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Desulfurization: critical step towards enhanced selenium removal from industrial effluents

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Abstract

Selenium (Se) removal from synthetic solutions and from real Flue Gas Desulfurization (FGD) wastewater generated by a coal-fired power plant was studied for the first time using a commercial iron oxide impregnated strong base anion exchange resin, Purolite® FerriX A33E. In synthetic solutions, the resin showed high affinity for selenate and selenite, while sulfate exhibited a strong competition for both oxyanions. The FGD wastewater investigated is a complex system that contains Se ($\sim 1200 \mu\text{g L}^{-1}$), SO_4^{2-} ($\sim 1.1 \text{ g L}^{-1}$), Cl^- ($\sim 9.5 \text{ g L}^{-1}$), and Ca^{2+} ($\sim 5 \text{ g L}^{-1}$), alongside a broad spectrum of toxic trace metals including Cd, Cr, Hg, Ni, and Zn. The resin performed poorly against Se in the raw FGD wastewater and showed moderate to good removal of several trace elements such as Cd, Cr, Hg, and Zn. In FGD effluent, sulfate was identified as a powerful competing anion for Se, having high affinity for the exchange active sites of the resin. The desulfurization of the FGD effluent using BaCl_2 led to the increase in Se removal from 3% (non-desulfurized effluent) to 80% (desulfurized effluent) by combined precipitation and ion exchange treatment. However, complete desulfurization using equimolar BaCl_2 could not be achieved due to the presence of bicarbonate that acts as a sulfate competitor for barium. In addition to selenium and sulfate

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