but can fail if not carefully selected, maintained and designed.

Acid mine drainage (AMD) can be produced from mining activities. AMD typically has low pH and elevated concentrations of dissolved metals, primarily iron and aluminium. Mixed with surface water, AMD can result in unacceptable impact to the aquatic environment.

There are generally two ways to approach this problem. One is through management activities on the mine site to prevent the formation of contaminated drainage in the first place. The other is through treatment of contaminated mine drainage to acceptable levels before discharging back to streams. The preventative approach, however, is typically more cost effective than trying to remove contaminants from mine drainage.

Can we prevent AMD?

Yes, to some extent. AMD is produced through the oxidation of sulphide minerals, primarily pyrite. To minimise the formation of AMD, management techniques can be applied during mining to limit one of the three components necessary for oxidation (water, oxygen and sulphide).

The first strategy to apply is to avoid mining problematic material. Otherwise, management techniques that may be used include: diversion of water around waste rock stockpiles to reduce water contact, encapsulation of sulphide-bearing rocks with impermeable material to prevent contact with water, inundation of sulphide-bearing rocks underwater to exclude oxygen, and construction of a cover over waste rock to limit water and oxygen input. If alkaline or neutralising material is present on the mine site, blending of acid-forming material with the neutralising material can neutralise, to some extent, acidity which may form.

In choosing a management technique, site-specific factors are considered, including local topography, climate, waste rock volume and composition, reactivity of sulphides, groundwater conditions, the position of the overburden and waste rock relative to surface and groundwater, and the presence or absence of neutralising material.

Can we treat AMD to acceptable levels?

Yes. There are many ways to treat AMD to acceptable levels, but to be effective, remediation techniques must be selected based on site-specific factors.

The overall goal of AMD treatment is to raise the pH and to lower dissolved and particulate metal concentrations to acceptable levels. To achieve this, we typically add a neutralising agent to raise the pH and capture hydroxide compounds which naturally precipitate as the pH increases. Some techniques involve creating a reducing environment in which sulphate and iron reduction occurs to remove metals as sulphides rather than hydroxides.

Treatment can be accomplished by either active or passive treatment systems (Figures 1 and 2).

Figure 1: Active treatment system.

This fact sheet is part of series relating to a framework for predicting and managing the water quality impacts of mining on streams.

The framework was developed as part of a collaborative research programme aimed at helping mining companies, councils and other end-users make more informed decisions about the possible environmental effects of mining on streams and how to reduce those effects. Stakeholders and end-users assisted in the development of the framework which explains:

- how you can assess the likely water quality coming from a mine,
- the impacts that mine water will have on stream life,
- options for management or treatment of mine drainage and
- guidance on how best to monitor mine discharges.

Active systems typically require continuous dosing with chemicals, consume power, and require regular operation and maintenance, but they are very reliable. Their main advantages are:

(1) they are very effective at removal of contaminants;

(2) they have precise process control such that they can be engineered and operated to produce a specific water chemistry;

(3) they can be accommodated in locations where only a small land area is available.

The main disadvantages of active treatment are the high capital cost and high ongoing operation and maintenance costs.

Active systems are more suited to active mine sites, which typically have limited land area available for remediation systems, changing drainage chemistry and flow rate, power and personnel to manage the system.

Figure 2: Passive treatment system.

Passive systems rely on natural physical, geochemical and biological processes but can fail if not carefully selected, maintained and designed. Most passive treatment systems rely on the dissolution of a neutralising material (usually limestone) to neutralise the acidity in AMD and sufficient residence time in the systems.

Selecting an active or passive treatment system

Selection of active or passive treatment systems will depend on a number of factors. A flow chart has been developed to aid in this selection (Figure 3). Once this decision has been made, then site specific factors such as chemistry, flow rate, topography and available land area will influence what specific systems are appropriate for use. Additional flow-charts to assist in selection of specific active or passive remediation systems have also been developed.

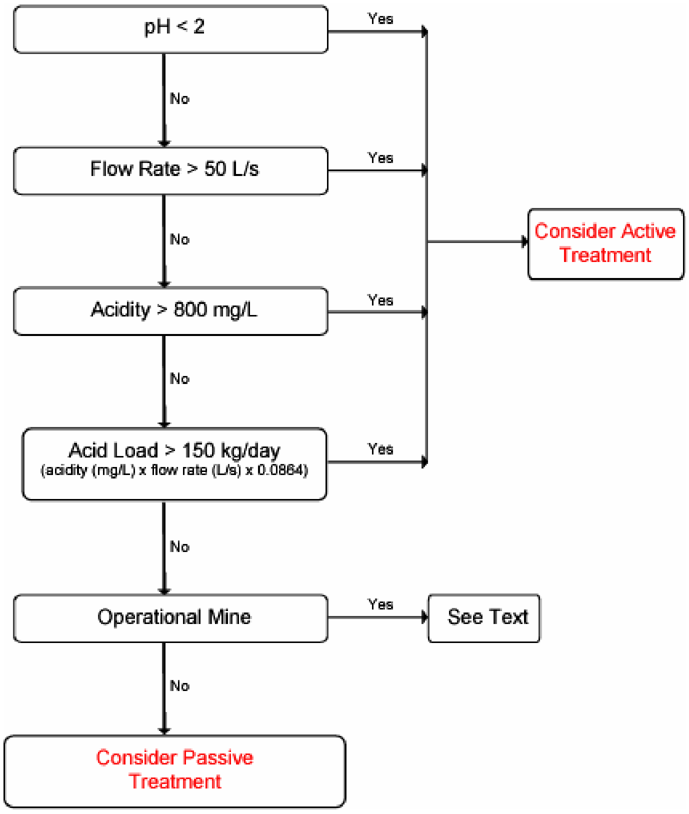

Figure 3: Flow chart to select active or passive treatment systems for acid mine drainage.

More information on the framework and underlying research is available from other fact sheets in this series and at: http://www.crl.co.nz/research/mine_drainage.asp.

Authors: Dave Trumm (CRL Energy Ltd), Rachel Rait (CRL Energy Ltd), and Rowan Buxton (Landcare Research).

This work was funded by the Foundation for Science, Research and Technology (FRST) grant CRLX0401 in collaboration with CRL Energy, Landcare Research, the University of Canterbury and the University of Otago.

Landcare Research Manaaki Whenua | CRL Energy Ltd | University of Otago Te Whare Wānanga o Otāgo New Zealand | UC University of Canterbury Te Whare Wānanga o Waitaha Christchurch New Zealand