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Book Reviews *

Turbulent Mixing and Chemical Reactions. By Jerzy Baldyga and John R. Bourne. John Wiley and Sons Ltd.: Chichester, UK. 1999. 864 pp. £195. ISBN 0-471-98171-0.

This book focuses on the important problem of understanding how the selectivity of fast competing reactions in low-viscosity liquids can be predicted when the reactions occur on the time scale of liquid mixing transients. It is by no means uncommon in chemical process development to obtain unexpected selectivities in reaction vessels or even laboratory flasks, and for the source of the problem to be traced to the way in which the reagents are mixed together or to the configuration of the reactor.

Chapters 1−3 give a good general introduction to the subject, although in places in a rather academic style, and provide a comprehensive review of published chemical examples where the problem has been recognised. In Chapter 2, there is a very good description of the effect of bulk flow patterns on selectivity and of the influence which the choice of reactor type has on the performance of common chemical kinetic schemes. There are some very good learning points or reminders for chemists and engineers involved in process development.

Chapters 4−6 deal with turbulence, turbulence modelling, and the application of turbulence theory to mixing and concentration transients, in 380 pages. Chapter 4 presents a useful review of the background and precise definitions prior to the detailed discussion of turbulence theory and turbulence models in Chapter 5. In Chapter 6 the application of the theory to the mixing of nonreacting materials is reviewed. Unfortunately, this part of the book is written in terms which will be almost incomprehensible to most organic chemists. Moreover, much of it will be very difficult for most normal chemical engineering graduates without in-depth prior knowledge of the subject.

It is unfortunate that many symbols remain undefined, and in some cases even the nomenclature is presented in terms which require a considerable degree of specialism in the area in order to be understood.

In Chapter 7 the techniques are described for combining the models of turbulent mixing with reaction rate equations, and the simplifying relationships, or "closure models" required to enable the calculations to be undertaken within reasonable computing time and power. A number of worked examples are used to illustrate the techniques. Chapter 8 provides concise definitions of the commonly used terms, micro-, meso-, and macro-mixing. The assumptions and derivations leading to simplified models for the prediction of reaction selectivity in micro- and meso- mixing regimes are described and, again, illustrated by application to worked examples. These two chapters comprise 210 pages but are not really accessible by anyone without considerable prior knowledge of the area.

Chapter 9 briefly reviews the planning of experiments and the criteria for reactions to test the theories, and then in Chapter 10 a number of test reactions are described. These are mainly diazo couplings but are useful models for a range of chemical systems. Looking through these and the worked examples should give any development chemist food for thought.

Chapters 11 and 12 deal with the comparison of the theories with experimental results, in 11 for the micro-mixing regime and in 12 for the meso-mixing regime. For the micro-mixing controlled reactions, worked examples show that the simplified engulfment model can be used, although there still seems to be a particular difficulty in knowing *a priori* what value of the key determining parameter, the local turbulent energy dissipation rate, should be used. For the meso-mixing systems, the experimental evidence for the importance of understanding the basic principles is clearly demonstrated, and again the analysis is demonstrated by a number of worked examples. Although most organic chemists will find even these chapters difficult, working through them will provide useful insights and pointers to problems common in process development.

Chapter 12 lists the characteristics of commonly used mixing equipment, and then Chapters 13, 14, and 15 apply some of the concepts from the earlier chapters to precipitation, droplet generation, and floc break-up. These are interesting chapters which add to the already large volume of literature on these topics, although most organic chemists would not have the background to appreciate much of the content.

Scattered throughout the book, and particularly in Chapters 1−4 and 11 and 12, are numerous pointers to how to recognise and deal with problems caused by reactant segregation during mixing and reaction. It is a pity that these ideas are not anywhere brought together in concise form. This would have greatly enhanced the value of the book to the organic process development chemist.

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Catalyst Manufacture, 2nd ed. by Alvin B. Stiles and Theodore A. Koch Marcel Dekker: New York. 1995. 291 pp. $145. ISBN 0-8247-9430-3.

*Unsigned book reviews are by the Editor.

