Identification and Prediction of Heavy Metal Pollution (AMD / ARD) Risk

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Heavy Metal Pollution (AMD/ARD) can often be readily identified in the field. It is commonly characterised by red coloured, very clear (low turbidity) water that displays a low pH, low dissolved oxygen content, elevated soluble metal concentrations (Fe, Al, Mn, Cu, Pb, Zn, As, Sb, Ni, Co, Cr, Cd, Hg) and high salinity (ie. electrical conductivity (EC) dominated by sulfate). Widespread or localised salt efflorescence's can highlight pollution sources and iron-rich precipitates form within and proximal to waterways, sometimes smothering riparian vegetation. Vegetation dieback, sporadic fish kills, crop contamination, human health and livestock impacts and infrastructure corrosion are also important indicators. With minor training and suitable field-based water monitoring equipment (pH, EC), Heavy Metal Pollution (AMD/ARD) can be easily recognised without expensive analytical testwork.

The major sources of Heavy Metal Pollution (AMD/ARD) at mine sites are waste rock piles, tailings dams, unsaturated pit wall rocks and underground mine voids, slag piles, heap leach piles and ore stockpiles. Low cost and simple geochemical testwork is a vital part of lowering the risk of heavy metal pollution (AMD/ARD) by facilitating management and prevention. Routine geochemical approaches for quantifying risk include static and kinetic geochemical testwork. Static testwork procedures include Net Acid Producing Potential (NAPP) and Net Acid Generation (NAG) tests, as well as full sulfur speciation analyses. Such testwork is important for quantifying the maximum potential acidity that geologic materials can generate. Kinetic test procedures include oxygen consumption tests, column leach and humidity cell trials, and larger-scale field-based test pads. These methods permit determination of acidity generation rates.

Important conclusions regarding the assessment of risks associated with heavy metal pollution (AMD/ARD) include:

- AMD risk is directly proportional to Acidity Generation Rates.
- The order of decreasing Heavy Metal Pollution (AMD/ARD) risk from geological materials at mine sites is commonly: waste rock – tailings – wall rock / mine voids – slag – heap leach piles – ore stockpiles.
- Based on suflide oxidation rate data, heavy metal pollution (AMD/ARD) from coal mines can be expected to continue for approximately 20-200 years post closure, while at metal mines it can continue for more than 2,000 years.
- This Heavy Metal Pollution (AMD/ARD) risk approach is important for identifying where management and remediation resources need to be focussed, either within a single mine site, at multiple mine sites across a province, or even for an entire country.
- Acidity Generation Rates are also closely related to water treatment (reagent) requirements, either for mine sites, provinces or countries.