Neutralisation of red mud leachate: mineralogical and trace metal effects

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Water in contact with bauxite residue red mud is highly alkaline saline, and can contain problematic concentrations of trace metals such as Al, As and V. Treatment of leachates from red mud therefore requires some form of neutralisation prior to discharge.

Leachate (pH 13) collected from Ajka, Hungary was neutralized to < pH 10 by HCl, gypsum, or seawater addition. During acid neutralization >99% Al is removed from solution during the formation of a boehmite-like precipitate and dawsonite. Some As (24%) was also removed from solution via surface adsorption. Gypsum addition results in the precipitation of calcite, both in experiments and field samples recovered from red mud affected rivers treated with gypsum. Calcite precipitation resulted in nonexchangeable removal of 86% Al and 81% As from solution. As-EXAFS analysis of the calcite precipitates revealed only isolated arsenate tetrahedra with no evidence for surface adsorption or incorporation into the calcite structure, possibly a result of very rapid As scavenging by the calcite precipitate. Seawater neutralization also resulted in carbonate precipitation, with >99% Al and 74% As removed during the formation of a hydrotalcite phase and via surface adsorption. Half the bound As could be remobilized by phosphate addition, indicating that As was weakly bound, possibly in the hydrotalcite interlayer. Only 5–16% V was removed from solution during neutralization, demonstrating a lack of interaction with any of the neoformed precipitates. High V concentrations are therefore likely to be an intractable problem during the treatment of red mud leachates.