The Waste Isolation Plant (WIPP) transuranic repository remains one of the U.S. Department of Energy’s (DOE) nuclear waste management efforts. Waste disposal operations began at the WIPP on March 26, 1999 but a requirement of the repository license is that the WIPP needs to be recertified every five years for its disposal operations. The WIPP is now pursuing its third recertification (to be submitted in March 2014) and there are many ongoing discussions about possible expanded missions and additional nuclear repository concepts in a Salt geology.

The overall ranking of actinides, from the perspective of potential contribution to release from the WIPP, is: Pu ~ Am > U >> Th and Np and remains unchanged from past recertification. The U – 50% U(IV) and 50% U(VI); Pu – 50% Pu(III) and 50% Pu(VI); with Am/Cm as the III oxidation state and thorium as Th(IV) solubility in the presence of carbonate-free brine after ~ 2 years equilibration. These were used to develop enhancement factors that were used to estimate dissolved actinide concentrations.

Th(IV) solubility in carbonates-free brine after ~ 2 years equilibration

Overall Observation on the Interactions between Colloidal, Dissolved and Solid Phases in Brine Systems

Technique demonstration: of sequential filtration

Intrinsic Actinide Colloids in Brine

The intrinsic colloidal contribution to dissolved actinide concentrations was re-evaluated using sequential filtration of the dissolved actinides in long-term multi-year actinide solubility experiments as a function of $pC_{am}$, brine composition. In almost all cases investigated, filtrable species that were <10 μm in size were observed (see Figures on the right for Nd, Pu, Th and U). These were used to develop enhancement factors that were used to estimate dissolved actinide concentrations.

Solubility of Th(IV) in Brine

Thorium is the analog for the Am(IV) oxidation state and thorium data are conservatively used to predict dissolved Am(IV) concentrations. Long-term solubility studies were completed to investigate the effects of $pC_{am}$, brine composition, and the presence/absence of organic chelating agents and carbonate. Key results are shown to the right. Initially, metastable and relatively high-concentrations that were independent of pH were observed. In time equilibration led to a thorium solubility of ~18-7 M that was in good agreement with the model-predicted values. Thorium is a particularly complex system that can persist in very high concentrations as a metastable species that always has a significant colloidal contribution. Equilibration appears to be between the colloidal (undissolved) and dissolved solid thorium. The prevalence of the colloidal species may be technique/approach-specific and data interpretation needs to be done carefully.

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