

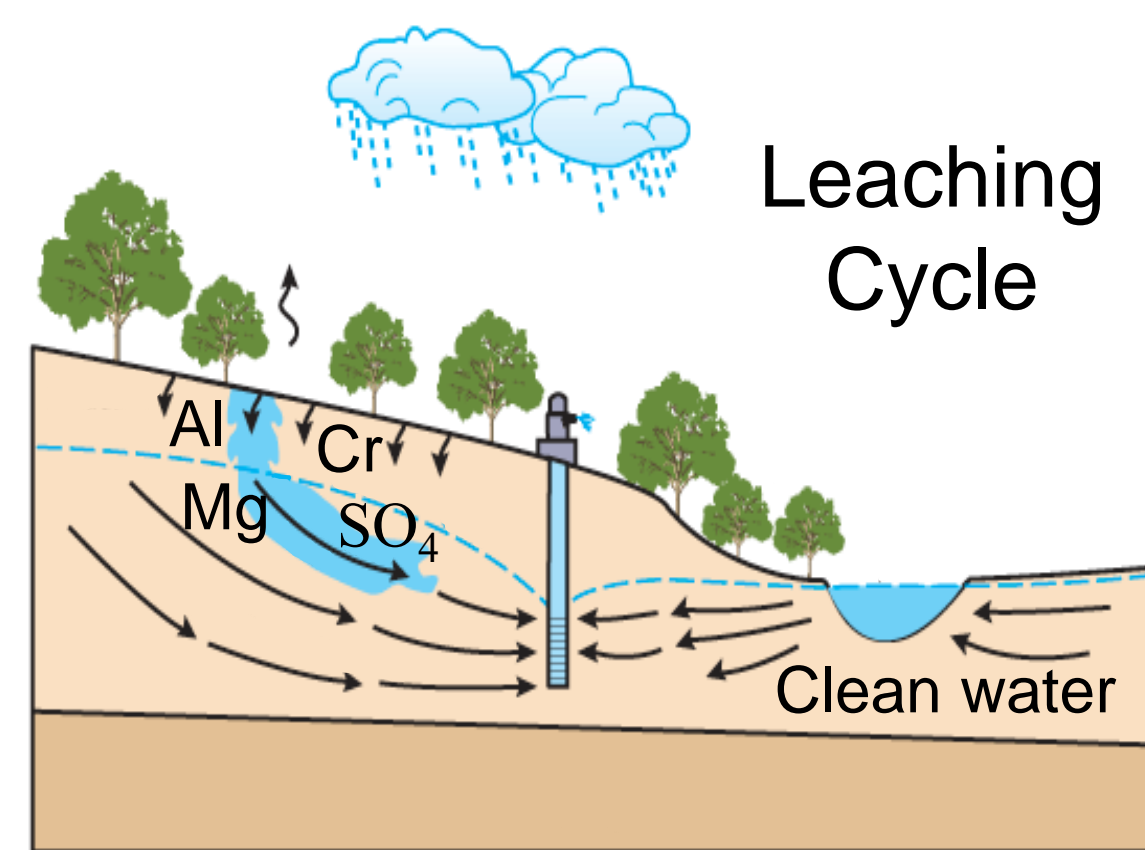
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Leaching Behavior of Metals from Taconite Tailings as an Embankment Fill Material

INTRODUCTION

Taconite tailings are the ore-bearing, by-product rocks of iron mining, predominantly consisting of silicate and fine magnetite crystals. It used to be difficult to dispose of the tailings in a safe matter after it became illegal to discard the tailings in Lake Superior in 1980. In recent years, the use of taconite tailings in pavement construction has increased considerably due to their superior mechanical properties.

