

## Extractive Metallurgy Of Copper 5th Edition

Achieving the goals and objectives of sustainable development requires better information about the consequences of proposed actions. Partial information accounts for many failed efforts in the past. The financial implications for the proponent of the projects have often been more thoroughly analyzed than the implications for other actors. The impacts on biological diversity, or on the social fabric of local communities, have often been ignored. Decision-makers may also focus more on the short-term consequences instead of long-term impacts, creating negative unintended consequences. It is clear that better decision-making processes are needed. Making better decisions requires identifying, obtaining, synthesizing and acting on larger and more diverse data sets, including information that has previously been overlooked in development decisions. The good news is that better processes are being developed and are becoming available. If the goal is to reach decisions that are broadly understood and accepted, affected communities need to be consulted. Early public participation in defining problems is a prerequisite to effective decision-making. There is no universal formula or checklist of information applicable to every proposed project. The scope of information required should not be determined from the start by small cadres of experts. It is unlikely that any individual or small group possesses all of the expertise to achieve the kind of profound interdisciplinary synthesis that is needed.

Annotation Comprehensive reference examines all aspects of mineral processing from the handling of raw materials to separation strategies to the remediation of waste products. Shows how developments in engrg., chemistry, computer science, and environmental science

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contribute to the ultimate goal of producing minerals and metals economically from ores. This volume presents a selection of papers from the WASTES 2015 conference, a platform for scientists and industries from the waste management and recycling sectors from around the world, who shared experiences and knowledge at the meeting. Covering discussions regarding the balance between economic, environmental and social outcomes, the developme

This book describes and explains the methods by which three related ores and recyclables are made into high purity metals and chemicals, for materials processing. It focuses on present day processes and future developments rather than historical processes. Nickel, cobalt and platinum group metals are key elements for materials processing. They occur together in one book because they (i) map together on the periodic table (ii) occur together in many ores and (iii) are natural partners for further materials processing and materials manufacturing. They all are, for example, important catalysts – with platinum group metals being especially important for reducing car and truck emissions. Stainless steels and CoNiFe airplane engine super alloys are examples of practical usage. The product emphasises a sequential, building-block approach to the subject gained through the author's previous writings (particularly Extractive Metallurgy of Copper in four editions) and extensive experience. Due to the multiple metals involved and because each metal originates in several types of ore – e.g. tropical ores and arctic ores this necessitates a multi-contributor work drawing from multiple networks and both engineering and science. Synthesizes detailed review of the fundamental chemistry and physics of extractive metallurgy with practical lessons from industrial consultancies at the leading international plants Discusses Nickel, Cobalt and Platinum Group Metals for the first time in one book Reviews extraction of multiple metals from the same tropical or arctic ore

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Industrial, international and multidisciplinary focus on current standards of production supports best practice use of industrial resources

This book is a printed edition of the Special Issue "Hydrometallurgy" that was published in Metals

Sponsored by The Extraction and Processing Division (EPD) of TMS, The Mineral and Metallurgical Processing Division (MPD) of SME, Metallurgical Society (MetSoc) of CIM 2003 TMS/EPD Fall Meeting held in conjunction with 33rd Annual Hydrometallurgy Meeting and 2003 Conference of Metallurgists Vancouver BC Canada August 24-27,2003.

This book presents an assortment of case-studies pertaining to the use of sustainable technologies for heavy metal removal and recovery from mining and metallurgical wastes, construction and demolition wastes, spent catalysts and electronic wastes. Wastewaters from diverse industrial and mining activities have caused pollution problems, but these sectors also serve as a hotspot for metal recovery. Several metal removal technologies based on physical, chemical and biological processes have been successfully implemented in full-scale operation, while metal recovery, which is beneficial for economic and environmental reasons, is still limited due to challenges arising from downstream processing. For instance, microbial recovery (bioleaching) of metals from their ores is an established technology with a number of full-scale applications. Bioleaching of electronic wastes to recover metals is also a highly promising technology with low environmental impact and high cost-effectiveness; yet, this technology is still at its infancy. As the individual chapters of this book focuses on the applications and limitations of different technologies, this book will serve as an excellent resource for chemical engineers, environmental engineers, mining engineers, biotechnologists,

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graduate students and researchers in these areas.

