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HASAN USLU

Editor PPT

Biography

- Dr. Hasan Uslu is working as a Professor (Associate) at Beykent University, Chemical Engineering Department, Turkey, Istanbul.
- His research interests include Liquid-Liquid Extraction, Reactive Extraction and Adsorption .

Recent Publications

- Hasan Uslu, Seyhan Günyeli, Zeynep İlbay, Ş. İsmail Kırbaşlar(2014) Distribution of Penicillin G from the Aqueous Phase to the Organic Phase Using Amberlite LA-2 Extractant in Different Diluents. Journal of Chemical & Engineering Data.
- Nil Pehlivanoğlu, Hasan Uslu, Ş. İsmail Kırbaşlar (2014) Separation of Oxoethanoic Acid from Aqueous Solution by N-Methyl-N,N-dioctyloctan-1-ammonium Chloride. Journal of Chemical & Engineering Data.
- Seyhan Günyeli, Hasan Uslu, Ş. İsmail Kırbaşlar (2014) Effect of Solvent on Reactive Extraction of 2-Methylidenebutanedioic Acid by Using N-Methyl-N,N-dioctyloctan-1-ammonium Chloride. Journal of Chemical & Engineering Data.

Liquid-Liquid Extractions

In liquid-liquid extraction, a soluble component (the solute) moves from one liquid phase to another. The two liquid phases must be either immiscible, or partially miscible.

usually isothermal and isobaric

- can be done at low temperature (good for thermally fragile solutes, such as large organic molecules or biomolecules)
- can be very difficult to achieve good contact between poorly miscible liquids (low stage efficiency)
- extracting solvent is usually recycled, often by distillation (expensive and energy-intensive)
- can be single stage (mixer-settler) or multistage (cascade)

