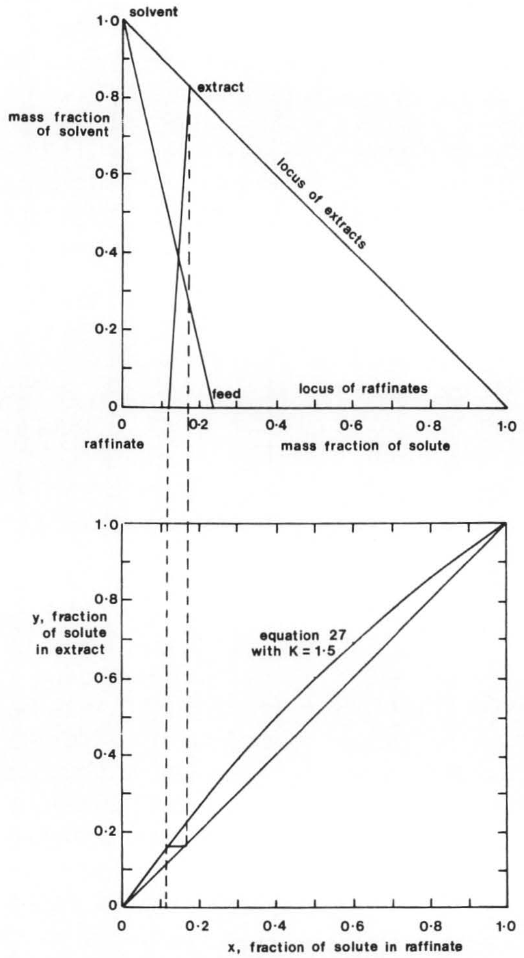

FIGURE 5. Single stage extraction with simple LLE system.

A single stage calculation of the extraction by a pure solvent of a solute from a mixture with only the diluent is shown in Figure 5. The value of the partition coefficient used in this example is K = 1.5. When written in terms of mass fractions rather than solute ratios, the equilibrium relationship is no longer in linear form. Substituting Eqs. (25) and (26) in the equilibrium relationship Y = KX gives the revised form of the equation

$$\left\{\frac{y}{1-y}\right\} = K\left\{\frac{x}{1-x}\right\} \tag{27}$$

Students are encouraged to derive the inverse lever arm rule from the material balances and to apply the rule to the single stage calculation. Analyses of cross- and counter-current extractions, including minimum solvent-to-feed ratio, can also be studied using the system shown in Figure 5. However, at this point in the first-year course, students would be expected to be using real chemical systems in which either one pair or two pairs of the three components are partially miscible, and the corresponding graphs would show the extract and raffinate loci not to be the sides of the triangle.

CONCLUSION

A simple liquid-liquid equilibrium system involving a constant partition coefficient, which is based on solute ratios, is used to develop an understanding of multistage contacting in the first-year separation processes course of BEng degrees at Bath. The algebraic solutions are used to demonstrate the advantage of counter-current operation over cross-current operation, to demonstrate the effectiveness of splitting the solvent in cross-current operation, and to demonstrate the problem of minimum solvent-to-feed flow ratio in counter-current operation.

NOTATION

F = mass flowrate of diluent in feedstock
K = distribution or partition coefficient expressed in mass ratio units
N = number of stages in solvent extraction battery
r = parameter defined by Eq. (4)
S = mass flowrate of pure solvent
x = mass fraction of solute (in feed or raffinate)
X = mass of solute per unit mass of diluent
y = mass fraction of solute (in extract)
Y = mass of solute per unit mass of solvent

Subscripts

f = feed
n = phase leaving stage n
N = phase leaving stage N
1 = phase leaving stage 1
2 = phase leaving stage 2 ❐

ChE books received

Organic Reactions: Volume 38, edited by Beak et al.; John Wiley & Sons, 1 Wiley Dr., Somerset, NJ 08875-1272; 805 pages, $89.95 (1990)

CAE: Computer Modeling for Polymer Processing, by Charles L. Tucker, III; Oxford University Press, 2001 Evans Road, Cary, NC 27513; 623 pages, $99 (1990)

Biotechnology Focus 2, by R. K. Finn and P. Prave; Oxford University Press, 2001 Evans Road, Cary, NC 27513; 543 pages, $79 (1990)

Fermentation: A Practical Approach, edited by McNeil and Harvey; Oxford University Press, 2001 Evans Road, Cary, NC 27513; 226 pages, $65.00 (1990)

Polymer Characterization, by Schröder, Müller, Arndt; Oxford University Press, 2001 Evans Road, Cary, NC 27513; 344 pages,, $47.50 (1989)