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Increased consumption of electronic equipment has brought with it a greater demand for rare earth elements and metals. Adding to this is the growth in low carbon technologies such as hybrid fuel vehicles. It is predicted that the global supply of rare earth elements could soon be exhausted. A sustainable approach to the use and recovery of rare earth elements is needed, and this book addresses the political, economic and research agendas concerning them. The problem is discussed thoroughly and a multi-disciplinary team of authors from the chemistry, engineering and biotechnology sectors presents a range of solutions, from traditional metallurgical methods to innovations in biotechnology. Case studies add value to the theory presented, and indirect targets for recovery, such as municipal waste and combustion ash are considered. This book will be essential reading for researchers in academia and industry tackling sustainable element recovery, as well as postgraduate students in chemistry, engineering and biotechnology. Environmental scientists and policy makers will also benefit from reading about potential benefits of recovery from waste streams. This book describes the phases for innovative metallurgical process development, from concept to commercialization. Key features of the book include: • Need for process innovation • Selection and optimization of process steps • Determination of the commercial feasibility of a process including engineering and equipment selection •

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Determination of the environmental footprint of a process • Case-study examples of innovative process development

The first of many important works featured in CRC Press' Metals and Alloys Encyclopedia Collection, the Encyclopedia of Iron, Steel, and Their Alloys covers all the fundamental, theoretical, and application-related aspects of the metallurgical science, engineering, and technology of iron, steel, and their alloys. This Five-Volume Set addresses topics such as extractive metallurgy, powder metallurgy and processing, physical metallurgy, production engineering, corrosion engineering, thermal processing, metalworking, welding, iron- and steelmaking, heat treating, rolling, casting, hot and cold forming, surface finishing and coating, crystallography, metallography, computational metallurgy, metal-matrix composites, intermetallics, nano- and micro-structured metals and alloys, nano- and micro-alloying effects, special steels, and mining. A valuable reference for materials scientists and engineers, chemists, manufacturers, miners, researchers, and students, this must-have encyclopedia: Provides extensive coverage of properties and recommended practices Includes a wealth of helpful charts, nomograms, and figures Contains cross referencing for quick and easy search Each entry is written by a subject-matter expert and reviewed by an international panel of renowned researchers from academia, government, and industry. Also Available Online This Taylor & Francis encyclopedia is also available through online subscription, offering a variety of extra benefits for researchers, students, and

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What makes this book unique is a specific focus on aluminum recovery, rather than just recycling in general. It also offers an integrated discussion of scrap recovery and re-melting operations and includes economic as well as technical elements of recycling. Important topics include a discussion of the scrap aluminum marketplace and how secondary aluminum is collected and sorted, the design and operation of furnaces for melting scrap, the refining of molten aluminum, and the recovery and processing of dross from re-melting operations. This second edition features more information on aluminum scrap pricing and the economics of recycling, the analysis of dross processing methods currently in use by the industry, and drosses produced. The book has been updated throughout to include the most up-to-date information.

The analysis, development, and/or operation of high temperature processes that involve the production of ferrous and nonferrous metals, alloys, and refractory and ceramic materials are covered in the book. The innovative methods for achieving impurity segregation and removal, by-product recovery, waste minimization, and/or

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energy efficiency are also involved. Eight themes are presented in the book: 1: High Efficiency New Metallurgical Technology 2: Fundamental Research of Metallurgical Process 3: Alloy and Materials Preparation 4: Roasting, Reduction, and Smelting 5: Sintering of Ores and Powder 6: Simulation and Modeling 7: Treatment of Solid Slag/Wastes and Complex Ores 8: Microwave Heating, Energy, and Environment

