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Book Reviews *

Organometallics in Process Chemistry. Edited by R. D. Larsen. Springer-Verlag: Heidelberg, Germany. 2004. 299 pp. $229.00. ISBN 3-540-01603-1 (also available in electronic version via springerlink.com)

This volume maintains the high standard of the other books in the series "Topics in Organometallic Chemistry". Dr. Larsen has done an excellent job of persuading chemists from major pharmaceutical companies not only to write about their own work, but also to review the extensive literature on the use of organometallic chemistry in process R&D.

Topics include "Organolithium in Asymmetric Processes", "Applications of Organotitanium Reagents", "Rhodium/Ruthenium Applications", "Asymmetric Processes Catalysed by Chiral Salen Complexes", Asymmetric Dihydroxylation and Aminohydroxylation", "Heck Arylation", "Palladium Catalysed Cross Coupling Reactions" and "Stereospecific Introduction of Cephalosporin Side Chains". All of these chapters are well written, with the focus on process research i.e., developing the best synthesis rather than on development and scale-up.

The chapters I enjoyed most were both written by workers from BMS. The first was on the development of transition metal-mediated cyclopropanation reactions, where the use of Simmons−Smith or diazocompounds both have had scale-up issues in the past. This outstanding chapter not only covers the synthesis issues but also examines each method with respect to scale-up and hazard minimisation.

The final chapter on "Removal of Metals from Process Streams" is also excellent, having a considerable chemical engineering input and therefore a focus on scaleability. This is a very timely survey, and all chemists will wish to have a copy of this chapter close at hand. It is full of practical advice and good references to the literature.

The literature, however, covers only to 2002 with an occasional reference in one or two chapters to 2003. So in this fast moving subject, some of the chapters were written over 2 years ago. The publishers do not serve the chapter authors well by taking so long to get the book published.

I also felt that the literature was not covered comprehensively, with several chapters having no references to important *Organic Process Research & Development* (OPRD) articles. Thus, in the article on Palladium Catalysed Cross Coupling Reactions, the use of trithiocyanuric acid to remove Pd is mentioned, but the reference is to a 1999 patent, rather than the 1997 paper in OPRD. But these are minor criticisms of what is an excellent book. I hope that the publishers will publish another process chemistry volume in a few years' time, when the subject will have advanced considerably.

In conclusion, every process chemist needs to read this book, which contains a wealth of information, some of it unpublished, in an extremely accessible and readable form. The editor is to be congratulated on producing an excellent book on such an important topic.

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Side Reactions in Organic Synthesis: A Guide to Successful Synthesis Design. By F. Zaragoza Dörwald. Wiley VCH: Weinheim. 2005. 374 pp. £65.00 (Paperback). ISBN 3-527-310215.

Don't be misled by the first part of the title of this excellent book: it is essentially about understanding organic reactions and what goes wrong. The author is a medicinal chemist from Novo Nordisk and takes the view, when carrying out synthetic chemistry, that failed syntheses are not only discouraging and frustrating but also cost time and money. By understanding the structure−activity relationships of organic compounds, successful (right first time?) synthesis can be achieved. Process chemists would say that choice of conditions is a key part of process R&D—this book will help all process chemists to understand reactions and side products and to choose reaction conditions which give high yields. The author is to be commended on producing a highly readable physical organic chemistry book with lots of interest for the synthetic chemist. All process chemists should read it. In some ways it reminds me of Herbert House's *Modern Synthetic Reactions* of over 30 years ago.

Introductory chapters on stereoelectronic effects and the reactivity and the stability of organic compounds are followed by comprehensive sections on aliphatic nucleophilic substitutions, alkylation of carbanions (the largest chapter at 86 pages), alkylation of heteroatoms, acylation of heteroatoms, palladium-catalysed C−C bond formation, cyclisations, and monofunctionalisation of symmetric bisfunctional substrates.

Throughout the book the focus is on understanding the mechanism, the kinetics and thermodynamics, as well as the importance of entropy considerations in many processes. In 374 pages it is difficult to be comprehensive; however, although the Wittig rearrangement is mentioned several times, the more important Wittig reaction does not appear in the index. The focus is also more towards regioselectivity and stereoselectivity of reactions, whereas enantioselectivity is not covered so extensively. Enzymes are only briefly mentioned, almost as a curiosity, and the industrial importance of enzyme processes (e.g. partial nitrile hydrolysis to amides) would not be apparent from reading the text. This is true in other areas such as the oxidation of carbanions leading to radicals which dimerise, a process used for the large-scale manufacture of bipyridyls.

*Unsigned book reviews are by the Editor.

