Basics of Chromatography

A. Chromatography vs. Countercurrent distribution

B. Type of Chromatography

C. Chromatography Parameters: t_R, t_M, V_R, V_M, t_R', V_R', W_b, W_h.

D. Solute Retention: k, $k = t_R'/t_M$ $t_R' = k\, t_M$ $t_R = (k+1)\, t_M$

E. Efficiency of Chromatography and Plate Theory: N and H

$$N = (t_R/\sigma_t)^2$$

F. Measures of Solute Separation: α, R_s

G. Fundamental factors affecting resolution:

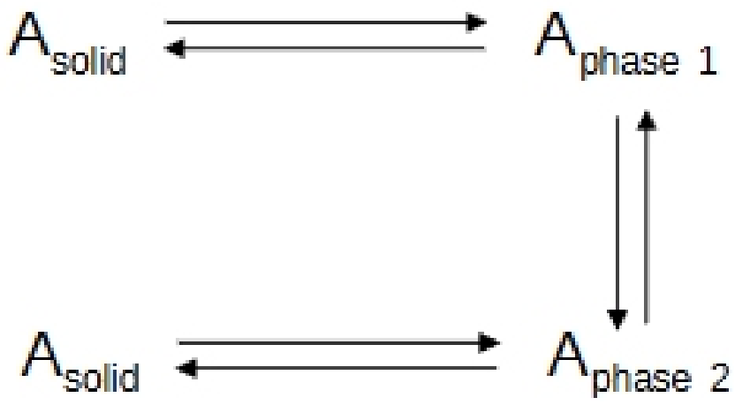
$$R_s = \frac{t_{R2} - t_{R1}}{(W_{b2}+W_{b1})/2}$$

$$R_s = [N^{1/2}/2][(k_2-k_1)/(2+k_1+k_2)$$

$$R_s = [N^{1/2}/4][(\alpha-1)/(\alpha)]*[k_2/(1+k_2)], \quad \alpha = k_2/k_1$$

Hildebrand solubility parameters and k

$$\ln (K_D) = -\frac{\bar{V}_i}{RT} (\delta_1 - \delta_2)(\delta_1 + \delta_2 - 2\delta_A)$$



$$\ln(K) = \left(\frac{-\Delta\mu_i^0}{RT}\right) \qquad \Delta\mu_i^0 = \Delta\bar{H}_i^0 - T\Delta\bar{S}_i^0$$

$$\Delta H_i^0 = \Delta H_{i\,\beta,}^0 - \Delta H_{i,\,\alpha}^{\beta}$$

$$\Delta H_m = \bar{V}_i (\delta_i - \delta_j)^2$$

Hildebrand solubility parameter (δ).

$$\delta = (\Delta E_v/V)^{1/2}$$

Where: $\Delta E_v/V$ = energy per unit volume, required to completely vaporize a solution of pure compound

Disadvantages: not accurate because the simple model

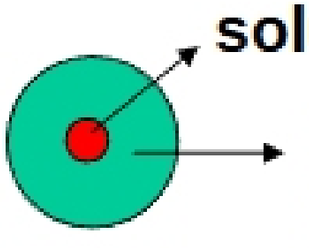
A General model for solvent-solute interactions
-- cavity model

1. The process of dissolving a solute molecule is broken down to two steps: (a) cavity formation process, and (b) solute/solvent interactions

2. Cavity formation: a cavity or hole of sufficient size to accommodate the solute molecule is constructed in the solvent. This is an endoergic process, and *the amount of the energy involved increases with the size of the solute molecule*.

3. In the second stage of the solution process, the solute is allowed to interact with solvent. (1) Dipole-dipole interactions; (2) dipole-induced dipole (Induction interactions), (3) Dispersion interaction (London forces), and (4) acid-base interactions: H-bonding (a. solvent as donor(acid) and solute as accepter(base), b. solvent as acceptor(base) and solute as donor (acid)).

$$XYZ = XYZ_0 + \text{cavity formation energy} + \sum \text{Solute-solvent interactions}$$



XYZ: Free Energy