Mechanical activation of solids is a part of mechanochemistry, the science with a sound theoretical foundation exhibiting a wide range of potential application. Mechanical activation itself is an innovative procedure where an improvement in technological processes can be attained via a combination of new surface area and defects formation in minerals. Mechanical activation is of exceptional importance in extractive metallurgy and mineral processing and this area forms the topic of this book and is the result of more than twenty years of research and graduate teaching in the field. In pyrometallurgy, the mechanical activation of minerals makes it possible to reduce their decomposition temperatures or causes such a degree of disordering that the thermal activation may be omitted entirely. The potential mitigation of environmental pollutants is becoming increasingly important in this context. The lowering of reaction temperatures, the increase of the rate and amount of solubility, preparation of water soluble compounds, the necessity for simpler and less expensive reactors and shorter reaction times are some of the advantages of mechanical activation in hydrometallurgy. The environmental aspects of these processes are particularly attractive. Several

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industrial processes are examined and their flowsheets are presented as successful of activation. In these processes, the introduction of a mechanical activation step into the technological cycle significantly modifies the subsequent steps. The book is designed for researchers, teachers, operators and students in the areas of extractive metallurgy, mineral processing, mineralogy, solid state chemistry and materials science. It will encourage newcomers to the mechanochemistry to do useful research and discover novel applications in this field.

A wide variety of technologies and products have already become widespread in our society. However, policies have not been well-implemented to effectively reduce energy consumptions and CO<sub>2</sub> emissions by promoting low-carbon technologies and products. This Special Issue focuses on studies targeting specific products (e.g., motor vehicle, household dishwashers, etc.) and/or technologies (e.g., information and communication technology, transport technology, CO<sub>2</sub> capture technology, etc.) and quantifying resource and energy consumptions and CO<sub>2</sub> emissions associated with products and technology systems using the reliable inventory database. Thus, this Special Issue provides important studies on how demand- and supply-side policies can contribute to reducing energy consumptions and CO<sub>2</sub> emissions from consumption- and production-based perspectives.

The latest knowledge on mineral ore genesis and the exploration of ore deposits Global demand for metals has risen considerably over the past decade. Geologists are



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developing new approaches for studying ore deposits and discovering new sources. Ore Deposits: Origin, Exploration, and Exploitation is a compilation of diverse case studies on new prospects in ore deposit geology including atypical examples of mineral deposits and new methods for ore exploration. Volume highlights include: Presentation of the latest research on a range of ore deposit types Application of ore deposits to multiple areas of geology and geophysical exploration Emphasis on diverse methods and tools for the study of ore deposits Useful case studies for geologists in both academia and industry Ore Deposits: Origin, Exploration, and Exploitation is a valuable resource for economic geologists, mineralogists, petrologists, geochemists, mining engineers, research professionals, and advanced students in relevant areas of academic study.

This collection focuses on ferrous and non-ferrous metallurgy where ionic melts, slags, fluxes, or salts play important roles in industrial growth and economy worldwide. Technical topics included are: thermodynamic properties and phase diagrams and kinetics of slags, fluxes, and salts; physical properties of slags, fluxes, and salts; structural studies of slags; interfacial and process phenomena involving foaming, bubble formation, and drainage; slag recycling, refractory erosion/corrosion, and freeze linings; and recycling and utilization of metallurgical slags and models and their applications in process improvement and

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optimization. These topics are of interest to not only traditional ferrous and non-ferrous metal industrial processes but also new and upcoming technologies. This new edition has been extensively revised and updated since the 3rd edition published in 1994. It contains an even greater depth of industrial information, focussing on how copper metal is extracted from ore and scrap, and how this extraction could be made more efficient. Modern high intensity smelting processes are presented in detail, specifically flash, Contop, Isasmelt, Noranda, Teniente and direct-to-blister smelting. Considerable attention is paid to the control of SO<sub>2</sub> emissions and manufacture of H<sub>2</sub>SO<sub>4</sub>. Recent developments in electrorefining, particularly stainless steel cathode technology are examined. Leaching, solvent extraction and electrowinning are evaluated together with their impact upon optimizing mineral resource utilization. The book demonstrates how recycling of copper and copper alloy scrap is an important source of copper and copper alloys. Copper quality control is also discussed and the book incorporates an important section on extraction economics. Each chapter is followed by a summary of concepts previously described and offers suggested further reading and references.