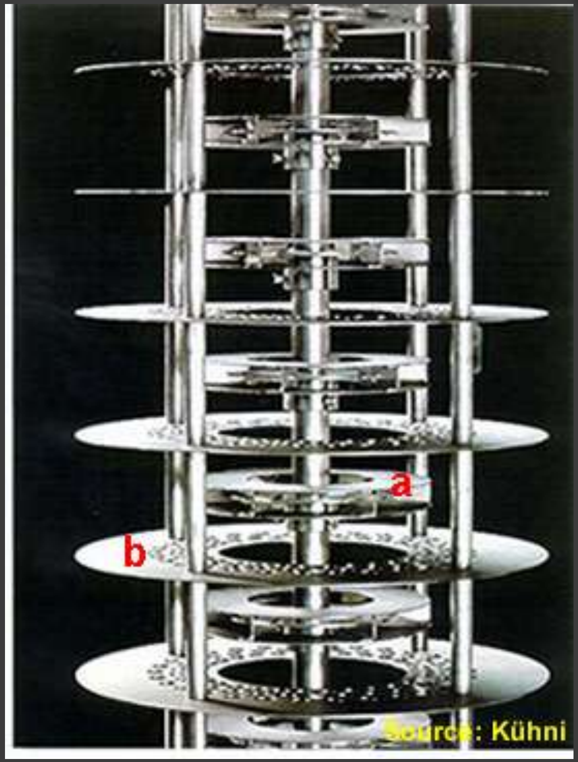
Extraction equipment

Batch

Separatory funnel

Single-stage

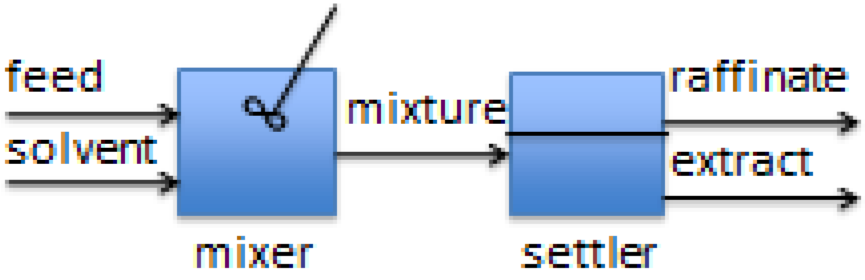
Column



Rotating-disk contacter

Mixer-settler

Stream labeling



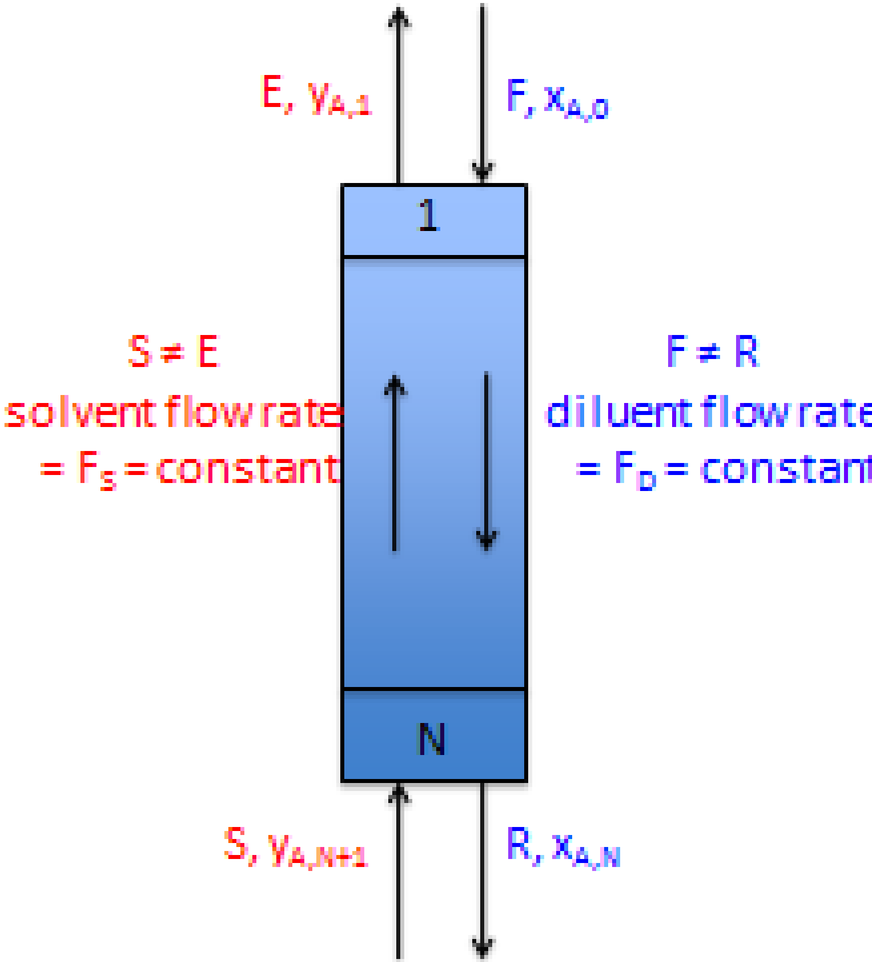
Feed (F) contains solute A (x_A) dissolved in *diluent* D ($x_D = 1 - x_A$).

Solvent (S) extracts A (y_A), creating the product *extract* stream (E). The depleted feed becomes the product *raffinate* stream (R).

Equilibrium (no longer VLE!) is defined by the distribution ratio, K_d:

$$K_d = y_A/x_A$$

Note that y_A does not refer to gas composition.



Usually specified:

$y_{A,N+1}$, $x_{A,0}$, F_D/F_S and $x_{A,N}$.

McCabe-Thiele analysis: Counter-current extraction with immiscible liquids

Equation of the operating line:

$$Y = \frac{F_D}{F_S} X + (Y_1 - \frac{F_D}{F_S} X_0)$$

(analogous to operating line for stripper column).

