Special Topics Related to Staged Processes

Two section absorber/stripper for the fraction of mixture A and B

For $K_B > K_A$:

Reduces to absorber form of KSB equation if $m = 1$, $n = N$ and $y_{out}^* = 0$

Two section KSB equation:

$$\frac{V_{i,N}}{L_{i,1}} = \left( \frac{K_i V}{L} \right)^n \left[ \frac{\left( \frac{K_i V}{L} \right)^m - 1}{\left( \frac{K_i V}{L} \right)^n - 1} \right]$$

Top section:

Efficient absorbing of A

$$\frac{L}{K_A V} > 1 \implies \frac{L}{V} > K_A$$

Inefficient absorbing of B

$$\frac{L}{K_B V} < 1 \implies \frac{L}{V} < K_B$$
Efficient stripping of B
\[ \frac{K_a V}{L} > 1 \Rightarrow \frac{L}{V} < K_B \]

Inefficient stripping of A
\[ \frac{K_a V}{L} < 1 \Rightarrow \frac{L}{V} > K_A \]

All 4 conditions are satisfied if:
\[ K_B > \frac{L}{V} > K_A \]

Often the optimal value for \( \frac{L}{V} \) is given by: \( \sqrt{K_A K_B} \)

**Component A:**

Top (absorption) Section
Slope = \( \frac{L}{V} \)

Bottom (stripping) Section
Slope = \( \frac{L}{V} \) > \( K_A \)

Material balance at feed point
\[ f_{A} + (X_{A,f+1})(L) = x' L \]

**Component B:**

\( y_B \)

Low removal of B
\( X_B \)

High removal of B
\( x' \)
Staged extraction for fractionation of solutes

Examples:

**PUREX Process-**
Plutonium Uranium Extraction

Production of Streptomycin (an antibiotic)

Final step is the removal of Streptomycin B from the active form (Strep. A)
Extraction Equipment

Mixed- Setter:

Centrifugal Extractor:

MONO-STAGE CENTRIFUGAL EXTRACTORS:
Cross section sketch of 4 stage centrifugal extractor
The Podbielniak extractor
Invented by Walter J. Podbielnick
Operates like a sieve plate tower

- Heavy liquid out
- Light liquid in
- Heavy liquid in
- Light liquid out
- Sieve plates
- Clarifying zone
- Extraction zone

Diagram showing liquid flow through a sieve plate tower.
Penicillin

Figure 8.7. (a) Penicillin fermentation flow sheet, illustrating the inoculum stages. (b) The recovery train for penicillin.