A kinetic study on the extraction of Americium(III) into $CyMe_4$-BTBP

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Abstract

$CyMe_4$-BTBP is the current European reference molecule used in the development of *r*-SANEX processes for separating Am(III) and Cm(III) from Ln(III). Successful spiked and hot tests were performed at Jülich [1] and ITU [2]. Also, a successful spiked 1c-SANEX process, directly extracting only Am(III) and Cm(III) from a simulated PUREX raffinate, was performed at Jülich [3]. However, due to $CyMe_4$-BTBP's rather slow extraction kinetics [4], comparatively low flow rates had to be used. Quantitative kinetic investigations on the extraction of Eu(III) into $CyMe_4$-BTBP in a rotating membrane cell support this [5].

Since no quantitative kinetic data on Am(III) were available, we studied extraction and stripping kinetics for the system Am(III) – NO_3^- / $CyMe_4$-BTBP – TODGA – diluent in the INE stirred cell [6]. Such kinetic data are important to perform highly reliable flow-sheet calculations. Extraction rates from 1 mo/L HNO_3 were measured as a function of nitrate concentration (via addition of NH_4NO_3), $CyMe_4$-BTBP concentration, TODGA concentration, and diluent (standard diluent was 1-octanol; cyclohexanone was also tested). Am(III) stripping rates into dilute HNO_3 (from a loaded phase with or without TODGA) or into glycolate solution were also measured. The following results were obtained:

- With an organic phase consisting of $CyMe_4$-BTBP in 1-octanol, Am(III) extraction rate increase first order both with *[$CyMe_4$-BTBP]* and with the interfacial area. Nitrate concentration has a small effect.
- With an organic phase consisting of $CyMe_4$-BTBP + TODGA in 1-octanol, Am(III) extraction rate is practically independent of *[$CyMe_4$-BTBP]*. However, Am(III) extraction rate increases first order both with *[TODGA]* and with the interfacial area. TODGA has a positive kinetic effect; e.g., Am(III) extraction rate increases by approx. one order of magnitude when 5 mmol/L TODGA is added to the organic phase.
- Replacing the diluent 1-octanol with cyclohexanone has a positive kinetic effect; extraction rate is slightly higher than that for an organic phase containing 10 mmol/L TODGA in 1-octanol.
- TODGA also accelerates stripping into dilute HNO_3 by approx. an order of magnitude. However, stripping into 0.5 mol/L glycolate solution (pH = 4) results in an even higher stripping rate.

All extraction and stripping rates (except for stripping into glycolate solution) are below 10^{-6} m/s. This indicates chemical regime. However, the stripping rate into glycolate solution is $2.5 \cdot 10^{-6}$ m/s, indicating a significant diffusive influence [**Error! Bookmark not defined.**].

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