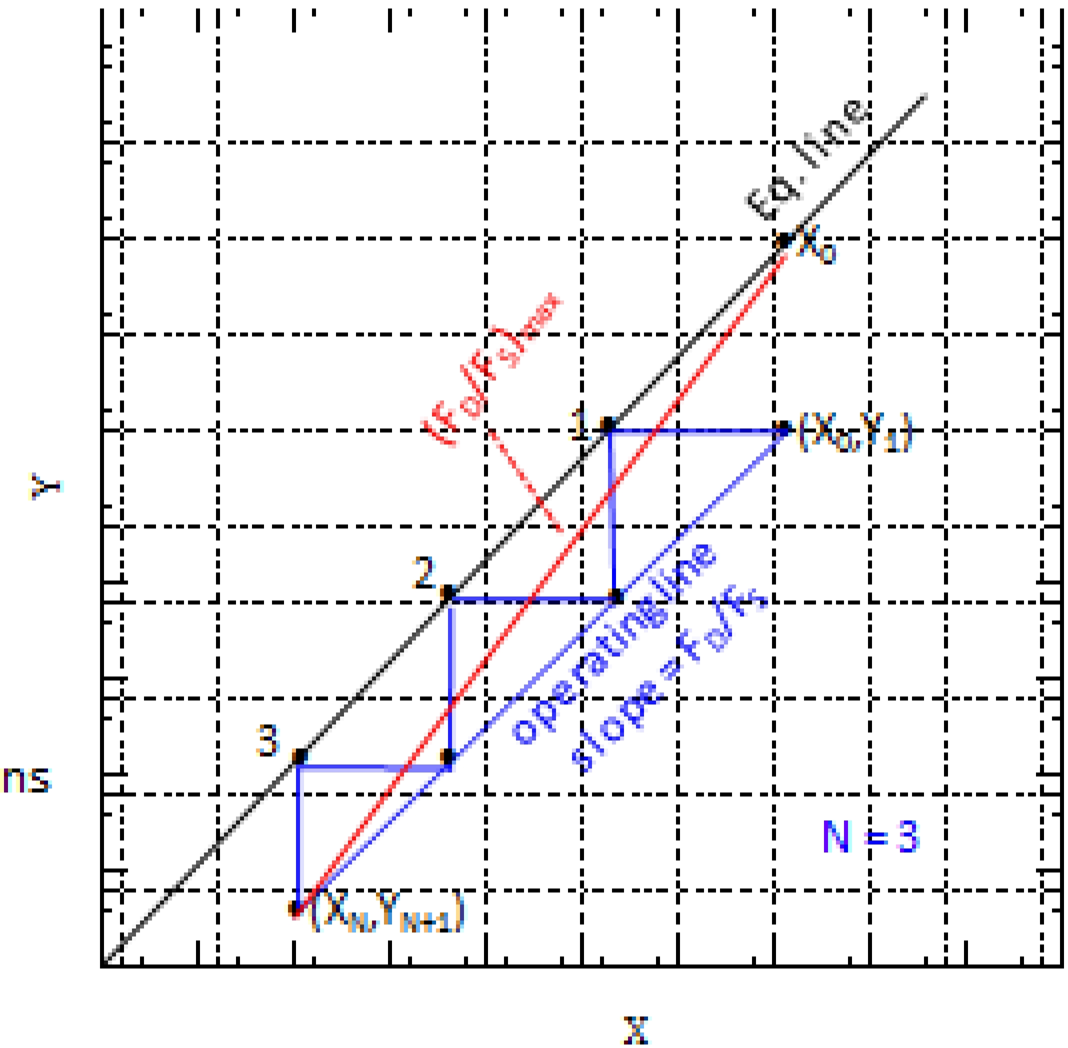
$(F_D/F_S)_{max}$ gives $F_{S,min}$ for $N = \infty$.

For dilute solutions,

$$y = \frac{R}{E} x + (y_1 - \frac{R}{E} x_0)$$

Can also use Kremser eqns, if solutions are dilute *and* equil. line is straight.

$$N = \frac{\ln\left[\left(1 - \frac{mE}{R}\right)\left(\frac{y_{N+1} - y_0}{y_1 - y_0}\right) + \frac{mE}{R}\right]}{\ln\left(\frac{R}{mE}\right)}$$



