Geochemistry of In-Situ Recovery of Metals

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Extended Abstract

The applicability of in-situ recovery (ISR) of (technology) metals is mainly determined by ore body characteristics as well as hydrogeological and mineral/geochemical conditions in the mining aquifer. In addition to optimizing wellfield operation, the environmental impacts need to be addressed by considering hydrological and long-term geochemical processes within the *regional* scale. Whereas 3D hydrological modelling of ISR wellfields embedded into the relevant stratigraphic system is a state-of-the-art approach [1], the complex understanding of geochemical conditions by computer simulation is often constrained by the limited availability or uncertainty of kinetic and thermodynamic data of rock-solution interactions.

Based on the long-term experience in planning, operating and optimizing acidic ISR of uranium in saturated aquifers the main geochemical parameters determining the recovery and economics of ISR mining have been identified and characterized by studying both field data and results from dedicated lab-tests with ore samples from various deposits. In addition to basic simulations using PhreeqC [2], several categories of reactive transport models have been developed to study both uranium recovery from wellfields and environmental impacts [3]. In particular, well-calibrated models are available to *control* the geochemistry of ISR operation.

This paper describes the methodology of geochemical, reactive transport modelling of ISR in practical terms and represents applications to both acid and alkaline leaching of various ore rock types. Results are generalized to detail the ISR applicability criteria for technology metals.

In addition to the geochemical aspects of recoverability, the potential environmental impact of mining solutions in the vicinity of ISR wellfields have been studied in several application cases. Post-mining scenarios include both natural attenuation of mining fluids and aquifer restoration measures.

Key words: In-situ recovery, wellfields, geochemistry, reactive-transport modelling, post-mining

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