

Thermodynamic assessment of Hg(II)–gibbsite interactions

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Abstract

As discrete particles and/or as surface coatings on other minerals in natural systems, aluminum hydroxides are efficient sinks for Hg(II). The Hg(II) adsorption on gibbsite was determined as a function of temperature (T), pH, and the type of background electrolytes, i.e., NaNO₃, NaClO₄, and NaCl. When the equilibration time $t_E \sim 2$ h, the Hg(II) retention on gibbsite was found to be a reversible process, which was ascribed to adsorption. The Hg(II) adsorption capacity, i.e., $\Gamma_{\text{Hg(II)}}$, varied with the type of electrolyte used in accordance with the following order: $\Gamma_{\text{Hg(II)}}^{\text{NO}_3} \geq \Gamma_{\text{Hg(II)}}^{\text{ClO}_4} > \Gamma_{\text{Hg(II)}}^{\text{Cl}}$. In all cases, the estimated thermodynamic parameters showed that the Hg(II) adsorption on gibbsite was endothermic and spontaneous. The Hg(II) adsorption data were quantified with the Langmuir or Hill, and Dublin–Radushkevick (DR), isotherms at all temperatures and acidity levels examined. Always, the Hg(II) adsorption data were in compliance with the DR model. However, the Hg(II) adsorption in NaNO₃ or NaClO₄ was interpreted in terms of the Langmuir model. When NaCl was used as electrolyte, the Hg(II) adsorption was modeled well with the Hill equation. The mean free energy values calculated from DR plots concluded that Hg(II)–gibbsite interactions are a result of chemical bonding.

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