

## Review of Methods and Reagents for Green Chemistry

**Methods and Reagents for Green Chemistry.** Edited by P. Tundo, A. Perosa, and F. Zecchini (Ca' Foscari University of Venice). Wiley-Interscience, Hoboken, NJ, USA. 2007. xvii + 314 pp. 16 × 24 cm. \$100.00. ISBN 978-0-471-75400-8.

The Summer School on Green Chemistry traces its origins to 1998 and was devised by the Italian Interuniversity Consortium as a high-level training school to teach young scientists to incorporate green chemistry into their profession. This book contains 15 treatises authored by various participating instructors from the summer school over the past eight years. The book is separated into three different areas of green chemistry: Green Reagents (four chapters), Alternative Reaction Conditions (four chapters), and Green Catalysis and Biocatalysis (seven chapters).

The section on green reagents covers topics in multiple component reactions (MCRs), carbohydrates as an alternative to petroleum-based feedstocks for industry, dimethylcarbonate (DMC) as a green reagent, and photoinitiated industrial reactions. The MCR chapter discusses the many ways in which the Ugi reaction can be used as a clean, efficient pathway to industrial chemicals. The chapter on carbohydrates is by far the most in-depth and offers the reader an insight into their direct uses and how this renewable carbon source can be modified into various industrial chemical feedstocks. The chapter on photochemistry is simply a brief introduction to the basics of photochemistry, rather than a serious discussion of its application to industrial processes. The chapter on DMC describes how it can serve as a useful green alkylating and acylating reagent in industry.

Alternative reaction conditions are presented in four chapters covering ionic liquids, supported liquid phase catalysts, organic chemistry in water, and mechanisms for the formation of chlorinated dioxins in industrial processes. By far the most interesting was the chapter on dioxin formation. The authors do an excellent job of discussing the current proposed mechanism for the formation of dioxins as unintended byproducts in industrial chemical reactions. This reviewer found the section on dioxin classification particularly informative. The chapter on ionic liquids attempts to make a case for the “greenness” of ionic liquids and the simplicity of their synthesis; an example of their current use in industrial processes is presented. The chapter on water as a green solvent is completely devoted to how the Diels–Alder reaction can be run in water.

The section on green catalysis and biocatalysis begins with an excellent chapter on the basics of the E-factor and atom efficiency, which are two key components of modern green chemistry. The chapter entitled “Seamless Chemistry for Sustainability” represents a futuristic view of how renewable sources (CO<sub>2</sub>, vegetable oils, carbohydrates) can replace current petroleum-based resources. Two chapters in this section are devoted to green methods for acid-catalyzed industrial isomerization (zeolites and alternatives to liquid mineral acids. There is a

chapter of particular interest to chemical engineers on alternative methods to convert isobutane to methylmethacrylate. The final chapter describes various ways in which cell-free enzyme preparations or cell preparations can be used to synthesize important pharmaceutical precursors. There is also some insight into how to screen living organisms for sources of industrial biocatalysts.

Overall, this book provides an insight into the state of European industrial green chemistry. Some of the chapters were written as extensive review articles, while others appear to be nothing more than a summary of a lecture topic from the summer school course. The book lacks the depth to be considered a reference book or a classroom text, although the chapter on dioxins was exceptionally informative and detailed. Nevertheless, it does provide a broad overview of green chemistry, and I am sure that I will be opening it again as I continue to incorporate green chemistry principles into my teaching and research.

**Kirk P. Manfredi**

University of Northern Iowa  
 Cedar Falls, Iowa

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