

ture, geometry and mechanism of energy transfer. Another topic is the relationship of major electrical properties of interest in thermal processing to the physico-chemical basis of their dielectric behavior at high frequencies. The hindering of dipole rotation due to possible interactions of undissolved protein, lipid and ash content with free water and salts is illustrated. Predictions of dielectric behavior with models in terms of temperature, chemical composition and physical structure effects is discussed. Time-temperature profiles, integrated lethality, and nutrient retention levels are estimated, their accuracy evaluated and applicability and limitations assessed. Success is reported for various geometries for Newtonian and non-Newtonian fluids.

This text is expansive in its coverage of pertinent subjects. However more emphasis could have been directed to extrusion, supercritical fluid extraction, and packaging, as related to storage and food-package interactions. Also, the editors indicate in the preface that this book will be useful in teaching a senior level undergraduate or graduate level course. I concur with them if one uses this text as a teaching aid, not as the primary text, since there are no examples or homework problems.

Overall, I am pleased with this book. It is a valuable addition to my personal library; the references are current and directed to research in the pertinent areas.

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Hydrometallurgical Extraction and Reclamation

By E. Jackson, Ellis Horwood Limited,
Halsted Press, Chichester, 1986, 266 pp.,
\$41.95

This book is intended primarily as an introductory text on hydrometallurgical extraction and reclamation for first-degree students in metallurgy, minerals extraction, materials processing and reclamation, and applied science. For some time there has been an acute need for a comprehensive, up-to-date, introductory text on hydrometallurgy; therefore, it will be welcomed by students and instructors alike. Although it will be of limited use to those working in the field of hydrometallurgy, it might be of interest to engineers from related disciplines seeking an intro-

duction to this area. The extensive list of references provided at the end of each chapter and the final bibliography will be of particular interest to the latter group of readers.

Material is arranged to reflect the order in which the unit processes of hydrometallurgy are usually performed. The first chapter defines mineral reserves and resources, briefly discusses the importance of secondary materials, and considers the advantages of hydrometallurgical processing. The second chapter then covers the leaching of ores, concentrates and secondary materials, considering thermodynamic, electrochemical and kinetic principles, along with leaching methods and processes used in practice. The third chapter is devoted to separation, purification and enrichment processes used for treating pregnant leach and waste solutions, discussing the principles and practice of ion exchange, carbon adsorption, solvent extraction and liquid membrane processes. Precipitation processes used for purification, such as the precipitation of hydroxides and sulphides, are considered in a separate chapter, along with reductive processes such as cementation and hydrogen reduction, and precipitation methods used for recovery from waste streams. The final chapter discusses electrowinning and electrefining, in both aqueous and molten salt media.

In general, the approach used is appropriate for the intended readers. Although it is assumed that the reader has a good grasp of basic chemistry and thermodynamics, the fundamental principles of each unit process are discussed at some length. There are occasional typographical errors that could cause confusion and the treatment of electrochemistry is rather weak. The causes and effects of galvanic interactions are muddled, and although the polarization of electrochemical reactions is discussed in the chapter of electrolytic processes at the end of the book, polarization is ignored when discussing the kinetics of electrochemical processes such as leaching and cementation. Elsewhere, however, the fundamentals are explained clearly and effectively to demonstrate the relationship between basic science and engineering applications.

The fundamental principles of each unit process are usually illustrated with practical examples. Although a text of this nature cannot be expected to be ex-

haustive, the examples cited do not always reflect current commercial practice. Leaching, for example, is discussed largely in terms of processes for copper and uranium, several of which were experimental or are no longer used. While this is quite understandable, given the fluctuating financial situation of the minerals industry, it is surprising that no mention is made of the leaching of zinc calcine and zinc sulphide concentrates, given the commercial importance of these processes. At times, as in the section on hydrogen reduction practice, the practical examples given are too broad, covering the whole of a commercial operation rather than the unit process under consideration, which could be confusing to a student. It might have been more effective, if individual unit processes were described succinctly and the book had a final chapter analyzing representative flowsheets.

It is commendable to include hydrometallurgical processes for treating secondary materials and recovering metals from waste solutions and effluents; students should be aware that the versatility of hydrometallurgical processes makes them ideal for these applications, which are certain to increase in importance in the future. Overall, this is a sound, well-written and very readable book that should be considered seriously by anyone teaching hydrometallurgy at the undergraduate level.

