BOOK REVIEWS

Electrochemical Process Engineering: A Guide to the Design of Electrolytic Plant

By F. Goodridge and K. Scott, Plenum Press, 1995, 312 pp., $59.50.

If you needed to start from scratch to design a reactor for electrosynthesis of an organic compound, this book could help you through the steps. It offers a few of the basics of electrochemical systems, such as thermodynamics and mass transfer, although it does not provide a critical knowledge of any subtle points. It also brings in nonelectrochemical subjects by relating the design problem to conventional (stirred-tank and plug-flow) reactors, to associated heat exchange and downstream separations, and to cost estimation for capital and operating costs. As a result, you may be able to produce a preliminary reactor design and some rough cost estimates. This 300-page book is modest in its goals.

You, however, will not come away with any in-depth view of how electrochemical reactors work, and there is a lack of historical perspective. References are generally restricted and come from the secondary literature (either reviews or later work). To my astonishment, the essence of my MS thesis was reproduced in Chapter 5 without a proper citation.

The book is mainly about electroorganic syntheses, although there is passing mention of inorganic syntheses (including metal winning and refining) and effluent treatment. Deliberately neglected are fuel cells and batteries.

We should like to be able to decide whether a chemical conversion can be performed electrochemically in an economical manner, in competition with purely chemical routes. An objective of this book is to lay out the elements needed for this decision. A secondary impact is to concentrate on electrochemical reactor models simple enough to be integrated into more or less standardized methods or software packages for the design of other components of the plant. In this way, one can create an approach to the design of the overall plant.

Design examples indicate how certain variables do or do not interact strongly with associated nonelectrochemical equipment. I learned something useful here about the principles of optimization of subsystems within a process. Thus, it is better to design for a specified conversion unless the cost of subsequent separation is included. On the other hand, optimization over the average current density is generally safer (although some interaction with heat-transfer equipment may occur).

John Newman
Dept. of Chemical Engineering
University of California
Berkeley, CA 94720

Innovations in Supercritical Fluids: Science and Technology

Edited by K. W. Hutchenson and N. R. Foster, ACS Symp. Ser. 608, American Chemical Society, 1995, 408 pp., $125.95.

Until quite recently, supercritical fluids were often described as a solution looking for a problem. During the last decade, however, a number of novel environmental, pharmaceutical and materials processing applications have given the field vitality and a renewed sense of purpose. This is true not just for technology-driven research: improved fundamental understanding is now seen as key to the commercialization of processes that exploit the properties of supercritical mixtures over wide ranges of temperature and pressure. In their informative introductory chapter to this selection of papers presented at the Symposium on Supercritical Fluid Science and Technology held at the 1994 AIChE meeting, the editors illustrate this point convincingly. They show that our ability to measure and predict solubility falls far short of what is needed for reliable scale-up of processes involving even the simplest of supercritical mixtures. The limitations of commonly-used equations of state in the vicinity of the critical point, and the discrepancies that exist in the published literature on the solubility of biological molecules in carbon dioxide, are well-chosen reminders of the gaps in basic knowledge that exist and of their technical consequences.

The editors have organized the contents into four sections: Molecular Interactions and Phase Behavior (eight chapters), Chemical Reactions in Supercritical Fluids (seven chapters), Special Topics and Applications (nine chapters), and Supercritical Fluids in the Forest Products Industry (five chapters). They are preceded by a truly excellent introductory chapter, a critical discussion of the technical and commercial impact of current limitations in modeling and measurement of solubilities, followed by a review of recent developments in chemistry and catalysis in supercritical fluids, in oxidative destruction of organic wastes in supercritical water, and in particle formation techniques utilizing supercritical fluids.

The section on Molecular Interactions and Phase Behavior includes three interesting computational studies of hydrogen bonding and solvation in supercritical water. Mizan et al. explore hydrogen-bond cluster statistics; Cummings and coworkers investigate ion pairing between Na^+ and Cl^- in supercritical water; and Johnston, Rossky and coworkers contrast the solvation of electrolytes and nonelectrolytes in water, from ambient to slightly subcritical conditions, using molecular dynamics and fluorescence spectroscopy. These studies illustrate the valuable insights into solvation and solution structure in supercritical water than can be obtained by computer simulation. An important unresolved question here is the discrepancy between neutron diffraction and simulation data on hydrogen bonding in supercritical water, as well as the unambiguous interpretation of the neutron data (Postorino et al., *Nature*, **366**, p. 668, 1993). Another interesting study in this section is due to Zhang and Fulton, who report on the different behavior upon pressurization of normal (oil-in-water) and reverse (water-in-oil) microemulsions formed in supercritical solvents. The large changes in conductivity and viscosity in the latter type of complex fluid are particularly noteworthy.

The section on reactions includes an interesting chapter by Brennecke and coworkers on the use of pulse radiolysis