Acid Mine Drainage (AMD) - Remediation

VALE Thompson Nickel Mine – Construction of the CB wall

Rio Tinto – Construction of the SB wall

WHAT IS IT?

Acid Mine Drainage is linked to the action of water and air on existing sulphur in mining residue leading to the creation of sulphuric acid.

Iron sulfide minerals, especially pyrite (FeS2), chalcopyrite (FeS.CuS) and pyrrhotine (FeS) contribute the most to formation of AMD.
As a consequence the pH of the water significantly decreases, This water acidification favours the solubilisation of heavy metals or metalloids (As, Zn, Cu, Cd…) and the corrosion of existing structures.

REMEDIATION STRATEGY

AMD treatment involves several aspects :

1. **Reduction of the water circulation** in the residue storage (rainwater and underground water)
2. **Reduction of the oxygen contact** in the residue storage
3. **Correction of the pH of the residual water** coming out of the residue storage.

For each line of action, several techniques can be implemented depending on the site/local conditions.

PEM – Site before, during and after remediation

ASPECT 1

Reduction of the groundwater circulation in the residue storage can be addressed by diverting the upstream groundwater flow to prevent it from going through the residue storage.

This can be done with **draining trenches or underground barrier walls** (SB* walls, SCB* walls, CB* walls).

Hydraulically and geologically understanding the whole groundwater circulation and its contact with the residues is an essential prerequisite to the design of an efficient solution, which implies the availability of sufficient information and data.

Our references:

- Rio Tinto Australia – 2016-2017 – 2 cut-off walls (180 ml and 210 ml, 3 to 9m depth) with 2 upstream collection trenches, and their collection sumps.
- Millenium Chemicals, France – 2004 – anti-acid slurry cut-off wall (16 to 30m depth, 77000m2)

** SB: soil-bentonite*
SCB: soil-cement-bentonite
CB: cement-bentonite

ASPECT 2

Reduction of the rainwater and the oxygen circulation in the residue storage can be achieve by:

- **The residue storage landforming**, which will direct the water run off so as to reduce its contact with the residues, **and**
- **Capping the residue storage with alkaline material**, which will raise the pH and decrease the activity of sulfate-reducing bacteria.

Calcium carbonate material or industrial alkaline byproducts can be used for the capping. **The availability of alkaline byproducts** (eg. sludge from the paper industry) compatible with the geotechnical requirements of providing a capping durably mechanically stable is a key element in the budget of the final project as such a material easily available **can lead to very significant money savings**.

Our references:

- Péchiney ElectroMétallurgie (PEM), France – 1999-2000 – ex situ (on site) stabilization (formation of scorodite) and in situ solidification of 98,500 tons of residues (contaminated with iron arsenate and sodium sludge from cobalt activity)

ASPECT 3

Collection of water coming from the residue storage **and correction of its pH** can be either done by directly directing it to downstream ponds filled with calcium carbonate or by collecting it thanks to upstream draining trench / barrier walls and then sending it into these ponds.

eg.

- Aerobic wetlands
- Anaerobic vertical flow wetlands
- Anoxic limestone drains
- Limestone leachbeds
- Flushed limestone leachbeds
- Limestone sand dumps
- Steel slag leachbed
- PRB or S-PRB*

Our references:

- Le Chéni gold mine – France 2008 – PRB technology for arsenic and acid contamination of the groundwater, cut-off wall and draining trench

**S-PRB: Serviceable Permeable Reactive Barrier*
Similar to a funnel and gate where the gate consists of a cassette type structure with one or a series of filters. The filtering media can be replenished as often as needed at minor cost.

PREVENTION STRATEGY

To avoid the AMD issue, the best method is always prevention. Some of the preventive measures are:

Flooding/sealing of underground mines, under water storage of mine tailings, landbased storage in sealed waste heaps, total solidification of tailings, microencapsulation (coating), groundwater diversion & capping.

Our references:

- VALE Thompson Nickel Mine, Canada – 2013 – CB wall to raise a tailing dam (400ml, 10m depth)

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