

SORPTION OF IODINE BY HYDROTALCITE AND HYDROTALCITE-LIKE COMPOUND - PROPERTIES AND EFFECT OF CARBONATE ION

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For the long-term safety assessment of radioactive waste disposal, anionic species in radioactive waste, e.g. $^{99}\text{TcO}_4^-$ and $^{129}\text{I}^-$ are of serious environmental and critical regulatory concerns. Due to poor sorption onto common minerals, their transport from constructed repositories into the biosphere is predicted to be very rapid. In this context, extensive efforts have focused on identifying minerals that might impede the movement of the anionic species. From the result of such previous studies, sulfide and selenate minerals containing Fe, Cu, Sb, Hg and Pb are derived as efficient anion scavengers (OSCARSON et al., 1986; BALSLEY et al., 1998). However, addition of such minerals to the backfill is still a desk plan because of their uncertainty of long-term stability, geochemical complexity and toxicity of such heavy metals. Hydrotalcite ($\text{CO}_3\text{-HT}$) has also been investigated for the retardation of the anionic species due to its high anion exchange capacity (for example KANG et al., 1996). Given the relatively low selectivity of $\text{CO}_3\text{-HT}$ for I^- , OSCARSON et al. (1986) concluded that $\text{CO}_3\text{-HT}$ would not be effective buffer additive for the immobilization of $^{129}\text{I}^-$.

In this study, iodine sorption experiments at pH 9.6 for the synthesized $\text{CO}_3\text{-HT}$ and hydrotalcite-like compounds with NO_3^- ($\text{NO}_3\text{-HT}$) as an interlayer anion were performed in laboratory batch tests at 20 °C to elucidate and compare sorption characteristics of each phase. In addition, to obtain information on the sorptive competition between I^- and CO_3^{2-} for $\text{NO}_3\text{-HT}$, sorption experiments for the synthesized $\text{NO}_3\text{-HT}$ were also conducted in CO_3^{2-} -bearing solutions with different concentrations of KCO_3 .

As the results of adsorption experiments with KI concentration range between 10-1000 mg/l, much of the I^- in solution may be exchanged for the NO_3^- in the $\text{NO}_3\text{-HT}$ (see Figure). The amount of I^- sorbed to contacting $\text{NO}_3\text{-HT}$ increased linearly with an increase in the equilibrium concentration of I^- in solution, and was totally larger than that to $\text{CO}_3\text{-HT}$. On the other hand, in the adsorption isotherm of the $\text{CO}_3\text{-HT}$, the saturation was around 1 mg adsorbed per g $\text{CO}_3\text{-HT}$, whereas the same linear increase was observed at lower equilibrium concentration of I^- in solution. From the competitive isotherms of I^- with CO_3^{2-} , no effects on adsorption properties and linear isotherms were observed in the experiments with KCO_3 concentration less than 10^{-3} mol/l (here, CO_3^{2-} was 5.1×10^{-5} mol/l). Although the adsorption of I^- by $\text{NO}_3\text{-HT}$ would not be practical under such high carbonate conditions, the $\text{NO}_3\text{-HT}$ is presumably an effective scavenger of $^{129}\text{I}^-$ under high Ca conditions such as cementitious repositories.

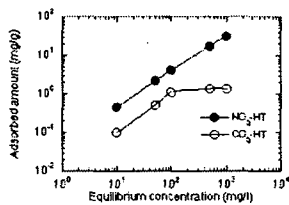


Figure 1. Adsorption isotherms of iodine onto $\text{CO}_3\text{-HT}$ and $\text{NO}_3\text{-HT}$ at 20°C.

References

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