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Book reviews

Physicochemical Treatment of Hazardous Wastes
Walter Z. Tang (Ed.), Lewis Publishers, Boca Raton, FL, 2004, 603 pp., Price $149.95 ISBN 1-56676-927-2

The treatment and disposal of hazardous wastes, as well as the remediation of contaminated sites, present scientists and engineers with many technical problems, as well as many opportunities. Among these opportunities are the treatment potential of several emerging biological and physical treatment processes. This book examines many of these processes based on a concept new to me—QSARs, which is the acronym for Quantitative Structural–Activity Relationships.

The author had five goals in writing this book. They are:

1. To utilize the fundamental theories of thermokinetics such as transition state theory to integrate research findings in the Advanced Oxidation Process (AOP) research.
2. To explain reaction kinetics and mechanism for each AOP in terms of elementary reactions and reactive center.
3. To introduce the term QSARs as methodologies to assess the treatability of organic compounds.
4. To use computational molecular descriptors such as E_{HOMO} and E_{LUMO}.
5. To compare the kinetics of various AOPs so that the most effective process can be selected for a given class or organic pollutants.

In my opinion, he has done the above well. Tang has generated a comprehensive treatise on the chemistry and kinetics underlying AOPs, processes which are being actively studied in research institutions as well as being utilized in the field in a few instances to treat hazardous organic wastes.

The author writes in the preface: "This book is divided into five parts. Chapters 1–4, define the hazardous waste problems and physiochemical approaches to solve these problems. Chapter 5, explains QSAR theory and its applications to predicting molecular descriptors and hydroxyl radical reactions. Chapters 6–12 focus on each of the eight most important AOPs. Chapter 13 presents a major reductive treatment technology, zero-valence iron, and Chapter 14 compares each AOP according to its oxidation kinetics for specific classes of organic compounds."

Personally, I was most interested in the AOP process chapters. Discussed in detail were: Fenton's reagent, ultraviolet/hydrogen peroxide, ultraviolet/ozone, ultraviolet/titanium dioxide, supercritical water oxidation, sonolysis, high-energy electron beam, and zero-valance iron. some of these processes still are relegated to laboratory experimentation while others have been used in the "real" world.

The author notes "Each chapter begins with an introduction of the process and its historical development". The intention is to demonstrate how fundamental sciences guide the search for these innovative technologies. Also, such introductions provide the information necessary for readers to delve into the literature for current research topics. Then, the principles of the process and the degradation kinetics, along with mechanisms of organic pollutants are explained in terms of elementary reactions. These elementary reactions not only are important in assessing the treatability of organic pollutants using QSAR but are also critical in properly designing AOP processes. Finally, QSAR models are discussed to demonstrate the effect of molecular structure on their degradation kinetics and to rank the treatability of each organic compound.

The unique aspect of this book (for me, at least) is a new concept—QSAR Theory. The book is not simply a discussion of various treatment processes and their results. Rather, it is based on a thorough recitation of reaction kinetics. I fully expect, this book will be adopted in many university graduate environmental courses as well as being of interest to researchers and consultants.

Gary F. Bennett

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Riegel's Handbook of Industrial Chemistry
James A. Kent, (Ed.), 10th ed., Kluwer Academic/Plenum Publishers, Dordrecht, The Netherlands, 2003, 1383 pp., Price $595.00 (€ 607; £ 381) ISBN 0-306-47411-5

Few books have presented a greater challenge for me to review than this one. The size and broad coverage in the book preclude a comprehensive review, not the least due to my unfamiliarity with many of the topics presented in its 31 chapters written by 48 subject matter experts. Kent, the Editor, notes that he is "... in awe of the breadth and depth of the knowledge that the contributing authors (brought) to this work". I join him in this observation.

Kent also wrote in his preface that "The central aim of this book is to present in a single volume an up-to-date account

of the chemistry and chemical engineering which underlie the major areas of the chemical process industry". In my opinion, he has done that well.

Given my background initially in fermentation research and later in environmental control, it is not surprising that I read with a great deal of interest the chapters on these topics. Fermentation was discussed in Chapter 24 which is entitled "Industrial Fermentation: Principles, Processes and Products". That was the first chapter I read. Given that one of the authors of this chapter was Arthur Humphrey, who is a respected researcher and author himself, it is not surprising that the breadth and depth of the presentation were excellent. I was particularly interested in the presentation of microbial kinetics and fermentation theory since most other chapters in the book are more descriptive and theoretical. The coverage begins with a mathematical discussion of fermentation kinetics and ends with a discussion of the production of insulin via recombinant DNA technology. This chapter was followed by one new to the book. It discusses industrial cell culture.

Putting aside my personal interests, I returned to the beginning of the book which has six general chapters. The first chapter discusses the "Economic Aspects of the Chemical Industry".

Not surprisingly, the environment is a topic of the next two chapters. In each of the two chapters, the authors are US EPA employees. Chapter 2 is entitled "Pollution Prevention and Waste Minimization". The author notes that "This chapter is intended to familiarize the reader with the concepts of pollution prevention and waste minimization, and to help understand how these practices are preferable to the more traditional practices of pollution control and waste management". The chapter stops short, however, of discussing the more advanced topic of sustain ability that the US EPA is pursuing.

Chapter 3, entitled "Pollution Control Technology", is a well-written and comprehensive (or as comprehensive as one can be in 23 pages) discussion of air and water pollution control processes. The chapter contains equipment diagrams, process control configurations, etc. However, the practice of hazardous waste treatment and disposal is not discussed. Not treated, also, is the topic of contaminated site remediation. I realize, however, that space limitations have placed constraints on the coverage topics.

The other three chapters in this introductory section are entitled: "Applied Statistical Methods and the Chemical Industry"; "Safety Considerations in the Chemical Process Industries," and "Managing an Emergency Preparedness Program". The latter two chapters are clearly in the mainstream of current chemical industry concerns.

The rest of the book is devoted to descriptions and discussions of industrial sectors. The titles of these chapters are as follows:

- Wood and wood products.
- Animal and vegetable fats, oils, and waxes.
- Sugar and other sweeteners.
- Phosphorus and phosphates.
- Fertilizers.
- Salt, chlor-alkali, and related heavy chemicals.
- Industrial gases.
- Sulfur and sulfuric acid.
- Petroleum and its products.
- Natural gas.
- Coal technology.
- Rubber.
- Synthetic resins and plastics.
- The chemistry of structural adhesives: epoxy, urethane, and acrylic adhesives.
- Manufactured textile fibers.
- Synthetic organic chemicals.
- Dye application, manufacture of dye intermediates and dyes.
- Industrial fermentation: principles, processes, and products.
- Chemistry in the pharmaceutical industry.
- Soap, fatty acids, and synthetic detergents.
- Pigments, paints, polymer coatings, lacquers, and printing inks.
- Synthetic nitrogen products.
- The agrochemical industry.
- Chemical explosives and rocket propellants.

Each of these chapters is unique, but in general the authors discuss raw materials, production processes (and process flow diagrams), equipment and production utilization.

This book represents a monumental effort in writing and editing. It deserves a place on the shelves of libraries both in universities and industries.

Gary F. Bennett

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