Cross-flow cascade

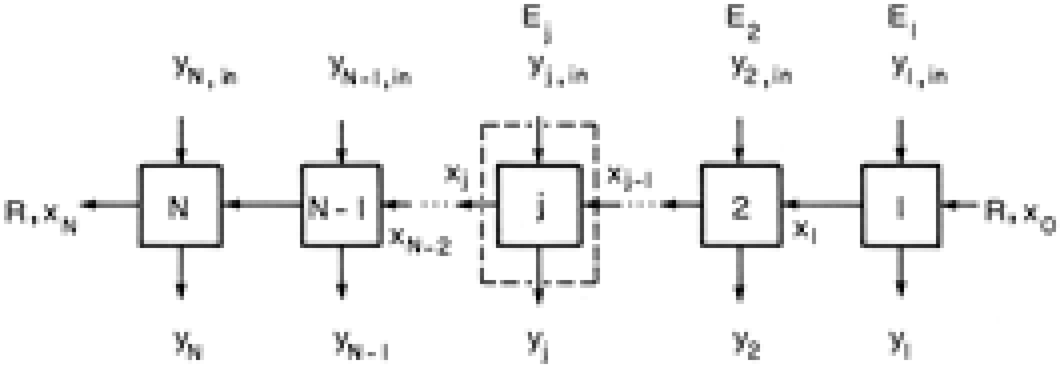
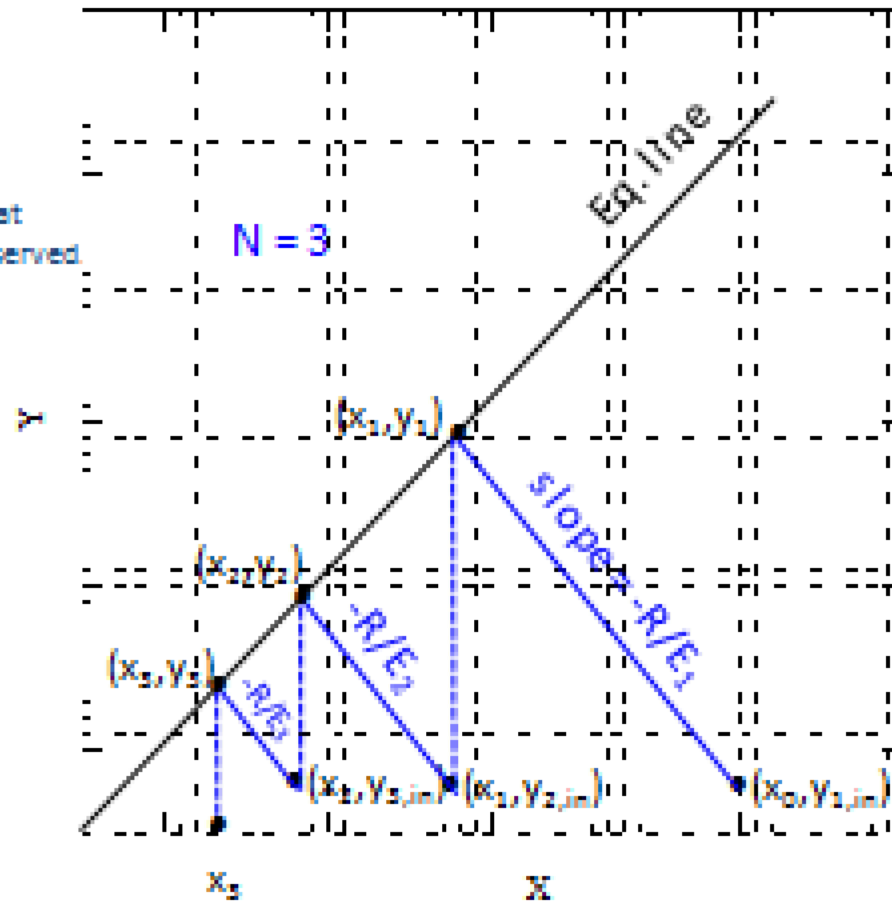


Figure 13-8 Cross-flow cascade

- Increase overall efficiency by introducing fresh extracting solvent at each stage.
- Each stage has its own mass balance and operating line
- Uses much more solvent than counter-current cascade (requires much more solvent recovery)
- A mixer-settler is just one cross-flow stage.

From mass balance around stage *j*:

$$y_j = -\frac{R}{E_j}x_j + \left(y_{j,in} + \frac{R}{E_j}x_{j-1}\right)$$



Dilute fractional extraction

A common situation:

the feed contains two important solutes (A, B), and we want to separate them from each other.

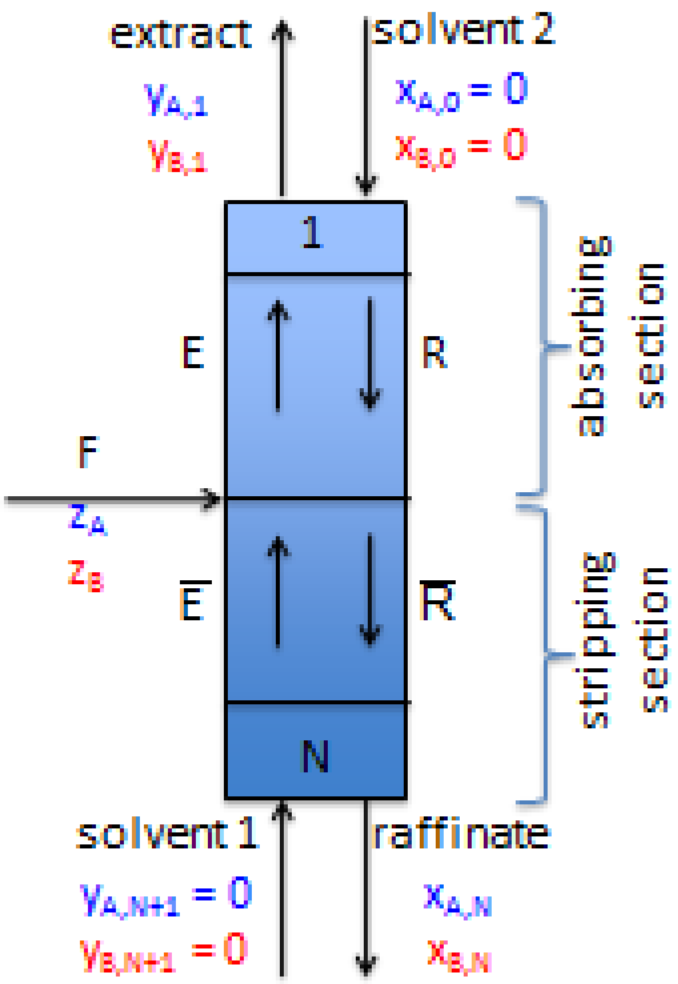
Choose two solvents:

