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Electrokinetic in situ recovery of copper: The influence of mineral occurrence, zeta potential, and electric potential

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Hypothesis: in-situ recovery is an alternative to conventional mining, relying on the application of an electric potential to enhance the subsurface flow of ions. The governing physics of electrokinetic transport are electromigration and electroosmotic flow, which depend on the electric potential and excess charge adhered to mineral surfaces, respectively. Hence, mineral occurrence and its associated zeta potential should be the governing parameters that affect the efficacy of EK-ISR. Theory and Simulations: The governing model includes three coupled equations: (1) Poisson equation, (2) Nernst–Planck equation, and (3) Navier–Stokes equation. These equations were solved using the lattice Boltzmann method within X-ray computed microtomography images. The effects of mineral occurrence, zeta potential, and electric potential on a complex 3-dimensional synthetic iron ore were evaluated. Findings: Although the positive zeta potential of chalcopyrite can induce a flow counter to the direction of electromigration, the net effect is dependent on the occurrence of chalcopyrite. However, the ion flux induced by electromigration was the dominant transport mechanism, whereas electroosmosis made a lower contribution. Overall, Electrokinetic in-situ recovery is a promising technique that can be controlled because the dominant ion transport mechanisms are electromigration and diffusion. The former term depends on the applied external electric potential, and the latter term depends on the lixiviant injection.

Participation

In-Person

References

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