

Book review

Environmental Chemistry Fundamentals, J.G. Ibanez, M. Hernandez-Esparza, C. Doria-Serrano, A. Fregoso-Infante, M.M. Singh. Springer Science + Business Media, LLC, New York, NY (2007). 352 pp., Price: US\$ 89. 95, ISBN: 978-0-387-26061-7

This book has been written mainly for undergraduate students in their sophomore or junior year. It is supplemented by a companion book which I have not seen but which purports to contain 24 relevant experiments. The preface contains a succinct summary of the book's contents which reads as follows:

“The beginning of the theoretical section comprises a general introduction to Environmental Chemistry (Chapter 1), and a summary of the main background concepts that a student of Environmental Chemistry ought to know (Chapters 2 and 3). We assume that the students have the minimum background in Organic Chemistry and in Biochemistry necessary for Environmental Chemistry. Subsequent chapters discuss the composition and characteristics of the natural chemical processes that occur in the atmosphere (Chapter 4), the lithosphere (Chapter 5), and the hydrosphere (Chapter 6). This discussion concludes by examining natural biochemical processes and introducing the organisms in the biosphere (Chapter 7). Chapters that follow then analyze the effects of many pollutants (Chapters 8 and 9), their treatment (Chapters 10 and 11), and the minimization and prevention of pollution, emphasizing Green Chemistry (Chapter 12). Each chapter also contains a list of educational experiments in the literature related to its subject and a list of other useful references.”

The authors note that their book contains 240 questions, problems and examples for which over 100 are provided with solutions. In addition, there are 156 figures, 70 tables and 1300 references. The coverage of environmental topics is reasonably comprehensive except for solid and hazardous waste issues.

The importance of environmental chemistry is illustrated by the following statement:

“All the chemical reactions that take place in the environment – and that are directly related to the natural cycling and transformation of the elements on Earth – are identified as Environmental Chemistry. Likewise, the transformations or chemical interactions and processes of (a) substances introduced by human activity into the environment, (b) natural compounds, or (c) living organisms are included in this concept.”

The first chapter ends with a succinct, but I believe clearly articulated discussion of the importance of environmental chemistry.

“As indicated above, knowledge of Environmental Chemistry is essential for understanding what happens in nature and for predicting the fate and the chemical reactions that natural compounds and artificial pollutants may undergo; for understanding their interactions, and for predicting what may happen to certain compounds if discharged into the environment, and if organisms (human or not) come into contact with them. It is also fundamental to know what are the abiotic transformations, the metabolic pathways, or other biotic transformations carried out by microorganisms that take place under different environmental conditions (e.g., aerobic or anaerobic).”

And in recognition of the new environmental era, Green Chemistry enters the discussion at several points in the book.

The book has three major sections titled as follows:

- Introductory concepts
- The chemistry of natural environmental processes
- Effects, treatment and prevention of pollution

The first section lays the theoretical foundation for the topic with discussions of chemical equilibria, acid-based reactions, redox processes, complexes and complex formation, chemical kinetics, photochemical processes, and radiochemistry.

Numerous worked example problems are included in each section.

The second major section is entitled “The chemistry of natural environmental processes” It has four chapters titled as follows:

- The chemistry of processes in the atmosphere
- The chemistry of processes in the lithosphere
- The chemistry of processes in the hydrosphere
- Natural biochemical processes and organisms in the biosphere

Following this excellent treatment of the underlying fundamental chemistry of environmental reactions, the third (and longest) section discusses the practical aspects of environmental pollution and solutions to the problems. There are five chapters in this section:

- Effects of pollutants on the chemistry of the atmosphere, hydrosphere, and lithosphere
- Effects of pollutants on the biosphere: biodegradability, toxicity, and risks
- Physicochemical and physical treatment of pollutants and wastes
- Biological treatment of pollutants and wastes
- The minimization and prevention of pollution: green chemistry

I was particularly interested in the chapter on waste treatment (Biological treatment of pollutants and wastes). It contained an excellent discussion (both in words and diagrams) of wastewater treatment processes; however, it was short on theory and performance data. A minor point is that the reference list was quite short given the voluminous material available on the topic. Included, however, was a discussion of the important topic of treatment of soil and groundwater.

The final section of the book addressed the most current of the environmental topics: Green Chemistry. Actually, the chapter is

entitled “The minimization and prevention of pollution: green chemistry”. The importance of life cycle assessment was briefly discussed. This chapter covers in addition how to prevent waste problems from appearing, effective design of nontoxic products, how to minimize chemical waste using catalytic reactions, and the design of benign products.

A surprising end to the last section was a one-half page discussion of accident potential and its minimization. Although this discussion is outside the topic of the book, it is good to alert students to its importance.

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