A prefers solvent 1 ("extract")

B prefers solvent 2 ("raffinate")

$$K_{d,A} = y_A/x_A > 1$$

$$K_{d,B} = y_B/x_B < 1$$



Center-cut extraction

When there are 3 solutes: A, B and C,

and B is desired

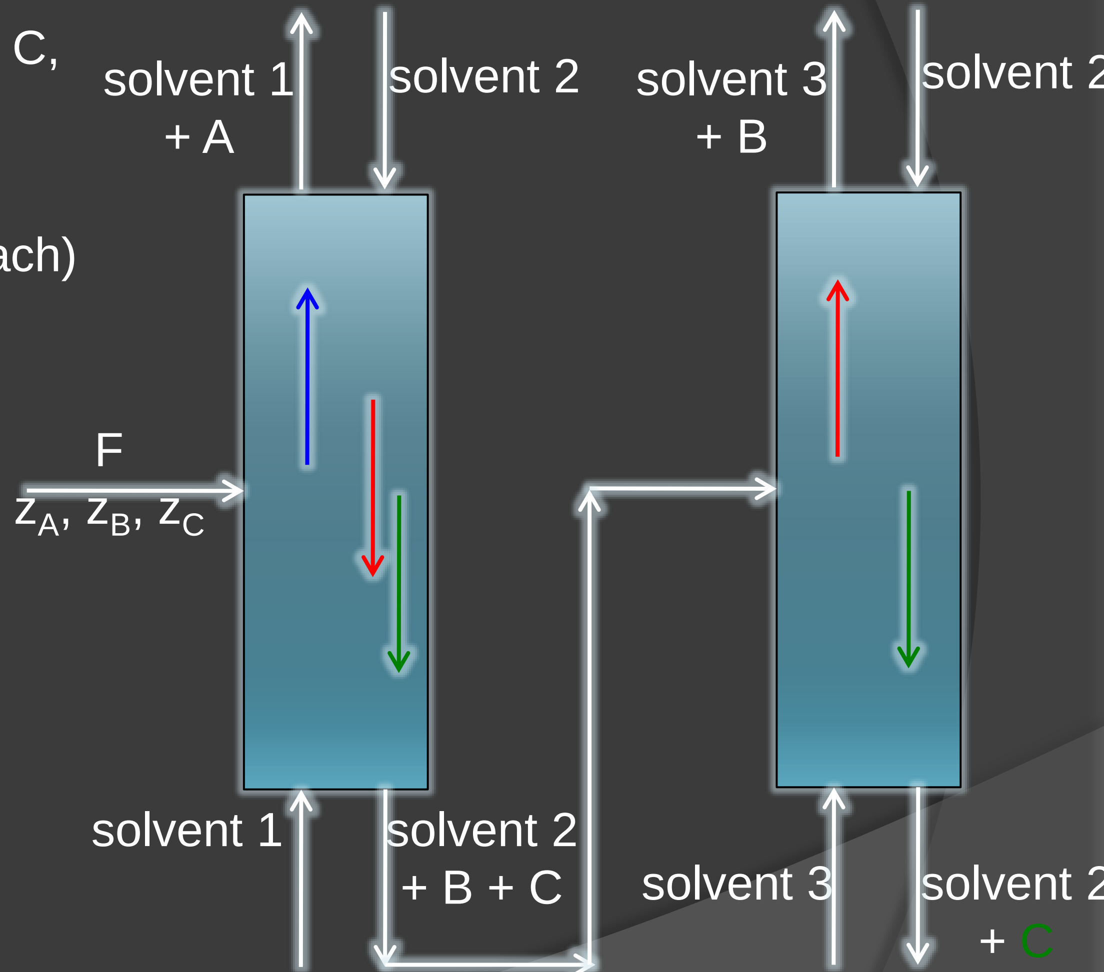
(A and C may be > 1 component each)

Requires *two* columns:

- column 1 separates A from B+C
- column 2 separates B from C

Requires *three* extracting solvents:

A prefers solvent 1 over solvent 2
B, C prefer solvent 2 over solvent 1
B prefers solvent 3 over solvent 2
C prefers solvent 2 over solvent 3



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