Removal of selenate by co-precipitate with ettringite in aqueous solution

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Selenium can be toxicant with high concentrations in aqueous solutions. ^{79}Se isotope is also one of the radionuclide present in high-level nuclear wastes with long half life periods. Because of negative surface charge of most minerals in earth crust. Selenate is quite mobile in ground waters.

Ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$)is known as one of products formed in an early stage during hydration of Portland cement and can also occur naturally. The structure of ettringite consisting of column parts with $\{Ca_6[\underline{Al}(\underline{OH})_6]_2\cdot 24H_2O]\}^{6+}$and channel parts including tetrahedral SO_4^{2-} and H_2O. It has been reported that Ca^{2+}, Al^{3+} and SO_4^{2-} can be replaced with nuclide species. Selenate can also be partly and fully substituted with sulfate.

In the present work, we have investigated on immobilization of selenate by co-precipitation with ettringite. resulting in different types of ettringite by mixing stoichiometric amounts of $Ca(OH)_2$ and $Al_2(SO_4)_3$, $AlCl_3$ with Na_2SeO_4 in ultrapure water. Using $Ca(OH)_2$ and $AlCl_3$ as Ca and Al sources, selenate was substituted with sulfate in ettringite, providing the highest concentration of Se in the solid residues. The potential stability of selenate-substituted ettringite has been assessed by exposing in aqueous solution under the different pHs. It was found that more than 90% of selenate was immobilized in the structure of ettringite under the initial pH value from 5 to 11.This suggests that selenate can be effectively immobilized in the structure of ettringite in wide range of pH.