6.3 REE separation

A. Geist

The extraction of trivalent lanthanide ions by acidic organophosphorus extracting agents such as di(2-ethylhexyl)phosphoric acid (D2EHPA) is usually described by the following equilibrium, considering the dimerization of D2EHPA in non-polar diluents.

$$Ln^{3+} + 3\ (HL)_2 \rightleftharpoons Ln(LHL)_3 + 3\ H^+ \qquad (1)$$

Applying a concentration-based equilibrium model, a slope of 3 is expected for plotting $\lg D_{Ln(III)}$ over p*H*. However, slopes of approximately 3.5 are observed when extracting from HNO_3. This discrepancy is caused by the ionic interaction between Ln^{3+} and NO_3^-. The Specific Ion Interaction Theory (SIT) [13] is one way to account for this interaction.

We have previously been using SIT based equilibrium models for describing solvent extraction systems used for actinide separations. Consequently, such a model was tested for the extraction of Eu(III) into D2EHPA. This model calculates equilibrium distribution ratios as a function of initial concentrations. Activities are used in the aqueous phase, concentrations are used in the organic phase. Ion interaction coefficients of $\varepsilon(H^+, NO_3^-) = 0.07$ and $\varepsilon(Eu^{3+}, NO_3^-) = 0.27$ and an extraction constant of $K = 1500$ are used.

Figure 4 compares experimental and calculated Eu(III) distribution ratios as a function of initial HNO_3 concentration. Excellent agreement is achieved throughout; the small deviations at 0.03 and 2 mol/L HNO_3 are due to experimental uncertainties frequently observed for distribution ratios below 0.001 or above 1000.

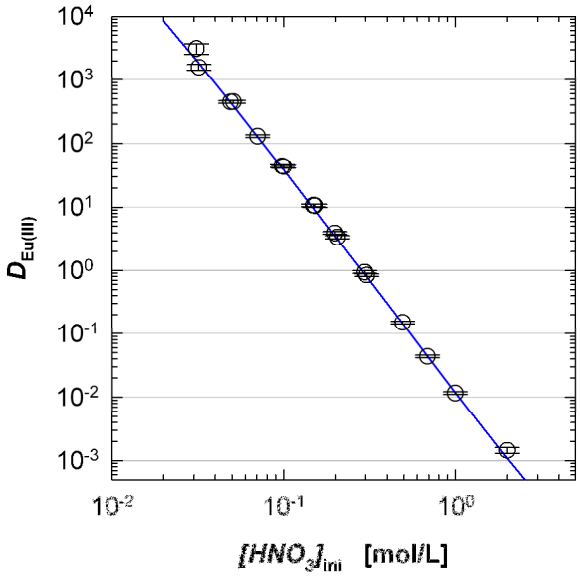

Fig. 4: *Extraction of Eu(III) from HNO_3 into D2EHPA. Organic phase, 0.1 mol/L D2EHPA in kerosene. Aqueous phase, 2 kBq/mL ^{152}Eu(III) + 50 mg/L Eu((III) in HNO_3. A/O = 1, T = 20 °C.*

Again, SIT was shown to be useful for describing solvent extraction systems. Further experiments to validate the model under loading conditions (i.e. for metal ion concentrations that result in a significant consumption of the extracting agent) are foreseen.

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