A compilation of engaging and insightful papers from the prestigious 2009 Plant Design Symposium, the volume is a sequel to Mineral Processing Plant Design,

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Practice, and Control, an industry standard published in 2002. Both books are indispensable texts for university-level instruction, as well as valuable guides for operators considering new construction, plant renovation, or expansion. You'll learn the role of innovation, how to finance and conduct feasibility studies, and how to reduce your plant's carbon footprint.

This collection honoring Professor Jiann-Yang Hwang focuses on characterization and processing development in minerals, metals, and materials. Topics include but are not limited to: • Characterization methodology of minerals, metals, and materials • Microwave-assisted material processes • Recycling and reuse of metallurgical byproducts • Materials for hydrogen storage • Wastewater treatment and environmental protection • Natural materials for value-added applications • Principles and interactions of material characterization and manufacturing processing.

In this volume, operators, engineers, and researchers present information about all aspects of current processing technologies for nickel and cobalt, as well as emerging technologies for both metals. Contributions from industry and academia encompass metallurgical aspects of metals commonly associated with nickel and cobalt, such as copper and platinum group metals (PGMs). Specific focus areas of the collection include, but are not limited to mineral processing, metallurgy of

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nickel and cobalt ores, battery materials, recycling, recovery of associated byproducts and PGMs, and sulfide and laterite processing.

Proceedings of the 2015 Chinese Intelligent Automation Conference presents selected research papers from the CIAC'15, held in Fuzhou, China. The topics include adaptive control, fuzzy control, neural network based control, knowledge based control, hybrid intelligent control, learning control, evolutionary mechanism based control, multi-sensor integration, failure diagnosis, reconfigurable control, etc. Engineers and researchers from academia, industry and the government can gain valuable insights into interdisciplinary solutions in the field of intelligent automation.

This volume recognizes the growing role of solvent extraction and electrowinning technology in the world copper business. This well-established, remarkable hydrometallurgical achievement fills an important role in our technical ability to extract copper in an efficient and cost-effective way. This proceedings documents the present status of the SX-EW business. It represents a substantial body of historical, scientific, engineering, and commercial information regarding the growth and application of the technology. Sections include: The Business and Technology of SX-EW, Theory and Practice of Copper Leaching, Theory and Practice of Tankhouse Operations, and Theory and Practice of Solvent

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### Extraction.

Chemical metallurgy is a well founded and fascinating branch of the wide field of metallurgy. This book provides detailed information on both the first steps of separation of desirable minerals and the subsequent mineral processing operations. The complex chemical processes of extracting various elements through hydrometallurgical, pyrometallurgical or electrometallurgical operations are explained. In the choice of material for this work, the author made good use of the synergy of scientific principles and industrial practices, offering the much needed and hitherto unavailable combination of detailed treatises on both compiled in one book.

This collection focuses on energy efficient technologies including innovative ore beneficiation, smelting technologies, recycling and waste heat recovery. The volume also covers various technological aspects of sustainable energy ecosystems, processes that improve energy efficiency, reduce thermal emissions, and reduce carbon dioxide and other greenhouse emissions. Papers addressing renewable energy resources for metals and materials production, waste heat recovery and other industrial energy efficient technologies, new concepts or devices for energy generation and conversion, energy efficiency improvement in process engineering, sustainability and life cycle assessment of energy systems, as well as the thermodynamics and modeling for sustainable metallurgical processes are included. This volume also includes topics on CO<sub>2</sub> sequestration and reduction in greenhouse gas emissions

