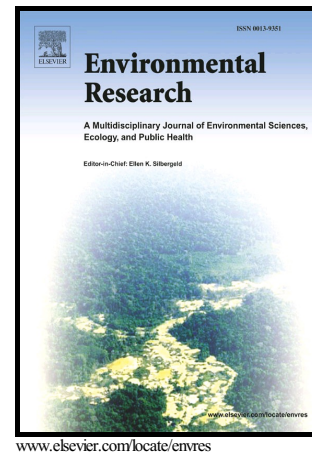


Author's Accepted Manuscript

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PII: S0013-9351(18)30383-9
DOI: <https://doi.org/10.1016/j.envres.2018.07.018>
Reference: YENRS8002

To appear in: *Environmental Research*

Received date: 6 March 2018
Revised date: 16 May 2018
Accepted date: 9 July 2018

Cite this article as: Hanna Runtti, Emma-Tuulia Tolonen, Sari Tuomikoski, Tero Luukkonen and Ulla Lassi, How to tackle the stringent sulfate removal requirements in mine water treatment—A review of potential methods, *Environmental Research*, <https://doi.org/10.1016/j.envres.2018.07.018>

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

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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 ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). However, the lowest reachable concentration is theoretically $1500 \text{ mg L}^{-1} \text{ SO}_4^{2-}$ 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 ($< 1500 \text{ mg L}^{-1}$) 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;

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