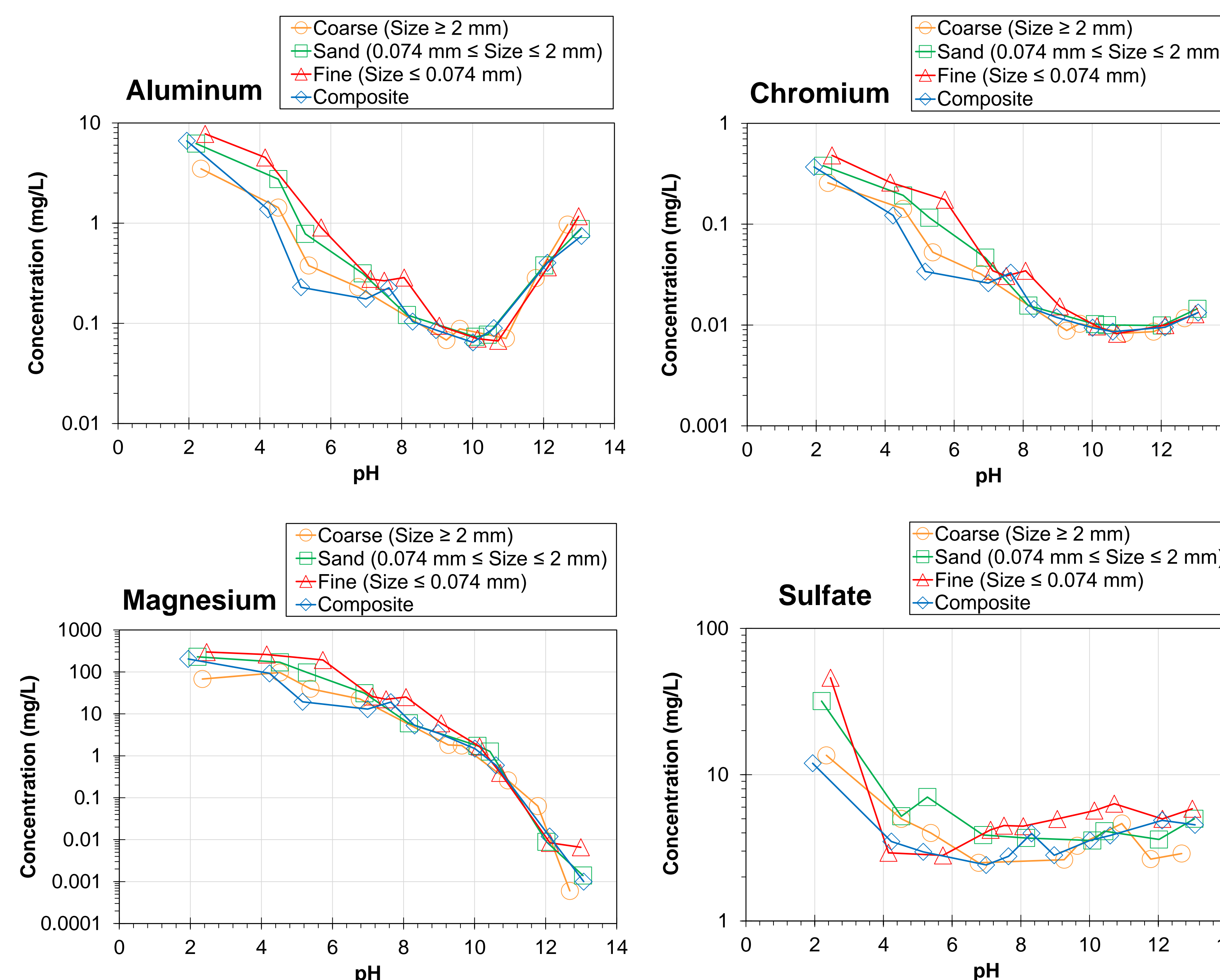
However, an environmental impact assessment of taconite tailings is required before their potential use in construction purposes. Taconite tailings may leach heavy and toxic elements, which could contaminate the soil, surface, and groundwater.