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from process engineering, sustainable technologies in extractive metallurgy, as well as the materials processing and manufacturing industries with reduced energy consumption and CO<sub>2</sub> emission. Contributions from all areas of non-nuclear and non-traditional energy sources, such as solar, wind, and biomass are also included in this volume. Papers from the following symposia are presented in the book: Energy Technologies and CO<sub>2</sub> Management Advanced Materials for Energy Conversion and Storage Deriving Value from Challenging Waste Streams: Recycling and Sustainability Joint Session Solar Cell Silicon Stored Renewable Energy in Coal Waste electrical and electronic equipment (WEEE) generation is a global problem. Despite the growing awareness and deterring legislation, most of the WEEE is disposed improperly, i.e. landfilled or otherwise shipped overseas, and treated in sub-standard conditions. Informal recycling of WEEE has catastrophic effects on humans and the environment. WEEE contains considerable quantities of valuable metals such as base metals, precious metals and rare earth elements (REE). Metal recovery from WEEE is conventionally carried out by pyrometallurgical and hydrometallurgical methods. In this PhD research, novel metal recovery technologies from WEEE are investigated. Using acidophilic and cyanide-generating bacteria, copper and gold were removed from crushed electronic waste with removal efficiencies of 98.4 and 44.0%, respectively. The leached metals in solution were recovered using sulfidic precipitation and electrowinning separation techniques. Finally, a techno-economic assessment of the technology was studied. This research addresses the knowledge gap on two metal extraction approaches, namely chemical and biological, from a secondary source of metals. The essential parameters of the selective metal recovery processes, scale-up potential, techno-economic and sustainability assessment have been studied.

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This three volume set presents papers from the first collaborative global metallurgy conference focused exclusively on extractive topics, including business and economic issues.

Contributions examine new developments in foundational extractive metallurgy topics and techniques, and present the latest research and insights on emerging technologies and issues that are shaping the global extractive metallurgy industry. The book is organized around the following main themes: hydrometallurgy, pyrometallurgy, sulfide flotation, and extractive metallurgy markets and economics.

In recent years, global metallurgical industries have experienced fast and prosperous growth. High-temperature metallurgical technology is the backbone to support the technical, environmental, and economical needs for the growth. This collection features contributions covering the advancements and developments of new high-temperature metallurgical technologies and their applications to the areas of processing of minerals; extraction of metals; preparation of metallic, refractory and ceramic materials; treatment and recycling of slag and wastes; and saving of energy and protection of environment. The volume will have a broad impact on the academics and professionals serving the metallurgical industries around the world.

Rev. ed. of: Extractive metallurgy of copper / A.K. Biswas and W.G. Davenport. 1994. 3rd ed. With both nickel and cobalt featuring heavily in modern industry, there is an ongoing and intense interest in ore supplies and processing, applications development, and recycling. This book presents a collection of authoritative papers covering the latest advances in all aspects of nickel and cobalt processing, including fundamentals, technology, operating practices, and related areas of Platinum-Group Metals (PGM) processing. Special emphasis is given to the

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treatment of sulphide and laterite ores, concentrates, and secondary materials for the production of nickel and cobalt.

The book deals with the ancient exploitation and production of copper, exemplified by the mining district of Faynan, Jordan. It is an interdisciplinary study that comprises (mining-) archaeological and scientific aspects. The development of organizational patterns and technological improvements of mining and smelting through the ages (5th millennium BC to Roman Byzantine period), in a specific mining region, is discussed.

Mineral processing deals with complex particle systems with two-, three- and more phases. The modeling and understanding of these systems are a challenge for research groups and a need for the industrial sector. This Special Issue aims to present new advances, methodologies, applications, and case studies of computer-aided analysis applied to multiphase systems in mineral processing. This includes aspects such as modeling, design, operation, optimization, uncertainty analysis, among other topics. The special issue contains a review article and eleven articles that cover different methodologies of modeling, design, optimization, and analysis in problems of adsorption, leaching, flotation, and magnetic separation, among others. Consequently, the topics covered are of interest to readers from academia and industry.

Extractive Metallurgy of Copper, Volume Six expands on previous editions, including sections on orogenesis and copper mineralogy and new processes for efficiently recovering copper from ever-declining Cu-grade mineral deposits. The book evaluates processes for maintaining concentrate Cu grades from lower



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grade ores. Sections cover the recovery of critical byproducts (e.g., cesium), worker health and safety, automation as a safety tool, and the geopolitical forces that have moved copper metal production to Asia (especially China) and new smelting and refining processes. Indigenous Asian smelting processes are evaluated, along with energy and water requirements, environmental performance, copper electrorefining processes, and sulfur dioxide capture processes (e.g., WSA). The book puts special emphasis on the benefits of recycling copper scrap in terms of energy and water requirements. Comparisons of ore-to-product and scrap-to-product carbon emissions are also made to illustrate the concepts included. Describes copper mineralogy, mining and beneficiation techniques Compares a variety of mining, smelting and converting technologies Provides a complete description of hydrometallurgical and electrometallurgical processes, including process options and recent improvements Includes comprehensive descriptions of secondary copper processing, including scrap collection and upgrading, melting and refining technologies

