BOOK REVIEWS

Unified Separation Science

By J. Calvin Giddings, Wiley, New York, 320 pp., 1991.

What does an outstanding analytical and physical chemist have to say to chemical engineers about separations? The author states that this book was written for a graduate-level course in analytical separations. Thus, the coverage is very strong on chromatography, field flow fractionation, and electrophoresis, but lacks in details of methods used for large-scale industrial separations. This book won't directly help the chemical engineer design a better distillation column. It, however, will help the engineer:

1. Understand the analytical chemists he or she works with.
2. Understand the strengths and weaknesses of chromatography.
3. Appreciate the molecular basis of separations.
4. See new connections among separation techniques.
5. Gain new insights.

Indirectly, the result may eventually be better understanding and design of separation systems.

The author writes in an abstract style that is appropriate for a unifying approach, but which is inappropriate for neophytes. Some previous knowledge of separations, particularly chromatography, is necessary to fully benefit from this book. The chemical engineer reading this book must also accept that the author's viewpoint differs from those in engineering books. Giddings relies more on physical insight and approximate derivations than is the norm in current chemical engineering books. This difference is also the book's major strength. He shows connections and explains separations in a way that does not occur in chemical engineering books.

After the required introductory chapter, the author discusses the thermodynamic basis for separation. The author's use of chemical potential as the driving force for separation is a useful unifying concept. Chapter 3 on "Separative Transport" focuses on diffusion, while chapter 4 discusses "Flow Transport and Viscous Phenomena." These chapters are probably more familiar reading for engineers than chemists. One interesting detail is Giddings' suggestion that 270 be used in the Karmen-Kozeny equation instead of 180 or 150. This represents the bias of a chromatographer who uses columns of carefully packed small particles. Chapter 5 discusses zone spreading and introduces the Gaussian function or the related error function as the central distribution function in analytical chemistry. A random walk analysis is used to explain why Gaussian functions occur, and in section 5.4 is used to explain how flow fluctuations (eddy dispersion) cause the commonly used Fickian axial dispersion form. This explanation is a prime example of how the author's different viewpoint can give engineers new insight. Chapter 6 continues the discussion of zones. All chemical engineers who occasionally rely on analytical chemists for the analysis of complex mixtures should read sections 6.7 and 6.8 to understand the problem of overlapping peaks in chromatography.

A natural dividing point in the book occurs in chapter 7 where separation methods are first classified and compared. The chemical potential profile and the flow relative to this profile are used to classify separations. This scheme shows some surprising comparisons of separations. For example, reverse osmosis, ultrafiltration, and zone melting are all classified alike.

The remaining four chapters focus on specific analytical separation methods. Chapter 8 is on electrophoresis and centrifugal sedimentation, while chapter 9 is an overview of field flow fractionation (FFF) and chromatography. Since the author invented FFF, the coverage of FFF is understandably a bit heavy. Chapters 10 to 12 discuss chromatography in considerably more detail. This amount of attention is justified by the central importance of chromatography in analytical chemistry. A large part of these three chapters closely follows Giddings' 1965 classic, *Dynamics of Chromatography*. The physical insights into zone spreading and optimization are useful for anyone interested in chromatography. The author's interest in analytical separations is evident in chapter 12 where he optimizes for resolution or analysis time, but not for throughput.

The book appears to be well-crafted and there are few typographical errors. One nagging problem is the author's somewhat excessive citing of his own publications. For example, Appendix II, which lists many of his publications, seems unnecessary. However, this is a very good book that could be accurately titled "Unified Analytical Separation Science."

Phillip C. Wankat
School of Chemical Engineering
Purdue University
West Lafayette, IN 47907

Porous Media: Fluid Transport and Pore Structure

By F. A. L. Dullien, Academic Press, 574 pp., 1992

The second edition of Dullien's book is a significant improvement over the earlier edition. The research in porous media transport proliferated in the decade that followed the original publication. The second edition includes many of those advancements in addition to improved presentation of the original material. The strength of the book lies in exposing the relation between pore structure and fluid transport; those sections have been further reinforced with new research findings. The weakness still lies in the treatment of some of the fluid mechanical and mathematical aspects of flow. The update misses on some of the significant and relevant research of the last decade outside the interest area of the author. This edition is an excellent research monograph, but not a comprehensive text or general reference.

Chapter 1 describes pore structure. The exposition was excellent in the original edition. It has been improved further by