Bureau of Mining Regulation and Reclamation

GUIDANCE DOCUMENT
PIT LAKE CHARACTERIZATION ANALYTICAL PROFILE

The Nevada Division of Environmental Protection (Division), Bureau of Mining Regulation and Reclamation (BMRR) offers the following guidance for an analytical parameter suite to be used for geochemical characterization relating to pit lake geochemical modeling. BMRR has long used the Profile 1 parameter list for evaluating groundwater quality pursuant to Nevada Administrative Code (NAC) 445A.424. In 2014, BMRR introduced the Profile III parameter list, which is utilized for analysis of existing pit lakes and for predictive geochemical modeling of future pit lakes. Profile III was specifically designed to provide a method by which pit lake water quality could be compared to toxicity limits for lifeforms. Comparison to toxicity is required for assessment of all pit lakes according to NAC 445A.429, which states that pit lakes must not have the potential to degrade groundwater or to adversely affect human, terrestrial, or avian life. Comparison of pit lake water quality to Profile 1 drinking water standards is also necessary for some pit lakes, specifically those that may include an outflow to groundwater. Since the incorporation of Profile III into BMRR permits and guidance, a number of pit lake predictive studies have been completed which did not include appropriate data from static or kinetic testing procedures for some parameters. Generally, the missing parameters are those that appear on the Profile III reference list but are not also on the Profile 1 reference list.

This guidance document provides instruction on the parameters that must be included in geochemical characterization procedures associated with pit lake predictive modeling. Applicable characterization procedures are humidity-cell tests (HCTs) and the meteoric water mobility procedure (MWMP), although any additional supplemental testing methods may also need to include all parameters listed herein. However, this parameter list is not applicable to the required characterization of acid-base accounting via the Nevada Modified Sobek procedure.

Unless otherwise approved in writing by BMRR, the parameters that must be included in analytical suites applied to pit lake predictive studies are listed in Table 1. The dissolved fraction (typically to minus 0.45 micron [µm]) of effluent from HCTs should be used to represent long-term solute loading in geochemical modeling. In some cases, the Division may allow the use of MWMP effluent or other field-scale testing methods (Plante et al., 2014). All other testing procedures must be consistent with BMRR-approved methods (i.e., ASTM D5744-13e1 or equivalent for HCTs and NDEP [2015] for MWMP).

For additional information on this guidance please contact the Bureau of Mining Regulation and Reclamation at (775) 687-9400.

Table 1 - Parameters (Profile 1 plus applicable Profile 3)
Acidity [1]
Alkalinity, Total [2]
Alkalinity, Bicarbonate [2]
Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chloride
Chromium
Copper
Fluoride
Iron
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Nitrate + Nitrite (as N)
Nitrogen, Total (as N)
pH
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Sulfate
Total Dissolved Solids
Thallium
Tin
Uranium
Vanadium
Zinc

Table Notes:

(1) Acidity as measured by titration (e.g., Kirby and Cravotta, 2005a; 2005b), reported in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$) equivalent, when pH is less than 5.0 standard units.

(2) Alkalinity as measured by titration (e.g., Kirby and Cravotta, 2005a; 2005b), reported in mg/L as calcium carbonate ($CaCO_3$).

References:

ASTM Standard D5744-13e1, 2013, "Standard test method for laboratory weathering of solid materials using a humidity cell", ASTM International, West Conshohocken, PA, 2013, DOI: 10.1520/D5744, www.astm.org

Kirby, C.S. and Cravotta, C.A. III, 2005a, Net alkalinity and net acidity 1: Theoretical considerations, *Applied Geochemistry*, vol. 20, pp. 1920-1940, DOI: 10.1016/j.apgeochem.2005.07.002.

Kirby, C.S. and Cravotta, C.A. III, 2005b, Net alkalinity and net acidity 2: Practical considerations, *Applied Geochemistry*, vol. 20, pp. 1941-1964, DOI: 10.1016/j.apgeochem.2005.07.003.

NDEP, 2015, Meteoric water mobility procedure bottle roll extraction option, Guidance document prepared by NDEP-BMRR, May 2015.

Plante, B., Bussière, B, and Benzaazoua, M., 2014, Lab to field scale effects on contaminated neutral drainage prediction from the Tio mine waste rocks, Journal of Geochemical Exploration, vol. 137, pp. 37-47, DOI:10.1016/j.gexplo.2013.11.004.

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