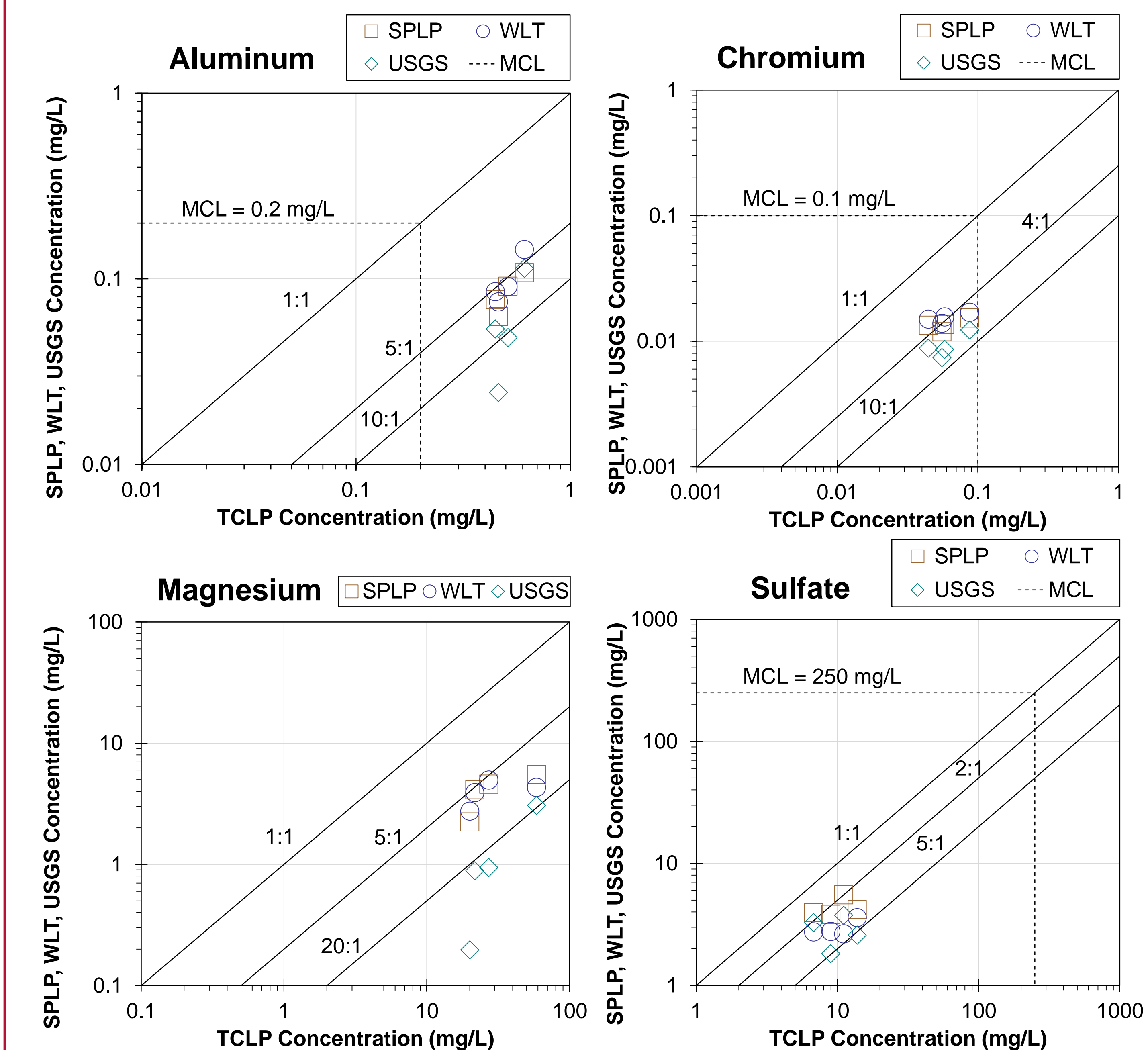
OBJECTIVES

- Evaluate the safety of taconite tailings for the groundwater, soil, and surface water.
- Examine the leaching patterns for various heavy metals.
- Recommend the most conservative leach test method to evaluate the leaching potential.

