

Chloride influence on cadmium retention onto smectite and aluminium oxide

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Cadmium is one of the pollutants of greatest environmental and health concern because it is a heavy metal, non-degradable, highly toxic to human, plants and animals, even being present in low levels. Different approaches and adsorbents are proposed for cadmium immobilisation, like precipitation, ion exchange, solvent extraction or adsorption on minerals, specially clays and oxides.

In this work, a combined experimental and modelling methodology was followed for a mechanistic approach to describe cadmium sorption onto smectite clay and aluminium oxide (γ -Al₂O₃). Previous sorption studies on both systems are reported, but some relevant aspects that prevent assessing their remediation power are still under discussion. In particular, there is a controversy regarding the role of chloride on complexing cadmium species. Some authors considered that cation adsorption may be promoted in chloride-bearing fluids, since chloride non-specific adsorption lowers charge at the oxide/water interface but other authors concluded that chloride complexing lowered Cd adsorbability.

A revision of available thermodynamic data for cadmium aqueous and solid species was carried out. According to speciation calculations, Cd²⁺ is the dominant aqueous specie up to pH 8, with small contribution of CdCl⁺, considering that CdCl⁺ specie has exactly the same “shape” and prevalence region than Cd²⁺. In order to isolate its contribution, comparable sorption experiments, in presence and in absence of Cl ions were carried out. Equivalent sorption was measured in presence or in absence of Cl in solution, both in smectite and γ -Al₂O₃. The inclusion of Cd-Cl complexes to describe Cd retention is not supported by our study. Given the analogy between strong sorption sites in clays and aluminol groups, the system comparison allowed isolating the contribution of different coexistent complexation and cation exchange mechanisms.