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Book Reviews *

Handbook of Industrial Mixing. Edited by E. L. Paul, V. A. Atlemo-Obeng, and S. M. Kresta. Wiley Interscience: New Jersey. 2004. 1437 pp. $100. ISBN 0-471-26919-0.

Organic chemists will not be enthused at the title of this formidable treatise, but they should be encouraged to dip into this massive volume. Two chapters in particular should be compulsory reading for all development chemists involved in scaling-up processes (Chapter 13, Mixing and Chemical Reactions, and Chapter 17, Mixing in the Fine Chemical and Pharmaceutical Industries). Engineers will find even more of interest, and the handbook should be on the shelf of every chemical engineer involved in chemical manufacture. The authors are, in part, experienced practitioners in industry and, in part, academics at the forefront of this field. The editors have tried to ensure that most chapters are written by a combination of academic and industrial experts. The result is a very readable work, with the emphasis on using the theory for practical application—I wish there were organic chemistry books in a similar vein.

The encyclopaedic volume begins with a fascinating introduction which includes "conversations" with an industrial person on problems encountered in the plant. The editors use this to point the reader to chapters where the relevant discussion on how to solve the problem occurs. At the end of the introduction, a series of decision trees related to particular problems, usually of scale up, are presented, again pointing the reader to the chapters where useful ideas are discussed.

The editors insist that this is not a book to be read cover-to-cover, but to be dipped into, reading a chapter at a time. Chapter headings include turbulence in mixing applications, laminar mixing, mechanically stirred vessels, mixing in pipelines, blending of miscible liquids, solid−liquid mixing, gas−liquid mixing in turbulent systems, immiscible liquid−liquid systems, heat transfer, mixing of particulate solids, mixing of viscous liquids, mixing on fermentation and cell culture, mechanical design of mixing equipment, and the role of the mixing equipment supplier. Perhaps a surprising omission is a separate chapter on gas−liquid−solid systems. As a result, the important area of heterogeneous catalytic hydrogenation is not given enough prominence. Thus, there is no mention of the use of loop reactors, pioneered by Buss in the 1950s and still in regular use today, particularly for the difficult and very exothermic nitro-group reductions. Of course, many companies these days are also using the special Biazzi reactors for the same purpose, but again, these are not mentioned specifically.

Another surprising omission was the recent trend towards the use of microreactors to improve mixing and to aid the selectivity of chemical processes. Since these reactors are already being used on the tonne scale by Merck (Darmstadt) and Clariant, I would have expected a separate chapter on this topic.

The chapters are, as one would expect, written by chemical engineers, but this means that only the chemical engineering literature is covered. Thus, there are no references to books on chemical development, where examples of mixing-related issues have been discussed (e.g., Anderson; Atherton and Carpenter) nor are there any references to articles in *Organic Process Research & Development* (OPRD). For example, in the discussion of the relevance of the particle size of inorganic reagents such as potassium carbonate to reactivity, and the agitation requirements of the vessel, the case study in OPRD from DSM and the Eindhoven University of Technology (*Org. Process Res. Dev.* **2003**, *7*, 622−640) is not mentioned. Nor is Bourne's OPRD review on Mixing and Selectivity of Chemical Processes (*Org. Process Res. Dev.* **2003**, *7*, 471−508). Perhaps this arises because the work has been a long time in preparation, with many chapters covering literature to only 2001.

Despite these criticisms, this is still an excellent book, which will be used as the reference work on mixing. It represents outstanding value for money at 100 U.S. dollars for over 1400 pages. At the current excellent exchange rate for Europeans, chemists and engineers can afford a personal copy. The library copy is likely to be well used, so a personal copy would be an excellent investment.

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Organic Reactions Mechanisms: 40 Solved Cases. By M. Gomez Gallego and M. A. Sierra. Springer: Heidelberg. 2004. 290 pp. 49.95 Euro, $54.95. ISBN 3-540-00352-5.

A simple, one-sentence review of this book would be—"This is an outstanding book—just buy it". But the authors deserve a bit more detail. They have written a book primarily for an academic audience, to assist in teaching chemists the importance of understanding reaction mechanisms in detail. But it is of immense value in teaching process chemists and engineers how to decide on the mechanism of a reaction. Why should they want to do this? Without understanding, there can be no control, and a key part of scaling-up processes is to appreciate the complexities of the mechanism and decide which factors (concentration, temperature, pressure, order and rate of addition of reagents, etc.) are critical to the success of the process. A knowledge of the mechanism also helps to understand why and how certain impurities are formed, and from this how to prevent their formation—this is much better than having to remove impurities afterwards.

The 40 examples the authors have chosen to examine in detail are all from the literature, mostly from within the last

*Unsigned book reviews are by the Editor.

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