METAL CONCENTRATION RESULTS



LEACH TEST RESULTS



METHODOLOGY

Coarse, sand, fine, and composite sized taconite tailings were subjected to pH-dependent leaching tests in the pH range of 2 to 13 to investigate the leaching behavior of aluminum (Al), chromium (Cr), magnesium (Mg), and sulfate (SO₄). Each solution was prepared with nanowater and either nitric acid (HNO₃) or potassium hydroxide (KOH). The samples were stored after mixing for 18 hours and pressure filtering. In addition, Toxic Characteristic Leaching Procedure (TCLP), Synthetic Precipitation Leaching Procedure (SPLP), Water Leach Test (WLT), and U.S. Geological Survey leach test (USGS) were performed to evaluate the leaching behavior of taconite tailings in different environmental conditions.

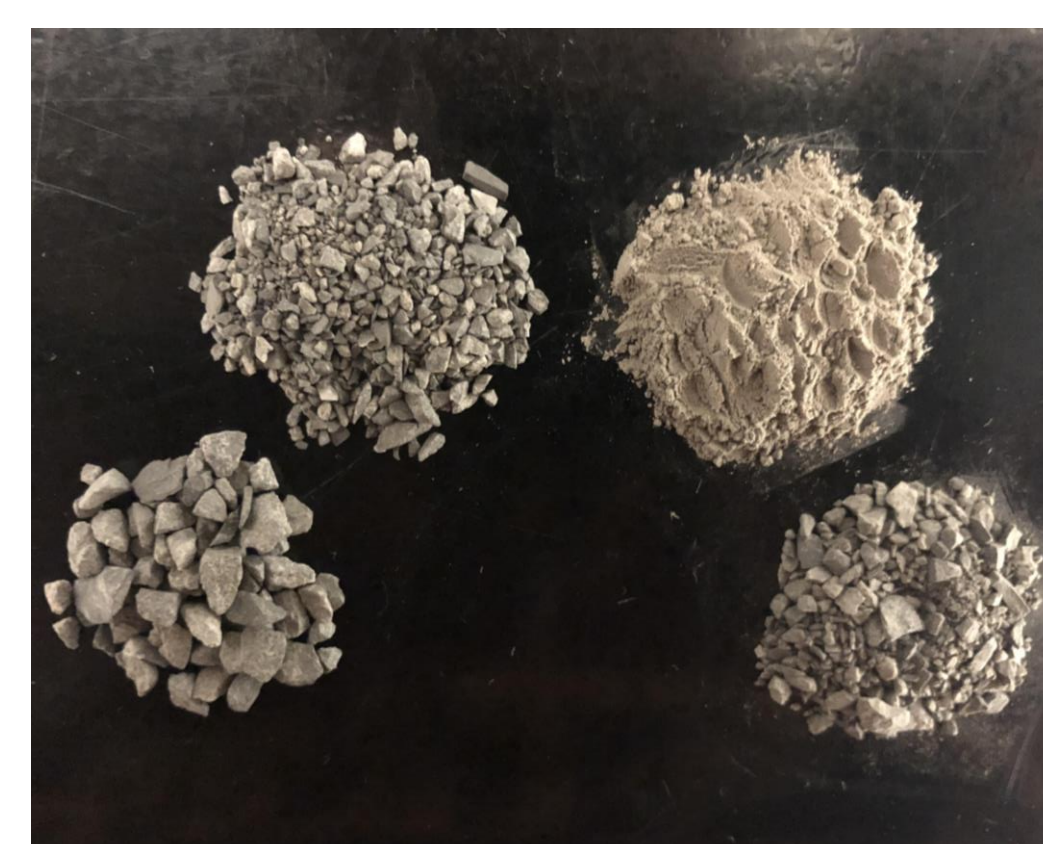


Figure 1: From left to right: coarse, sand, fine, composite