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The author has researched the recent literature to early 2003 and provides not only the literature reference but the title of the paper, too. This makes further reading of selective papers more "efficient". I think the author could have given more book, rather than journal, references at the early part of the chapter (e.g. to Jonathan Clayden's excellent book on Lithium Chemistry, *Organolithiums: Selectivity for Synthesis*, or to Faber's superb volume on biotransformations, *Biotransformations in Organic Chemistry*.

In conclusion, I enjoyed reading this book and will refer to it often for help to understand problem reactions. Highly recommended.

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Pharmaceutical Analysis. Edited by D. C. Lee and M. Webb. Blackwell/CRC Press: Oxford. 2004. 364 pp. £99.50. ISBN 1-84127-335-x.

David Lee and Mike Webb from GlaxoSmithKline have done an excellent job in persuading industrial (mainly colleagues or ex-colleagues from GSK) and academic authors to write chapters on topics of importance in the pharmaceutical industry. The initial chapter on QC and regulation focuses very much on the latter so there is little on specifications and impurity profiles. It would have benefited from the insertion of examples from industry. The chapter, however, is a useful summary of GLP/GMP requirements, ICH guidelines, and other regulatory issues.

The second chapter covers development of achiral separation methods including HPLC, GC, and CE, but with little on TLC. Hyphenated techniques are briefly summarised. The coverage of this vast topic in only 40 pages is, of course, rather brief, but again, more case studies and examples would have brought the subject to life. This important topic deserved separate chapters on HPLC and GC and much more detailed coverage. The other chapters (chiral analysis, NMR, MS, vibrational spectroscopy, solid-state analysis and polymorphism, microscopy and imaging, process analysis) are excellent and contain useful case studies to exemplify the discussion. In particular the chapter on vibrational spectroscopy is outstanding in its coverage of the solid state, particularly on polymorphism and hydrates. There is little overlap with the following chapter on solid-state analysis and polymorphism which is also excellent, covering X-ray diffraction, thermal analysis, and calorimetry and micrometric measurement. Perhaps one weakness is the omission of discussion on dynamic vapour sorption for hydrate analysis, so useful in the choice of a nonhygroscopic salt forms.

The final chapter on process analysis summarises the state of the art in 2002/3, but this important topic is moving fast, and the discussion seems a little dated. However, the principles and main techniques such as NIR are discussed in detail. There is also brief discussion of crystallisation monitoring (FBRM) as well as drying, milling, and cleaning monitoring.

In conclusion, this volume contains highly readable accounts of the major analytical techniques from an industrial viewpoint. Process R&D chemists should find something of interest in most chapters. I hope that the authors/publishers will produce a second edition in 4−5 years time.

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Chemical Process Equipment: Selection and Design, 2nd edition. By J. R. Couper, W. R. Penney, J. R. Fair, S. M. Walas. Elsevier/Gulf Professional Publishing: Oxford. 2005. 814 + xvii pp. £125. ISBN 0-7506-7510-1.

As in the first edition, written by Stanley Walas in 1988, the book focuses on equipment used in large-scale commodity chemical processes, with less emphasis on the fine chemicals and pharmaceutical industries. Nevertheless, chemical engineers working on smaller-volume products made by batch/semibatch processes should have this encyclopaedic volume on their bookshelves alongside Perry's *Chemical Engineer's Handbook*.

Prior to the introduction, an extremely useful summary of rules of thumb is given. The main chapters include Flow Sheets, Process Control, Drivers for Moving Equipment, Transfer of Solids, Flow of Fluids, Fluid Transport Equipment, Heat Transfer and Heat Exchanges, and Dryers and Cooling Towers. The latter chapter, for example did not include helical screw dryers (such as those made by Bolz or Nauta) which are being more and more used for fine chemicals drying. The references also omit more recent books such as van't Land on drying.

The following chapter on Mixing and Agitation has been completely updated from the first edition and has included sections on Fast Competitive-Consecutive Reactions and Micromixing as well as Scale Up. The next chapter, Solid−Liquid Separation, was rather weak on centrifugation and did not include combined equipment such as filter-driers.

Subsequent chapters included Disintegration, Agglomeration and Size Separation of Particulate Solids, Distillation and Gas Absorption, Extraction and Leaching, Absorption and Ion Exchange, and Crystallisation from Solution and Melts. The latter chapter's examples were mainly on inorganic salt crystallisations; crystallisations from organic solution and the possibility of polymorph production were not mentioned. The reference list on crystallisation from solutions contained all the up-to-date books on the subject except for those which focus on polymorphism (Bernstein, Byrn).

