练 习 十 一

1. The field of separation science, too, is of major importance to the chemical, metallurgical and biochemical industries, and must play a leading role in the remediation of environmental problems. The microstructured solvents provided by colloidal systems provide an interesting opportunity to mediate the solute-solvent interactions, and thus to enhance separation selectivities. Examples include the use of reversed micelles to solubilize polar solutes such as proteins and amino acids in organic solvent extractants, block copolymer micelles and amphiphilic star polymers for the removal of trace contaminants from surface and groundwaters, and two-phase aqueous polymer solutions or phase-separated micellar systems for the selective separation and concentration of biological species such as proteins and viruses. The opportunities offered by more exotic polymer and surfactant architectures offer many exciting challenges not only for separation processes, but also in drug delivery systems and in the controlled production of ultrafine particles.
2. A group of operations for separating the components of mixtures is based on the transfer of material from one homogeneous phase to another. Unlike purely mechanical separations, these methods utilize differences in vapor pressure or solubility, not density or particle size. The driving force for transfer is a concentration difference or a concentration gradient, much as a temperature difference or a temperature gradient provides the driving force for heat transfer. These methods, covered by the term mass-transfer operations, include such techniques as distillation, gas absorption, dehumidification, liquid extraction, leaching, crystallization, and a number of others.
3. The feasibility of separation of mixtures by distillation, absorption, or stripping depends on the fact that the compositions of vapor and liquid phases are different from each other at equilibrium. The vapor or gas phase is said to be richer in the more volatile or lighter or less soluble components of the mixture. Distillation employs heat to generate vapors and cooling to effect partial or total condensation as needed. Gas absorption employs a liquid of which the major components re essentially nonvolatile and which exerts a differential solvent effect on the components of the gas. In a complete plant, gas absorption is followed by a stripping operation for regeneration and recycle of the absorbent and for recovering the preferentially absorbed substances. In reboiled absorbers, partial stripping of the lighter components is performed in the lower part of the equipment. In distillation, absorption, or rectification and stripping are performed in the same equipment.
4. These distinctions between the two operations are partly traditional. The equipment is similar, and the mathematical treatment, which consists of material and energy balances and phase equilibrium relations, also is the same for both. The fact, however, that the bulk of the liquid phase in absorption-stripping plants is nonvolatile permits some simplifications in design and operation.
5. In liquid extraction, sometimes called solvent extraction, a mixture of two components is treated by a solvent that preferentially dissolves one or more of the components in the mixture. The mixture so treated is called the raffinate and the solvent-rich phase is called the extract.
6. In extraction of solids, or leaching, soluble material is dissolved from its mixture with an inert solid by means of a liquid solvent. The dissolved material, or solute, can be recovered by crystallization or evaporation.
7. Crystallization is used to obtain materials in attractive and uniform crystals of good purity. Since the formation of crystals separates a solute from a melt or a solution and leaves impurities behind, it is a separation operation, modern theories and models of industrial crystallization from solution, however, are focused on the processes occurring at the crystal-solution interface and the characteristics of particulate solid.
8. Like liquids, supercritical fluids can behave as solvents, dissolving a wide range of substances. This ability forms the basis of a system for separating the components of mixtures, a process known as supercritical fluid extraction. The solvent power of a supercritical fluid increases as its density increases. Conversely, lowering its density (either by decreasing pressure or increasing temperature) causes the supercritical fluid and the dissolved material to separate. With skillful manipulation of temperature and pressure, it is possible to separate the components of very complicated mixtures.