(A.1) In a solvent system the distribution ratio, D_U, is 2 for uranium and D_{Cs} is 0.003 for cesium. If 99.5% U is to be extracted in a repeated batch fashion eqn. (A.5)), (a) how much Cs is coextracted? If instead a countercurrent process is used with 10 extraction and 2 wash stages, what percentage of (b) uranium and (c) cesium is extracted? In an extraction equipment D_{Cs} 0.003 cannot be maintained, because droplets are carried over between stages; the practical value will be D'_{Cs} 0.02. (d) How much cesium is extracted in this latter case with the countercurrent equipment? Assume equal phase volumes.

Assume that equal phase volumes were used for all extractions.

$D_U := 2$ $\quad D_{Cs} := 0.003$ $\quad E_U := 99.5 \cdot \%$ $\quad NE_U := 1 - E_U$ $\quad \theta := 1$

$n := 3..7$ $\quad P_U := \theta \cdot D_U$ $\quad P_{Cs} := \theta \cdot D_{Cs}$

$\psi(n, P) := (P + 1)^{-n}$ eqn.(A.6)

n	$\psi(n, P_U) - NE_U$
3	0.032
4	0.007
5	$-8.848 \cdot 10^{-4}$
6	-0.004
7	-0.005

Thus 5 extractions was used to recover U in the given yield.

$\psi(5, P_{Cs}) = 98.513 \cdot \%$ $\quad E_{Cs} := 1 - \psi(5, P_{Cs})$ $\quad E_{Cs} = 1.487 \cdot \%$

The answer to (a) is: 1.487% rounded to: 1.5%

For a counter current extraction with constant phase volume ratio and constant *D*-values we have:

$\theta_W := 1$ $\quad P_{Uwash} := \theta_W \cdot D_U$ $\quad P_{Cswash} := \theta_W \cdot D_{Cs}$ $\quad$ OBS. 2 wash stages = m -1 hence, $m = 3$

$\theta_E := 1$ $\quad P_{Uext} := \theta_E \cdot D_U$ $\quad P_{Csext} := \theta_E \cdot D_{Cs}$

$$\psi(n, m, P_E, P_W) := \frac{(P_E - 1)\cdot(P_W{}^m - 1)}{(P_E{}^{n+1} - 1)\cdot(P_W - 1)\cdot P_W{}^{m-1} + (P_W{}^{m-1} - 1)\cdot(P_E - 1)} \qquad \text{eqn.(A.8)}$$

(b) For U we then get: $\quad E_U := 1 - \psi(10, 3, P_{Uext}, P_{Uwash})$

$E_U = 0.999$ $\quad E_U = 99.91 \cdot \%$

(c) and for Cs: $\quad E_{Cs} := 1 - \psi(10, 3, P_{Csext}, P_{Cswash})$

$E_{Cs} = 2.7 \cdot 10^{-8}$ $\quad E_{Cs} = 2.7 \cdot 10^{-6} \cdot \%$

(d) For D'_{Cs}=0.02: $\quad P_{Cse} := 0.02 \cdot \theta_E$ $\quad P_{Csw} := 0.02 \cdot \theta_W$

$E_{[illegible]} := 1 - \psi(10, 3, P_{[illegible]}, P_{[illegible]})$ $\quad E_{[illegible]} = [illegible] \cdot 10^{-4} \cdot \%$

$$E_{Cs} = 1 - \psi(10, 3, P_{Cse}, P_{Csw}) \qquad E_{Cs} = 8\cdot 10 \;\%$$