This book is dedicated to the processes of mineral transformation, recycling and reclamation of metals, for the purpose of turning metals and alloys into a liquid state ready for pouring. Even though "process metallurgy" is one of the

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oldest technologies implemented by man, technological innovation, with the development of processes that are both focused on product quality and economically and ecologically efficient, continues to be at the heart of these industries. This book explains the physico-chemical bases of transformations, vital to their understanding and control (optimization of operational conditions), and the foundations in terms of "process engineering" (heat and matter assessment, process coupling: chemical reactions and transport phenomena), vital to the optimal execution and analysis of transformation process operations. This book is addressed to students in the field of metallurgy and to engineers facing the problem of metal and alloy development (operation of an industrial unit or development of a new process).

This landmark publication distills the body of knowledge that characterizes mineral processing and extractive metallurgy as disciplinary fields. It will inspire and inform current and future generations of minerals and metallurgy professionals. Mineral processing and extractive metallurgy are atypical disciplines, requiring a combination of knowledge, experience, and art. Investing in this trove of valuable information is a must for all those involved in the industry—students, engineers, mill managers, and operators. More than 192 internationally recognized experts have contributed to the handbook's 128

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thought-provoking chapters that examine nearly every aspect of mineral processing and extractive metallurgy. This inclusive reference addresses the magnitude of traditional industry topics and also addresses the new technologies and important cultural and social issues that are important today. Contents  
Mineral Characterization and Analysis Management and Reporting  
Comminution Classification and Washing Transport and Storage Physical Separations Flotation Solid and Liquid Separation Disposal Hydrometallurgy Pyrometallurgy Processing of Selected Metals, Minerals, and Materials

This comprehensive textbook covers all major topics related to the utilization of mineral resources for human activities. It begins with general concepts like definitions of mineral resources, mineral resources and humans, recycling mineral resources, distribution of minerals resources across Earth, and international standards in mining, among others. Then it turns to a classification of mineral resources, covering the main types from a geological standpoint. The exploration of mineral resources is also treated, including geophysical methods of exploration, borehole geophysical logging, geochemical methods, drilling methods, and mineral deposit models in exploration. Further, the book addresses the evaluation of mineral resources, from sampling techniques to the economic

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evaluation of mining projects (i.e. types and density of sampling, mean grade definition and calculation, Sichel's estimator, evaluation methods – classical and geostatistical, economic evaluation – NPV, IRR, and PP, estimation of risk, and software for evaluating mineral resources). It subsequently describes key mineral resource exploitation methods (open pit and underground mining) and the mineral processing required to obtain saleable products (crushing, grinding, sizing, ore separation, and concentrate dewatering, also with some text devoted to tailings dams). Lastly, the book discusses the environmental impact of mining, covering all the aspects of this very important topic, from the description of diverse impacts to the environmental impact assessment (EIA), which is essential in modern mining projects.

A completely revised and up-to-date edition containing comprehensive industrial data. The many significant changes which occurred during the 1980s and 1990s are chronicled. Modern high intensity smelting processes are presented in detail, specifically flash, Contop, Isasmelt, Noranda, Teniente and direct-to-blister smelting. Considerable attention is paid to the control of SO<sub>2</sub> emissions and manufacture of H<sub>2</sub>SO<sub>4</sub>. Recent developments in electrorefining, particularly stainless steel cathode technology are examined. Leaching, solvent extraction and electrowinning are evaluated together with their impact upon optimizing

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mineral resource utilization. The volume targets the recycling of copper and copper alloy scrap as an increasingly important source of copper and copper alloys. Copper quality control is also discussed and the book incorporates an important section on extraction economics. Each chapter is followed by a summary of concepts previously described and offers suggested further reading and references.

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