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Cd SORPTION ON HYDROXYAPATITE IN THE PRESENCE OF EDTA IN AQUEOUS SOLUTION

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Calcium phosphate apatites are the main inorganic constituents of biological hard tissues such as bones or teeth. Phosphate materials like hydroxyapatite [HAP—$Ca_5(PO_4)_3OH$] can be used in situ to immobilize trace contaminants [1, 2]. Cadmium is one of the major heavy toxic elements which may be found in surface and underground waters. The main sources of contamination are industrial wastes and phosphate fertilizers [3]. The reaction mechanisms for metal immobilisation by phosphate minerals include ion exchange, surface complexation, dissolution-precipitation and co-precipitation processes [2, 4].

The mobility of metal ions in environment is controlled by a number of factors including natural and synthetic chelating agents [5]. Mechanistic studies of the trace metals binding mechanism into a solid phase is complicated because of the low concentration of the metal bound and several possible processes taking place simultaneously [6, 7]. In this case modelling the equilibrium state between solid and solution may led to a better understanding of the immobilisation mechanism.

The removal of cadmium from aqueous solutions by HAP was investigated with and without EDTA being present. Batch experiments were carried out using synthetic hydroxyapatite with Ca/P 1.58 and a specific surface area of 37.52 m^2/g in the pH range 4 to 9 (25 °C; 0.1 M KNO_3). The initial concentrations of Cd(II) and of EDTA were 0.002 M. The solid-solution ratio was 2 g/l. The amount of Cd removed from the solution increased with increasing pH, reaching ≈ 100 % at pH 9. The presence of EDTA reduced the HAP removal capacity to 95.5 % due to the formation of $[CdEDTA]^{2-}$ in solution. The solubility of HAP increases in the presence of EDTA at pH values above 6, mainly due to the formation of $[CaEDTA]^{2-}$.

The information from the chemical analyses was used to design an equilibration model that takes into account dissolution, solution and surface complexation, as well as possible phase transformations. The total concentration of protons, calcium, phosphate, EDTA, and cadmium in solution were used to calculate a model for the dissolution and surface complexation of HAP. In the calculations the computer code WinSGW, which is based on the SOLGASWATER algorithm, was used.

References

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