Book reviews

● *Introduction to high temperature oxidation of metals*, by N. Birks and G. H. Meier, London, Edward Arnold, 1983. 198 pp. R30,25.

Reviewers: M. B. Cortie and G. G. Garrett

This book deals with the basic principles and mechanisms underlying high-temperature oxidation processes, and begins with a whirlwind review of the experimental methods by which the high-temperature oxidation of metal samples can be measured, the pitfalls and advantages of several methods being discussed. A five-minute perusal of this chapter alone might save a budding researcher several months of work. In the following few chapters, the necessary thermodynamic and chemical aspects are reviewed and developed concisely. These chapters might be fruitfully read by any physical metallurgist or pyrometallurgist. Nevertheless, the material is not for the faint-hearted, and a working knowledge of metallurgical thermodynamics is assumed by the authors.

After the rather theoretical material presented in the first four chapters come three chapters of generalized discussion. Oxidation of alloys in simple and mixed environments is discussed, as is high-temperature corrosion, which the authors regard as a separate phenomenon.

The book concludes with two practical examples of industrial technology, namely atmosphere control in furnaces and decarburization of steels during heat treatment. The treatment is both theoretical and practical, and the book offers useful reading to the practising engineer.

The text is well illustrated with high-quality scanning-electron microscope micrographs, optical micrographs, and figures. Although the authors do not claim to present an 'exhaustive or extensive' review of the literature, they nevertheless have included copious references to published work as well as several useful tables of properties.

In conclusion, it is our opinion that the book is well suited for use in an academic or advanced industrial environment. However, the chapters on atmosphere control and decarburization would also be of direct use to a practising metallurgist or heat treater.

● *Seam gas drainage with particular reference to the working seam*, edited by A. J. Hargraves. Woollongong, The Australasian Institute of Mining and Metallurgy. 370 pp. $A30.

Reviewer: C. J. Fauconnier

This publication contains the proceedings of a symposium organized by the Illawarra Branch of the Australasian Institute of Mining and Metallurgy, and held at the University of Wollongong, Australia, from 11th to 14th May, 1982.

The 25 papers and discussions comprehensively cover such topics as the determination of the gas content of coal seams, mathematical modelling simulating seam-gas drainage, factors controlling the release of gas from the working seam, techniques of coal-seam degasification, automation of methane drainage, commercial potential of gas drainage, and legislation relating to seam-gas drainage.

Most of the major coal-producing countries of the world, including Australia, Canada, Germany, Japan, Poland, the U.K., and the U.S.A., were represented at this international forum.

A complete account of all the papers is not possible in a review of this nature, but the following points are worthy of note.

An improved method for the determination of the gas content of coal seams is presented. It makes use of a gravitational technique for the measurement of the gas desorbed. The amount of lost gas is estimated by the determination of an empirical relationship for the desorption of gas with time.

The features of seam-gas drainage from the point of view of mathematical modelling are outlined and discussed by the simulation of a conventional single-phase gas reservoir for very simplified modelling, a conventional petroleum reservoir altered into a specialized simulator for seam-gas drainage, and a conventional petroleum reservoir for the modelling of seam-gas drainage by way of pseudo-functions and the sacrifice of one dimension.

As a prelude to the study of the sorption/desorption and permeability behaviour of coal cores in a triaxial stressing rig using sorbable gases, the air permeability of typical cores was measured. As the permeability was measured at low confining stress relative to *in situ* stresses underground, the dynamic elastic modulus was measured for the cores by the use of an acoustic method. This showed that the coal compressibility increased between collieries in the same order as for permeability.

The United States Steel Corporation, in co-operation with the United States Government, is conducting a large-scale field demonstration of methane drainage using stimulated vertical boreholes drilled in advance of mining. A grid pattern of boreholes, isolating approximately 1,5 m^2 of coalbed area, has been drilled to the lower bench of the Mary Lee coalbed in Jefferson County, Alabama. Upon completion of drilling operations, various hydraulic stimulation treatments utilizing nitrogen-generated foam, water, and gelled fluid were applied to enhance the rate of methane removal.

The sale of recovered methane has proved so lucrative in many cases that not only has it paid for the installed system but has returned a real profit. Commercial projects based on the capture of methane within a mine, as well as the pre-draining of methane through boreholes from the surface, are currently being undertaken.

Two pre-mining drainage methods have been evaluated extensively in the U.S.A.: horizontal boreholes collared from within the mine, and vertical drilling from the surface with fracturing. Limited-size fracture treatments are advocated in order to prevent potential roof damage and the need for added support. Based on these test results, it is concluded that the selection of gas-drainage techniques depends primarily on site-specific considerations, including seam thickness, mining operations, site preparation, logistics, and economics.

A mathematical model for gas flow from a coal seam to a borehole through a discoidal fracture is proposed. From the numerical analyses, the apparent radius of the discoidal fracture in this model is shown to be a good indication of the gas-drainage ratio. In addition to this, an attempt to make fractures around a borehole using a high-velocity water jet is introduced.

The following methods of methane drainage are applied as additional means of combating the methane hazard in Polish coal mines: pre-drainage by means of boreholes drilled from the surface, pre-drainage from stone drivages and development working, degasification of coal-extraction workings, and degasification of sealed-off areas or old goaf areas. There is a relationship between methane capture by degasification, total methane make, and other factors. From the recovery rate of methane by degasification for the various mining systems empirical formulas establish relationships between the various parameters.

Modern methane-drainage plants are completely automated, using programmable controllers and°computers to provide control and management reporting functions. Complex mechanical systems are installed to extract the gas and to handle the storage processes. The installation, automatic control, and monitoring of these plants incorporates many facets of engineering from high-voltage power supply and computer technology to the complex gas-handling procedures used in gas compression storage and electric-power generation.

Gas drainage has been practised for many years, mainly for safety reasons, in various countries in Europe, the U.S.A., the U.K., and Japan. Legislation has been developed to control the production, transportation, and utilization of methane and associated gases. One paper briefly describes the drainage methods and legislation applied overseas, gives a brief history of gas drainage in New South Wales, and indicates the deficiencies of the present legislation. It outlines the approach to new legislation, which will deal comprehensively with gas-drainage operations and utilization in New South Wales.

This publication should be of general interest to environmental engineers and colliery managers alike. Although South African conditions may generally not require the extensive gas-drainage methods described in many of the papers, some mines may well benefit from the knowledge embodied in the proceedings of this symposium.

New books

● *Solvent extraction Part I*, by G. M. Ritcey and A. W. Ashbrook. Amsterdam, Elsevier, 1983.

● *Elektronishche Steuerungen und Mikroprozessoren im Bergbau. Sicherheit und Zuverlassigkeit.* (Electronic control systems and microprocessors in mining. Safety and reliability. Proceedings of an international symposium held in June 1983. In German.) Essen, Rheinisch—Westfalischer TuV, 1983. 335 pp. DM39.

● *Environmental impact control. Philosophical and procedural guidelines for the planning professions.* Johannesburg, EPPIC (Environmental Planning Professions Interdisciplinary Committee, P.O. Box 61019, Marshalltown 2107), 1984. (English and Afrikaans text in one volume.) R2,50.

● *Mineral processing and extractive metallurgy.* London, The Institution of Mining and Metallurgy. In preparation. £50.

This volume consists of the papers to be presented at a conference in Kunming (China) that is to be held in October 1984.

● *Reagents in the minerals industry.* London, The Institution of Mining and Metallurgy. In preparation. £50.

The papers making up this volume are to be presented at a conference in Rome in September 1984.