

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-