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Drying of Solids

Edited by Arun S. Mujumdar, John Wiley & Sons, 1986, 342 plus xi pp., \$39.95

DRYING OF SOLIDS is not a general text dealing with industrial drying principles and/or equipment design, operation and performance as the title might suggest. The subtitle, Recent International Developments, is more accurate. This book is a collection of 44, unreviewed, research and tutorial papers contributed from 18 countries with Canada, France, Japan, India and USSR being the primary sources. Thirty-six of the titles were listed in the initial program of the Fourth International Drying Symposium, Kyoto, Japan, 9-12 July 1984, with 17 of these titles ultimately being presented at that symposium and published in the Proceed-

ings thereof. In the Table of Contents, the papers are grouped into seven categories; viz., Modelling and Simulation, Drying of Granular Solids, Drying of Grains, Spray Drying, Drying of Paper and Continuous Sheets, Energy Aspects of Drying Solids, and Miscellaneous Topics. The smallest category, Spray Drying, contains three papers which were published previously. The largest category, Miscellaneous Topics, contains 16 papers with ca. one third published previously and ca. two thirds related to drying experience with a variety of natural products. Only three papers in this book have industrial authorship and four papers were either authored or coauthored by the editor.

Industrial drying involves many considerations other than simply moisture removal. Primary selections of drying equipment usually are based on the nature of the feedstock and a final choice generally is determined by the desired physical form of the dried solids. Mode and conditions of operation are normally dictated by required product properties. The coverage of the papers in this volume is somewhat broader than the category groupings suggest and reflects to a certain degree the variety and complexity of these considerations. Topics receiving greater attention are internal mechanism of drying, external mechanism of drying including use of superheated vapor, effect of feed formulation on product properties including flavor loss, particle and sheet mechanics, performance experience, and various aspects of system integration and energy utilization. Lesser attention is given to control and instrumentation, equipment design and selection, cyclic operation effects, equilibrium moisture content, and the roasting of ores. A review of electroosmotic dewatering also is included. Many of the papers contain new experimental data. A subject index containing 151 entries details the technical content. As might be anticipated, there is wide variation in breadth of coverage, style of presentation and quality of content.

The Preface of this book indicates that the individual papers were reproduced as submitted by the authors; there is no evidence of any effort to edit the manu-

scripts before final submission. In some instances reading is very difficult and, on occasion, understanding almost impossible. Typing and/or spelling errors are found in both titles and texts as well as in the book's Preface and Acknowledgments. Improper grammar, poor syntax, and awkward or incorrect word choice are commonly encountered. Particularly frustrating are incomplete nomenclature listings and undefined nomenclature. The lack of any technical review is unfortunate and certain explanations and interpretations of observed or suspected phenomena must be accessed with care.

The text is printed by photocopy reproduction on paper of only moderate quality. The cloth cover is marginal and the binding workmanship is poor. The publisher's price of over \$0.11 per printed page is difficult to justify. Regardless of interest or preconceived need, acquisition of this publication should be made only after prudent inspection.

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Catalytic Cracking: Catalysis, Chemistry, and Kinetics

Wojciechowski, B. W. and Corma, A. Marcel Dekker, 1986, 236 pp., \$55.00 (U.S. and Canada), \$66.00 (all other countries)

This book is an important extension of earlier reviews of catalytic cracking. It is well written, and the authors have presented an extensive literature review with interpretation of the chemistry, mechanism, and kinetics of catalytic cracking over acidic catalysts. The focus is on industrially important aluminosilicate catalysts, namely zeolites, and to some extent, amorphous silica/alumina.

The section on carbocation behavior covers the generation, energetics, structure and reactivity patterns of these important positive species, with strong emphasis on patterns observed in "superacids," often in the liquid phase. The authors then attempt to correlate these patterns with those observed with solid aluminosilicate catalysts. Also included is a discussion of the chemistry of carbocat-

ions in electrophilic aromatic reactions, paraffin alkylation, and related hydrocarbon systems.

In the section on cracking catalysts, the authors draw heavily from and expand upon material from earlier reviews. Amorphous vs crystalline catalysts is compared with discussion of acidic properties, thermochemistry, Lewis vs Brönsted sites, catalyst modification, catalyst preparation, the effects of metals, and properties of commercial catalysts. This is followed by a section on catalyst decay and selectivity behavior, which reviews and interprets different viewpoints on this complex and often controversial subject. Considerable emphasis is given to the Wojciechowski time-on-stream (TOS) concept.

The last two major sections describe conversion selectivity patterns, mechanism, and kinetics in reactions of pure hydrocarbons and gas oils, respectively, over amorphous and zeolitic cracking catalysts. These sections comprise a broad literature review with considerable mechanistic interpretation.

Because it contains a detailed, interpretive discussion of the literature up through early 1985, and thus expands upon earlier reviews, this book will be useful to academic and industrial chemists and engineers, as well as graduate students interested in a broad overview of the reaction mechanism and kinetics dimensions of catalytic cracking. The book cites over 600 literature references. Some difficult and even controversial aspects of catalytic cracking are discussed with good perspective. However, catalytic cracking is an exceptionally complex and multidimensional process system. The authors' hope—that the book be a "map" of catalytic cracking and that the "new methodologies for the exploration of this field" presented therein "will remove the ambiguities so often present in previous reports"—is only partially achieved. Nevertheless, the book is a positive addition to the literature of catalytic cracking and is recommended reading.

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