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Catalysts, a £5 billion per year business worldwide, play a vital role in the economy. It is often quoted that 90% of all chemicals involve at least one catalytic step in their manufacture. Hence, a book about catalyst manufacture is of interest to all chemists.

This is a revised and expanded second edition of the book *Catalyst Manufacture* which was first published in 1985 in the extensive Marcel Dekker series of "Chemical Industries" books. It is divided into two main sections, one describing typical catalyst manufacturing equipment (laboratory, pilot plant, and commercial plant scale) and the other describing preparation methods for a wide range of catalysts for 18 families of catalytic reactions. The catalyst range includes base metals, precious metals, and zeolites.

This excellent book is written in an informative, easy-to-read style with a good index. Unfortunately, the extensive list of references are not specifically referred to in the text. The book is likely to be of particular interest to academics as a starting point for a catalyst preparation for a specific application to allow them to develop an improvement.

Those involved in the commercial manufacture of catalysts will recognise the generality of the preparation methods. The book, however, emphasises the requirement for reproduciblecatalysts and highlights the need to avoid cross-contamination and the efficient extraction of detrimental ions during manufacture.

For each catalyst type, details are provided for possible regeneration procedures (if available) to allow catalyst reuse. Details are also provided for the responsible disposal of spent catalyst. The appendix lists numerous companies who can recover metals values from spent catalysts, but not surprisingly, this listing is very biased to North American refiners.

It is very much a practical book. There are 12 chapters in the section on manufacturing plant which describe the possible types of equipment for each unit operation, for example, filtration, drying, calcining, etc. In general this is very good, but I would have liked details of some of the latest advances in drying technology such as fluid-bed drying and vacuum-pan drying.

This second edition specifically addresses the changes that have been made in zeolites, reviews the application of enantioselective catalysts in the pharmaceutical and agrochemical industries, and updates automotive exhaust catalysts. I would recommend this book to all those involved in the R&D manufacture and use of catalysts.

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Comprehensive Organic Transformations: A Guide to Functional Group Preparations, 2nd edition. By Richard Larock. Wiley − Vat: New York. 1999. 1581 pp. £96.99. ISBN 0-4711-9031-4.

"We must admire Richard Larock's courage in undertaking this monumental task," was H. C. Brown's comment on the publication of the first edition of this work. The new edition is over twice the size of the first edition and comes only 10 years after. The work has always been one of the first volumes industrial and academics turn to for inspiration. The new edition is timely—there have been so many important synthetic transformations in the 1989−1998 period that the compendium is needed to summarise the literature. His problem always is what to leave out, where to draw the line. One of the limitations of the new volume—as the author points out in the forward—is that the number of journals covered in the 1989−1996 period has been restricted because of the mammoth task required. Thus, key review articles in *Angewandte Chemie International Edition*, *Chemical Reviews*, etc. may not have been abstracted. The journal coverage is mainly to 1996. With this minor quibble in mind, the term comprehensive in the title is slightly misleading. Nevertheless, the volume is a great place to browse for synthetic methodology and is a tremendous value for the money. It should be on every organic chemists bookshelf!

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Grignard Reagents − New Developments. Edited by H. G. Richey, Jr. Wiley: Chichester, UK. 2000. 418 pp. £145. ISBN 0-471-99908-3.

The appearance of this multiauthor volume has been timed to coincide with the centenary of the appearance of Victor Grignard's paper in 1900 on the formation of organomagnesium compounds. Whilst many of the chapters are of theoretical interest on the mechanism of Grignard formation and reactions and the structure of the organometallic species, one chapter alone will appeal directly to the process chemist and engineer, "Grignard Reagents − Industrial Applications and Strategy" is a superb review by F. R. Busch and D. M. de Antonis of the practices used at Pfizer to safely scale-up Grignard reactions. It includes such topics as reactor configuration, choice of solvent, process hazards, heating and cooling fluids, reaction initiation as well as some industrial examples. The book is worth reading for this chapter alone. The chapter includes industrial examples including the manufacture of tamoxifen, droloxifene, veltol, naproxen, and propoxyphene. Of course, the book will be compared to *Handbook of Grignard Reagents* (Marcel Dekker, 1996) but there is little overlap. Buy both for your library!

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