### TABLE 12.2
### Approximate HLB Values for a Number of Surfactants

| Generic or Chemical Name of Surfactant | HLB Value |
|---|---|
| Sorbitan trioleate | 1.8 |
| Propylene glycol monostearate | 3.4 |
| Glycerol monostearate | 3.8 |
| Propylene glycol monolaurate | 4.5 |
| Sorbitan monostearate | 4.7 |
| Glyceryl monostearate (self-emulsifying) | 5.5 |
| Sorbitan monolaurate | 8.6 |
| Polyoxyethylene-4-lauryl ether | 9.5 |
| Polyoxyethylene glycol 400 monostearate | 11.6 |
| Polyoxyethylene-4-sorbitan monolaurate | 13.3 |
| Polyoxyethylene-20-sorbitan monopalmitate | 15.6 |
| Polyoxyethylene-40-stearateb | 16.9 |
| Sodium stearate | 17.6[a] |
| Sodium oleate | 18.0 |
| Sodium *N* -lauroyl sarcosinate | 29[a] |
| Sodium lauryl sulfate | 40.0 |

*Source:* Taken from Schott, H., Colloidal dispersions, in *Remington: The Science and Practice of Pharmacy*, A.R. Gennaro (Ed.), Vol. 1, Mack Publishing Co, Easton, PA, 1995; Treiner, C. et al., J. Coll. Interf. Sci., 125, 261–270, 1988.

[a] Data was obtained from Treiner, C. et al., *J. Coll. Interf. Sci.*, 125, 261–270, 1988.

a 100% hydrophilic molecule such as polyethylene glycol would have an HLB value of 20. Thus, an increase in the polyethylene oxide (PEO) chain length leads to an increase in the polarity and the HLB value. The advantage of such a system is that to a first approximation one can compare any chemical type of surfactant to another type when both polar and nonpolar groups are different (Schott, 1971). Values of HLB for nonionic surfactants are calculated based on the proportion of PEO chain present.

## TEMPERATURE–COMPOSITION PHASE DIAGRAM

A temperature–composition phase diagram for a surfactant solution is a characteristic phase diagram that delineates the conditions under which crystalline surfactant, monomers, or micelles will exist. On the phase diagram shown in Figure 12.5 (Smirnova, 1995), L represents the liquid phase, S the solid phase, and $X_1$ the surfactant mole fraction. The critical micelle temperature, CMT, is defined as the line between the crystalline and micelle phases. Micelle formation occurs at temperatures greater than the CMT. The critical micelle concentration, CMC, line separates the micellar and monomeric phases. The Krafft point (point B) is defined as the triple point, or the CMT at the CMC, and at this point, the solubility curve intersects the CMC curve. At this temperature, the CMC is reached. Above it, a small increase in the solubility of the monomeric species involves a large increase in the concentration of the monomer and therefore, a large increase in the total concentration (Mukerjee, 1967). Point C (cloud point) occurs where a micellar solution is in equilibrium with both the solid (S) and the liquid crystalline (E) phases. Cloud point is a characteristic temperature at which solutions of surfactants undergo phase separation. Two lines going up from the points C and D are boundaries for the micellar solution (L) and liquid crystalline (E) phase equilibrium.