6.2 Am(III)/Cm(III) separations column experiments

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A solvent extraction system consisting of TODGA as organic phase extracting agent and SO_3-Ph-BTBP as aqueous phase complexing agent allows for the separation of Am(III) from Cm(III) and Ln(III) [11] (in contrast to systems using SO_3-Ph-BTP [5] or PTD [9] which do not differentiate Am(III) and Cm(III), thus co-separating them from Ln(III)).

With the SO_3-Ph-BTBP/TODGA system, a separation factor of 2.5 - 3 for Cm(III) over Am(III) is achieved. Even with such a comparatively low selectivity, efficient separation is possible using multi-stage counter-current equipment.

We investigated the performance of the SO_3-Ph-BTBP/TODGA system in a solid liquid setup. The TODGA based Eichrom® DGA resin was used as the stationary phase and a solution of SO_3-Ph-BTBP in HNO_3 is the mobile phase. Am(III) and Cm(III) distribution ratios were determined for varied SO_3-Ph-BTBP and HNO_3 concentrations in batch experiments, the aqueous phase speciation was studied by TRLFS, and finally a column experiment was performed.

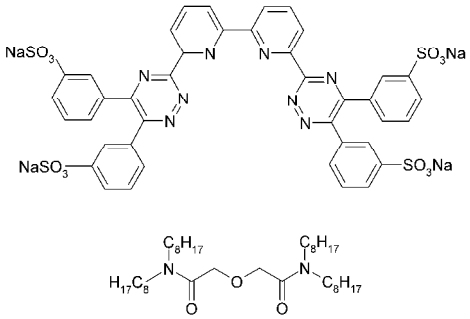

***Fig. 2**: Top, SO_3-Ph-BTBP; bottom, TODGA.*

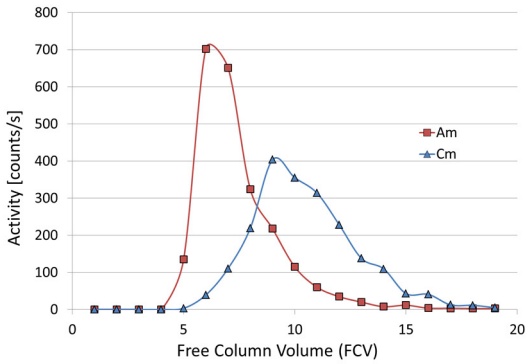

***Fig. 3**: Elution of Am(III) and Cm(III) from an Eichrom® DGA column by a solution of 5 mmol/L SO_3-Ph-BTBP in 0.15 mol/L HNO_3. FCV, 0.25 mL; Flow rate, 0.22 mL/min.*

Batch extraction experiments showed the SO_3-Ph-BTBP/ Eichrom® DGA system to perform similar to the SO_3-Ph-BTBP/TODGA liquid-liquid system [12]. Distribution ratios increase with increasing HNO_3 concentration and decrease with increasing SO_3-Ph-BTBP concentration. The separation factor for Am(III) over Cm(III) remains in the range of 2.5 - 3.5 throughout the experimental conditions applied.

The influence of the SO_3-Ph-BTBP concentration on the distribution ratios insinuates the formation of Cm(III)/SO_3-Ph-BTBP 1:1 complexes. This was already observed with the respective liquid-liquid extraction system [12], for which however the presence of 1:2 complexes was unambiguously determined by TRLFS [12]. Consequently, the aqueous phase from a SO_3-Ph-BTBP/ Eichrom® DGA experiment was investigated by TRLFS. In accordance with the liquid-liquid system, the exclusive formation of the Cm(III) 1:2 complex was proven.

Finally, a column experiment was run, eluting Am(III) and Cm(III) from a column packed with Eichrom® DGA resin, particle size 50 - 100 µm (ID = 4 mm, L = 40 mm). Elution was performed by passing a solution of 5 mmol/L SO_3-Ph-BTBP in 0.15 mol/L HNO_3 at a gravitational flow rate of approximately 0.2 mL/min.

As evident from Figure 3, Am(III) was preferentially eluted. Unfortunately, baseline separation was not achieved for the experimental conditions applied.

While the result from this first run is encouraging, optimization is required to achieve better separation between Am(III) and Cm(III). This may be achieved by using a longer column and/or finer material (which however will require the stationary phase being pumped). Also, running the column at an elevated temperature is expected to have a positive impact.