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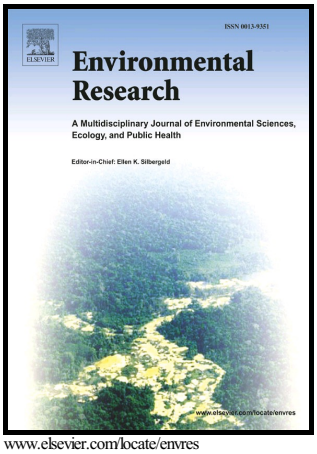

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Hanna Runtti, Emma-Tuulia Tolonen, Sari Tuomikoski, Tero Luukkonen, Ulla Lassi

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How to tackle the stringent sulfate removal requirements in mine water treatment—A review of potential methods

Hanna Runtti[1], Emma-Tuulia Tolonen[1], Sari Tuomikoski[1], Tero Luukkonen[2], Ulla Lassi[1,3]

1. University of Oulu, Research Unit of Sustainable Chemistry, P.O Box 4300, FI-90014, University of Oulu, Finland
2. University of Oulu, Fibre and Particle Engineering Research Unit, P.O. Box 4300, FI-90014, University of Oulu, Finland
3. University of Jyvaskyla, Kokkola University Consortium Chydenius, Unit of Applied Chemistry, Talonpojankatu 2B, FI-67100 Kokkola, Finland

Corresponding author: Tero Luukkonen, email: tero.luukkonen@oulu.fi

Abstract

Sulfate (SO_4^{2-}) is a ubiquitous anion in natural waters. It is not considered toxic, but it may be detrimental to freshwater species at elevated concentrations. Mining activities are one significant source of anthropogenic sulfate into natural waters, mainly due to the exposure of sulfide mineral ores to weathering. There are several strategies for mitigating sulfate release, starting from preventing sulfate formation in the first place and ending at several end-of-pipe treatment options. Currently, the most widely used sulfate-removal process is its precipitation as gypsum ($CaSO_4 \cdot 2H_2O$). However, the lowest reachable concentration is theoretically 1500 mg L^{-1} SO_4^{2-} due to gypsum's solubility. At the same time, several mines worldwide have significantly more stringent sulfate discharge limits. The purpose of this review is to examine the process options to reach low sulfate levels (< 1500 mg L^{-1}) in mine effluents. Examples of such processes include alternative chemical precipitation options, membrane technology, biological treatment, ion exchange, and adsorption. In addition, aqueous chemistry and current effluent standards concerning sulfate together with concentrate treatment and sulfur recovery are discussed.

Keywords: acid mine drainage; discharge limits; sulfate; sulfur recovery; water contamination;