

Effective removal of oxyanions from aqueous solution by coprecipitated with barite

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Radioactive anions, such as selenium-79, technetium-99, and iodine-129, present in high-level waste, have frequently been taken into the consideration in safety assessments of geological disposal because of their sparse adsorption/immobilization on clays and high mobility in environments. Selenium-79 is a prominent fission product in radioactive wastes; it has a long half-life (about 10^5 years), and it is harmful to organisms depending on its concentration and chemical form in water. In normal water environments, Se is dissolved as oxyanions (selenite: $\text{Se}^{\text{IV}}\text{O}_3^{2-}$; selenate: $\text{Se}^{\text{VI}}\text{O}_4^{2-}$) with high solubility and mobility. Several techniques can be used to reduce the level of Se in aqueous solutions, but there is a lack of effective removal techniques for selenite and selenate. In the present work, we designed and characterized methods using barite (BaSO_4) as a sequestering phase for removing oxyanions, such as selenite and selenate from polluted solutions based on the structural similarity between SO_4^{2-} and SeO_3^{2-} or SeO_4^{2-} . Barite is a cheap and effective material, and it can be used to remove toxic and/or radioactive elements from polluted solutions, but it has not been widely used in environmental studies.

In the present work, we investigated the coprecipitation mechanism of barite to determine the optimum condition for Se removal using barite. The uptake of Se(IV) by barite is dependent on pH, coexistent Ca^{2+} ion, and SO_4^{2-} concentration in the initial solution, possibly due to their effects on the chemical affinity and structural similarity. On the other hand, the uptake of Se(VI) is strongly dependent on SO_4^{2-} concentration in the initial solution owing to the structural similarity between SO_4^{2-} and SeO_4^{2-} , which is only related to the structural similarity. Based on the results, it was found that more than 80% of the SeO_3^{2-} and SeO_4^{2-} in the tested aqueous solution ($[\text{Se}]_{\text{initial}} = 80 \text{ mg/L}$) were incorporated into the barite during coprecipitation. In comparison with previous techniques, barite shows better Se(VI) removal performance, despite the high solubility and mobility of SeO_4^{2-} in aquatic environments.