The chapter on Chemical Reactors did not seem to have changed much from the earlier edition, with the latest reference being 1984. The editors should at least ensure that updated references are provided for each chapter of a new edition. In this chapter I would have expected a section on materials of construction and chemical compatibility tables to enable the engineer to avoid corrosion. Thus, there is no mention in the book of the use of Hastelloy as a material used in industry!

The other chapters are Process Vessels, Membrane Separations, Gas Solid Separation, and a final, very useful chapter on Costs of Individual Equipment.

Overall, this is a reasonably comprehensive encyclopaedia with the limitations I have already highlighted. The vast number of tables, figures, graphs, and examples will be most useful, particular in those chapters which have been updated. For non-U.S. engineers, and for all chemists, the use of ancient units such as inches, ft−lb, gallons, degrees Fahrenheit, etc. will be a severe drawback. Why cannot U.S. engineers come into the modern world and use the same units as everyone else? There is a potential safety issue when chemists and engineers or engineers from different continents use different units—mistakes can be easily made!

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Chirality in Natural and Applied Science. Edited by W. J. Lough and I. W Wainer Blackwell/CRC Press: Oxford. 2003. 313 pp. £95. ISBN 0-632-05435-2.

The history of chirality makes fascinating reading, and the early chapters on history as well as some later ones on chirality in the natural world are very well written. Chemists in industry will be more interested in the chapters on chirality in drug design and development, chirality in medicinal chemistry, and separation of chiral compounds. The latter chapter is the only one of direct relevance to development chemists, but nevertheless, chemists will learn a lot from reading the "medicinal chemistry" chapters, which cover almost 100 pages.

The authors/editors conclude by hoping that there is still a century or two left in the field of chirality and that chirality is within us and all around us in the natural world as well as in applied science. All those interested in the subject of chirality should learn a lot from this fascinating book.

OP050037+

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Process Development: From the Initial Idea to the Chemical Production Plant. By G. Herbert Vogel. Wiley VCH: Weinheim. 2005. 478 pp. $195. ISBN 3-527-31089-4.

The title of this learned text is a bit misleading. While the author does indeed present an interesting perspective on getting "to the Chemical Production Plant", he devotes limited space to the topic of process development itself and addresses it in only general terms. This book is part engineering text, part introduction to the chemical business, and part desk reference. Because of this, the focus and direction of the text are often unclear. But the book is not without definite merit.

The opening chapter presents an informed overview of how the face of the global chemical industry (and the R&D that supports it) have changed over the decades. Chapter 2, "The Chemical Production Plant and its Components" (occupying 225 pages of the 370-page text), covers such various topics as catalysis, reaction engineering, continuous distillation and other separation technologies, pipelines, pumps and compressors, measurement and control technology, and plant safety.

Pointing out that 85% of all industrial reactions carried out today require a catalyst, the author offers up a mathematical treatment of heterogeneous catalysis worthy of the most advanced academic text (33 pages), followed by a thorough derivation of the differential equations governing the behavior of continuous reactors (28 pages). He devotes only two pages to product supply and storage, and four pages to plant safety. Clearly the author has allowed himself (correctly so!) the luxury of expounding at length in his areas of greatest expertise. And his considerable experience in the German chemical and petrochemical industries is very evident.

Chapter 3, "Process Data", provides good coverage of the use of fundamental kinetic and thermodynamic reaction data in process scale-up, but again digresses into such topics as licensing and the competitive aspects of plant location.

The book begins to hit its stride with respect to its title by Chapter 4, "Course of Process Development", which presents a concise and informative snapshot of the R&D process from bench research to the construction of the commercial plant. Chapter 5, "Planning, Erection and Start-Up of a Chemical Plant", deals with the project management issues associated with plant design and new plant construction. Chapter 6, "Preparation of Study Reports", is a practical guide to the use of various process flow diagrams and methods to estimate capital expenditures, feedstock, operating, energy, labor, and other costs. The final chapter Chapter 7, "Trends in Process Development", offers only cursory coverage.

The Appendices include some very useful tables of mathematical relationships, physical constants, thermodynamic and other chemical data, unit conversions, lists of chemical companies, and a table of acronyms. Nearly 40 pages of references (many of which are in German) and a detailed subject index conclude the book.

In short, this is an authoritative, if eclectic, text and contains a great deal of useful information for those entering industry from academia or those interested in chemical plant development, design, construction, and operation. Unfortunately, the clarity of the writing often falls victim to poor translation and even poorer proofreading, with obvious spelling errors throughout. The text is at times so heavily punctuated with references as to break the reader's train of thought. These factors, along with its somewhat hodge-podge nature, detract from an otherwise worthy effort.

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