Figure 2: 1 L bottle shaker



Figure 3: ICPE-9810 Plasma Atomic Emission Spectrometer

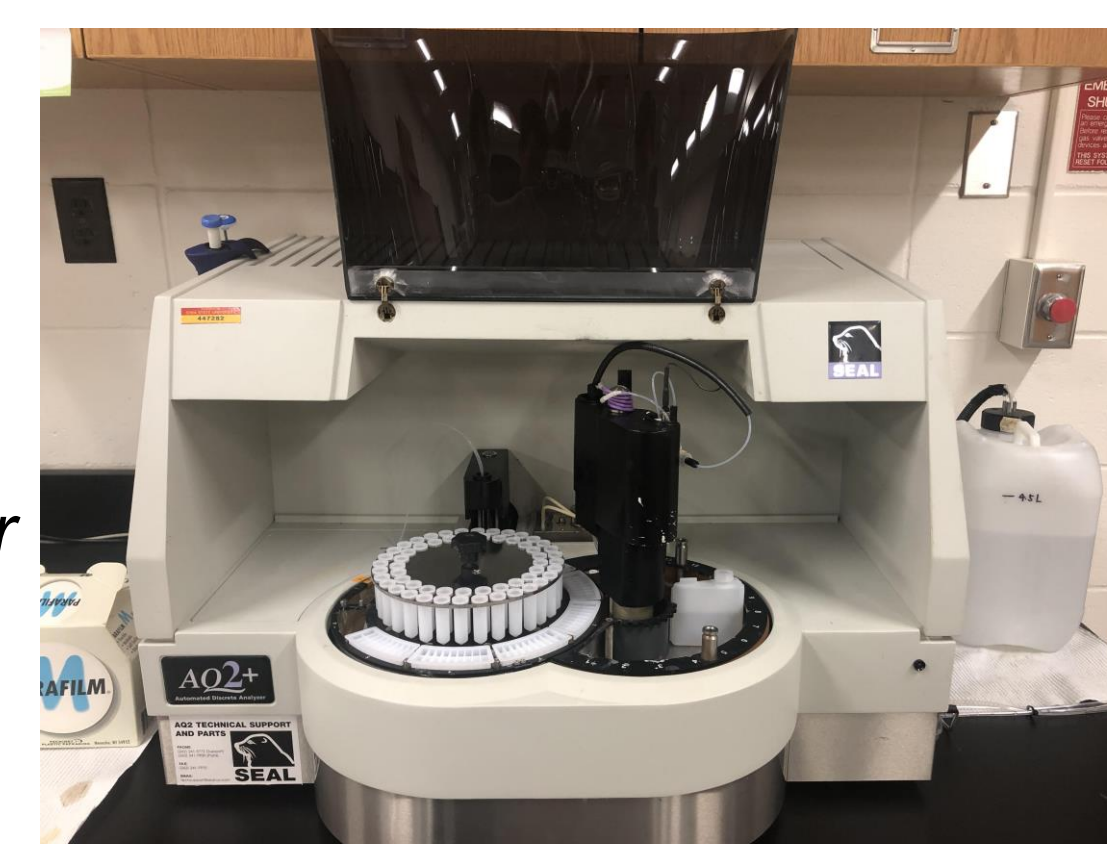


Figure 4: AQ2+ Automated Discrete Analyzer

CONCLUSION

- The highest concentrations of metals were leached from fine sized taconite tailings.
- Aluminum and chromium demonstrate cationic leaching patterns.
- Magnesium and sulfate indicate amphoteric leaching patterns.
- Aluminum may negatively effect the environment due to its high metal concentration with TCLP effluent.
- Chromium is at a safe concentration level for each leach test, but changing environmental factors could exceed the maximum contaminant level (MCL) of 0.1 mg/L for Cr.
- Toxicity characteristic leaching procedure (TCLP) evokes the highest metal concentrations and should be used as the most conservative leach test method.